



# Financial Guarantees

# **Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities**

---

REGDOC-3.3.1

January 2021



# **Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities**

Regulatory document REGDOC-3.3.1

© Canadian Nuclear Safety Commission (CNSC) 2021

Cat. No. CC172-231/2021E-PDF

ISBN 978-0-660-37024-8

Extracts from this document may be reproduced for individual use without permission provided the source is fully acknowledged. However, reproduction in whole or in part for purposes of resale or redistribution requires prior written permission from the Canadian Nuclear Safety Commission.

*Également publié en français sous le titre : **Garanties financières pour le déclasséement des installations nucléaires et la cessation des activités autorisées***

## **Document availability**

This document can be viewed on the [CNSC website](#). To request a copy of the document in English or French, please contact:

Canadian Nuclear Safety Commission  
280 Slater Street  
P.O. Box 1046, Station B  
Ottawa, ON K1P 5S9  
CANADA

Tel.: 613-995-5894 or 1-800-668-5284 (in Canada only)

Fax: 613-995-5086

Email: [cnsccs@canada.ca](mailto:cnsccs@canada.ca)

Website: [nuclearsafety.gc.ca](http://nuclearsafety.gc.ca)

Facebook: [facebook.com/CanadianNuclearSafetyCommission](https://facebook.com/CanadianNuclearSafetyCommission)

YouTube: [youtube.com/cnsccs](https://youtube.com/cnsccs)

Twitter: [@CNSC\\_CCSN](https://twitter.com/CNSC_CCSN)

LinkedIn: [linkedin.com/company/cnsccs](https://linkedin.com/company/cnsccs)

## **Publishing history**

January 2021      Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities

## Preface

This regulatory document is part of the CNSC's financial guarantees series of regulatory documents. The full list of regulatory document series is included at the end of this document and can also be found on the [CNSC's website](#).

Regulatory document REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*, sets out requirements and guidance for applicants and licensees regarding the establishment and maintenance of funding for the decommissioning of facilities and termination of activities licensed by the Canadian Nuclear Safety Commission.

REGDOC-3.3.1 provides information on financial guarantees used to ensure a licensee will have sufficient funds to decommission a licensed location and dispose of any associated nuclear substances. The document is intended to form part of the licensing basis for a regulated facility or activity within the scope of the document. It is intended for inclusion in licences as either part of the conditions and safety and control measures in a licence, or as part of the safety and control measures to be described in a licence application and the documents needed to support that application.

This document supersedes G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*, published in June 2000. For information on the implementation of regulatory documents in the licensing basis and on the graded approach, see REGDOC-3.5.3, *Regulatory Fundamentals*.

The words "shall" and "must" are used to express requirements to be satisfied by the licensee or licence applicant. "Should" is used to express guidance or that which is advised. "May" is used to express an option or that which is advised or permissible within the limits of this regulatory document. "Can" is used to express possibility or capability.

Nothing contained in this document is to be construed as relieving any licensee from any other pertinent requirements. It is the licensee's responsibility to identify and comply with all applicable regulations and licence conditions.

**Table of Contents**

**1. Introduction..... 4**

    1.1 Purpose..... 4

    1.2 Scope..... 4

    1.3 Relevant legislation..... 4

**2. Background ..... 4**

**3. Acceptance Criteria for Financial Guarantees ..... 5**

    3.1 Liquidity..... 6

    3.2 Certainty of value..... 6

    3.3 Adequacy of value ..... 6

    3.4 Continuity ..... 6

**4. Acceptable Financial Guarantee Instruments..... 6**

    4.1 Cash funds..... 6

    4.2 Investment funds..... 7

    4.3 Letters of credit..... 7

    4.4 Surety bonds ..... 7

    4.5 Insurance ..... 7

    4.6 Expressed commitments from Canadian government entities ..... 8

    4.7 Other types of instruments ..... 8

**5. Administration of Financial Guarantees ..... 8**

    5.1 Access to funds upon demand..... 8

    5.2 Separation of financial guarantee from licensee’s other assets..... 9

    5.3 Maintenance on a continuous basis..... 9

    5.4 Replacement of financial guarantee..... 9

    5.5 Signing officers..... 9

**6. Reporting requirements ..... 9**

**Part I: Financial Guarantees for the Decommissioning of Nuclear Facilities and Activities..... 10**

**7. Introduction..... 10**

    7.1 Scope..... 10

    7.2 Background..... 10

**8. Planning for Decommissioning ..... 10**

**9. Cost Estimates for Decommissioning ..... 10**

**10. Requirements for Costs to Be Included ..... 11**

**11. Cost Categories ..... 11**

**12. Presentation of Cost Estimate..... 11**

<b>13.</b>	<b>Elements of Cost Estimates .....</b>	<b>12</b>
13.1	Basis of estimate .....	13
13.2	Structure of estimate .....	13
13.2.1	Activity-dependent costs.....	13
13.2.2	Period-dependent costs .....	14
13.3	Collateral and special item costs.....	14
13.3.1	Contingency .....	14
13.4	Schedule.....	14
13.5	Uncertainty analysis.....	14
<b>14.</b>	<b>Development of the Financial Guarantee .....</b>	<b>15</b>
14.1	Constant dollars .....	15
14.2	Cash flow and planned disbursements.....	15
14.3	Net present value .....	15
<b>15.</b>	<b>Review of Financial Guarantees .....</b>	<b>16</b>
<b>Part II: Financial Guarantees for Termination of Licensed Activities .....</b>		<b>17</b>
<b>16.</b>	<b>Introduction.....</b>	<b>17</b>
16.1	Scope.....	17
<b>17.</b>	<b>Financial Guarantee Program .....</b>	<b>17</b>
<b>18.</b>	<b>Alternatives to Financial Guarantee Program.....</b>	<b>17</b>
<b>19.</b>	<b>Review of Financial Guarantees .....</b>	<b>17</b>
<b>Appendix A: Example of Letter of Credit .....</b>		<b>18</b>
<b>Appendix B: Cost Estimate Grades and Classification .....</b>		<b>20</b>
<b>Appendix C: Standardized Definitions for Cost Categories .....</b>		<b>22</b>
<b>Appendix D: International Structure for Decommissioning Costing Cost Item Hierarchy .....</b>		<b>24</b>
<b>Appendix E: Approaches to Cost Estimation.....</b>		<b>32</b>

## Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities

### 1. Introduction

#### 1.1 Purpose

Financial guarantees for decommissioning of nuclear facilities and termination of licensed activities are implemented in accordance with the *Nuclear Safety and Control Act* (NSCA) and the regulations made under the NSCA.

Applicants and licensees are required to make adequate provision for the safe decommissioning of existing or proposed new nuclear facilities by ensuring that sufficient financial resources are available to fund all approved decommissioning activities should the licensee not be able to fulfill its obligations. Operationally, the Commission may also require that financial resources be available for termination of licensed activities other than for decommissioning of nuclear facilities.

This document provides requirements and guidance to applicants and licensees regarding the establishment and maintenance of funding for the decommissioning of facilities and termination of activities licensed by the Canadian Nuclear Safety Commission (CNSC).

#### 1.2 Scope

This document presents information for those who have incurred, or expect to incur, obligations with respect to the decommissioning of nuclear facilities or the termination of activities licensed by the CNSC.

[Part I](#) of this document pertains to financial guarantees for decommissioning of nuclear facilities or activities for Class IA and IB licences issued in accordance with the *Class I Nuclear Facilities Regulations*, uranium mines and mills licences and waste nuclear substances licences.

[Part II](#) of this document pertains to financial guarantees for the termination of licensed activities, such as for nuclear substances and radiation devices, prescribed equipment, and Class II facilities.

#### 1.3 Relevant legislation

The provisions of the *Nuclear Safety and Control Act* and regulations that are relevant to this regulatory document include:

- [Nuclear Safety and Control Act](#), subsection 24(5)
- [General Nuclear Safety and Control Regulations](#), paragraph 3(1)(l)
- [General Nuclear Safety and Control Regulations](#), subparagraph 29(1)(j)(i) to 29(1)(j)(x)
- [General Nuclear Safety and Control Regulations](#) subsection 29(2)

### 2. Background

The CNSC's mandate is to regulate the use of nuclear energy and materials to protect health, safety, security and the environment; to implement Canada's international commitments on the

peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public.

The CNSC defines decommissioning as the administrative and technical decommissioning actions taken to allow the removal of some or all of the regulatory controls from a facility or location where nuclear substances are managed, possessed or stored. Decommissioning actions are the procedures, processes and work activities that lead to the release of a facility or location from regulatory control, with or without restrictions on its future use (for example, decontamination and/or dismantling of structures, systems and components).

Financial guarantees are a tangible commitment by a licence applicant or a licensee that there will be sufficient resources to safely terminate licensed activities. A financial guarantee does not relieve applicants or licensees from complying with regulatory requirements for decommissioning of nuclear facilities or termination of licensed activities – the financial guarantee ensures that there are funds available to the CNSC if applicants or licensees are unable to carry out safe decommissioning or termination of activities.

Financial obligations are intended to ensure:

- funding is available to make adequate provision for the health and safety of current and future generations
- the applicants and licensees establish adequate funds to pay for the decommissioning and termination of their licensed activities

Financial guarantees must be sufficient to cover the cost of decommissioning of nuclear facilities or termination of licensed activities authorized by the current licence.

The types of instruments for financial guarantees can vary. The applicants and the licensees should select an instrument that suits the scope and the timeframe of their decommissioning plan.

The requirements and guidance for decommissioning planning are provided in REGDOC-2.11.2, *Decommissioning* [1] and CSA standard N294-19, *Decommissioning of Facilities Containing Nuclear Substances* [2].

A graded approach may be applied by the CNSC when assessing the financial guarantees. The assessment could take into consideration the facility lifecycle stage, the type and complexity of the activity, and the level of detail provided in the decommissioning plan, which should be consistent with the magnitude of risk arising from the facility's decommissioning.

### **3. Acceptance Criteria for Financial Guarantees**

The following are the CNSC's general expectations for criteria of liquidity, certainty of value, adequacy of value and continuity. An applicant or licensee may propose alternative approaches to meet the intent of the acceptance criteria for financial guarantees. In all cases the financial guarantees must be accepted by the Commission or, where a designated officer has issued a licence, by the designated officer.

### **3.1 Liquidity**

The proposed financial guarantee must be established so that the only requirement for drawing upon it is a formal request or demand by the Commission or a person authorized by the Commission and so that payout for decommissioning purposes is not prevented, unduly delayed or compromised for any reason.

### **3.2 Certainty of value**

Applicants or licensees must select funding or security instruments or arrangements which provide full assurance of their value.

### **3.3 Adequacy of value**

The value of the financial guarantees for nuclear facilities must be linked to the cost estimate set out in the most recent decommissioning plan for nuclear facilities or activities authorized under Class I uranium mines and mills licences and waste nuclear substances licences.

Financial guarantees for other licensed activities, addressed in Part II of this document, must be linked to the licence for nuclear substances and radiation devices, prescribed equipment and Class II facilities.

### **3.4 Continuity**

The financial guarantees required for decommissioning and termination of licensed activities must be maintained on a continuing basis. This may require periodic renewals, revisions or replacements of securities provided or issued for fixed terms. In order to ensure continuity of coverage, financial guarantees must include provisions for advance notice to the CNSC of termination or the intent to not renew. See [section 5](#) for additional information.

## **4. Acceptable Financial Guarantee Instruments**

The following sections provide examples of acceptable financial guarantee instruments. In all cases the financial guarantee instruments must be accepted by the Commission, or where a designated officer has issued a licence, by the designated officer.

### **4.1 Cash funds**

Cash funds include cash as well as other equivalent securities such as certified cheques, bearer bonds and guaranteed investment certificates.

These instruments can provide certainty and adequacy of value, ease of liquidity, and continuity. Such instruments provide maximum protection against the risk of default.

Any cash collateral or direct funding should be made into an account which is controlled by the federal government (either the CNSC or the Receiver General for Canada) or by a Canadian chartered bank listed in Schedule I or II of the [Bank Act](#).



## 4.2 Investment funds

Investment funds are financial instruments that are publicly traded or can be easily liquidated if required.

Funds earmarked for financial guarantees purposes may be invested in an investment portfolio in order to earn interest income to help to cover the costs of decommissioning.

When investment funds are used, there are several economic estimates that must be made including the rate of inflation over time, and the estimated rate of return of the portfolio. Information on planned disbursements should be included in order for the CNSC to review the financial guarantee to ensure it is sufficient to cover costs of decommissioning.

## 4.3 Letters of credit

A letter of credit is an agreement between a licensee or applicant and a financial institution.

A letter of credit can provide for specific sums of money to be paid on demand to designated parties or their agents should a triggering event occur, such as a licensee defaulting on its obligation to decommission. Letters of credit can provide certainty of value, can be easily liquidated, and may be rewritten or revised as the required amount of security changes. [Appendix A](#) provides an example of a letter of credit.

Letters of credit should be issued by a Canadian chartered bank listed in Schedule I or II of the *Bank Act*.

## 4.4 Surety bonds

Surety bonds include bid bonds, performance bonds, labour and material payment bonds and maintenance bonds. Surety bonds are widely used in the construction industry.

Variations of these bond types may be appropriate as primary security, or to complement other instruments.

For example, under the terms of a performance bond agreement, a surety company could commit to responsibility for all claims and expenses for decommissioning up to a specified limit. Another form of financial guarantee will be required where the estimated cost of the decommissioning exceeds the value of the surety bond.

Surety bonds should name the CNSC as a beneficiary and the insurance or bonding agents should be Canadian companies subject to Canadian regulatory oversight.

## 4.5 Insurance

Insurance policies may be acceptable financial guarantee instruments provided the insurance policy is developed and accepted by the CNSC. Insurance policies should name the CNSC as a beneficiary, and the insurance agents should be Canadian companies subject to Canadian regulatory oversight.

#### **4.6 Expressed commitments from Canadian government entities**

An expressed commitment from a Canadian federal, provincial or territorial government, may be an acceptable financial guarantee instrument to cover all aspects of decommissioning a facility or site for which the government has assumed liability.

Expressed commitments from a Canadian provincial or territorial government are restricted to guarantees that the federal government has the right to offset through transfer payments as a method of enforcing the guarantee, if necessary. Universities and hospitals may also use expressed commitments as a financial guarantee instrument. In such a case, universities and hospitals must maintain a letter of commitment acknowledging the responsibility and liability for the decommissioning of the site. The letter of commitment must be signed by a person of authority at the institution<sup>1</sup>.

Institutions that operate research reactors, such as SLOWPOKE reactors, should maintain sufficient financial guarantees in a form other than expressed commitments to bring the facility to a safe state, including removal of fuel and radioactive and hazardous materials from the site. The remaining cost for completing the decommissioning of the facility may be covered by a letter of commitment acknowledging the responsibility and liability of decommissioning. The letter of commitment must be signed by a person of authority at the institution.

#### **4.7 Other types of instruments**

Other types of financial guarantee instruments may be considered by the Commission as part of the licensing or renewal process. In all cases, the financial guarantee instrument must satisfy the general acceptance criteria listed in section 3. Since parent company guarantees and pledges of assets do not satisfy the acceptance criteria listed in section 3, they are not considered acceptable financial guarantee instruments.

### **5. Administration of Financial Guarantees**

Financial guarantees are administered by clearly defined and legally enforceable arrangements acceptable to the CNSC. These arrangements must be structured to ensure that the financial guarantee provided by the applicant or the licensee includes the terms outlined in the following subsections:

#### **5.1 Access to funds upon demand**

The CNSC must be assured that it can, upon demand, access or direct adequate funds if a licensee is not available to fulfill its obligations for decommissioning. The funds must be structured such that the instrument can be drawn upon only with the prior acceptance of the CNSC and that such pay-out is not prevented, delayed or compromised, and must be structured such that the instrument can provide full assurance of value.

Where the province has a legislative framework in place, as the province of Saskatchewan does for uranium mines, the financial guarantee may be payable to a provincial entity qualified to decommission the mine, if this arrangement is approved by the Commission.

---

<sup>1</sup> Examples of a person of authority include the president or chief financial officer of the organization.

The provincial entity is also responsible for the following institutional control program, as legislated by the province.

## **5.2 Separation of financial guarantee from licensee's other assets**

The financial guarantee arrangements must be structured to ensure that the funds provided by the applicant or licensee to guarantee funding for an approved decommissioning plan are separated from its other assets. This might require the inclusion of terms restricting access to, or use of, monies realized from the funds.

Withdrawals from a fund, or access to monies realized from other security vehicles must only be permitted for approved purposes; in particular, to pay for approved decommissioning activities, or to refund excess monies to the licensee.

## **5.3 Maintenance on a continuous basis**

Financial guarantee instruments must be automatically renewed and must include provisions for advance notice to the CNSC of termination or the intent to not renew.

Financial guarantee instruments should be open-ended, or if written for a specified term, must be renewed automatically unless 30 days or more prior to the renewal date the issuer notifies the CNSC (as the beneficiary) and the licensee of any intention not to renew.

## **5.4 Replacement of financial guarantee**

If the licensee fails to provide a replacement acceptable to the CNSC within 10 days after receipt of notification of cancellation, the terms of arrangement should further provide that the full face value of the instrument may automatically be paid into an account which is controlled by the federal government (either the CNSC or the Receiver General for Canada) or by a Canadian chartered bank listed in Schedule I or II of the *Bank Act* prior to expiration, without proof of forfeiture required. The value of the instrument must be payable, for purposes of funding decommissioning or termination of activities.

## **5.5 Signing officers**

Applicants or licensees must provide, and continually update as required, a list of signing officers who have the requisite corporate or governmental authority to bind the corporation or the government as applicable.

# **6. Reporting requirements**

Licensees are required to report annually on the status and the validity of their financial guarantee. Licensees must indicate if their financial guarantee remains valid, in effect and sufficient to meet decommissioning needs according to the current decommissioning plan associated with the cost estimate used to establish the amount of the financial guarantee.

The expectations for reporting on financial guarantees are specified in the licence conditions handbook and in REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills* [3], and REGDOC-3.1.3, *Reporting Requirements for Waste Nuclear Substance Licensees, Class II Nuclear Facilities and Users of Prescribed Equipment, Nuclear Substances and Radiation Devices* [4].

## **Part I: Financial Guarantees for the Decommissioning of Nuclear Facilities and Activities**

### **7. Introduction**

#### **7.1 Scope**

Part I of this document provides information to applicants and licensees with regard to the CNSC's requirements and guidance for establishing financial guarantees for decommissioning of licensed facilities and activities for Class IA and IB licences issued in accordance with the *Class I Nuclear Facilities Regulations*, uranium mine and mill licences, and waste nuclear substances licences.

#### **7.2 Background**

The *Nuclear Safety and Control Act* (NSCA) and associated regulations require applicants and licensees to make adequate provision for the safe operation and decommissioning of existing or proposed operations.

In addition, a licence may contain conditions requiring licensees to have acceptable decommissioning plans in place, and an acceptable financial guarantee that must remain valid, in effect and sufficient to meet decommissioning needs according to the most up-to-date decommissioning plan.

### **8. Planning for Decommissioning**

Planning for the decommissioning of a facility or activity is an integral part of the lifecycle planning. The lifecycle stages of a facility include siting, construction (including design), operation and decommissioning. Planning for decommissioning is an ongoing process and should be considered at each lifecycle stage of the facility.

Requirements and guidance for decommissioning planning for CNSC-regulated activities and facilities are provided in REGDOC-2.11.2, *Decommissioning* [1], and CSA standard N294-19, *Decommissioning of facilities containing nuclear substances* [2]. Decommissioning plans can vary in complexity and detail in accordance with specific circumstances but must be sufficiently detailed to enable credible estimates of the amount of financial guarantees.

### **9. Cost Estimates for Decommissioning**

The cost estimate for decommissioning should be based on the most up-to-date decommissioning plan and should reflect the assumed decommissioning strategy and end state of the facility or activity.

The decommissioning cost estimates may vary depending on the stage in the lifecycle. In the case of estimates undertaken at the conceptual design stage of a project, the purpose is to:

- enable designers and client organizations to establish overall project costs
- inform the long-term financing process to provide for future funds when a facility will be decommissioned

Later, when the decommissioning project planning has advanced as a facility or activity nears the end of its period of operation, the cost estimate forms part of the basis for the detailed decommissioning planning.

Various approaches to determine the level of cost estimate accuracy exist. Organizations such as the Association for Advancement of Cost Engineering (AACE International) have guidelines for estimating cost for different industries [5]. Guidance establishing the cost estimate level of accuracy is provided in [Appendix B](#).

## 10. Requirements for Costs to Be Included

Cost estimates must include all decommissioning activities from operations, during shutdown to the final release from regulatory control. The cost estimate for decommissioning must address the cost of the following principal activities, if applicable:

- preparation for final shutdown
- facility shutdown activities
- additional activities for safe enclosure (if applicable)
- decontamination and dismantling activities
- waste processing and storage, including used fuel
- project management, engineering and site support
- site clean-up, landscaping and restoration (if required)
- long-term management, including disposal of radioactive waste and used fuel (if applicable)
- long-term monitoring and maintenance of the site and institutional control (if applicable)
- miscellaneous expenditures

The applicant or licensee must estimate the cost for all activities included in their decommissioning plan.

## 11. Cost Categories

Four cost categories should be defined for each principal activity:

- labour cost: payments to employees including social and health benefits
- investment cost: capital/equipment/material cost
- expenses: consumables, taxes, insurance, etc.
- contingencies: a specific provision for unforeseeable elements of cost within the defined project scope

The applicant or the licensee should reflect local construction rates for labour, and provide conservative estimates for materials, equipment and administrative expenses.

An example of standardized definitions for cost categories for all major activities is presented in [Appendix C](#).

## 12. Presentation of Cost Estimate

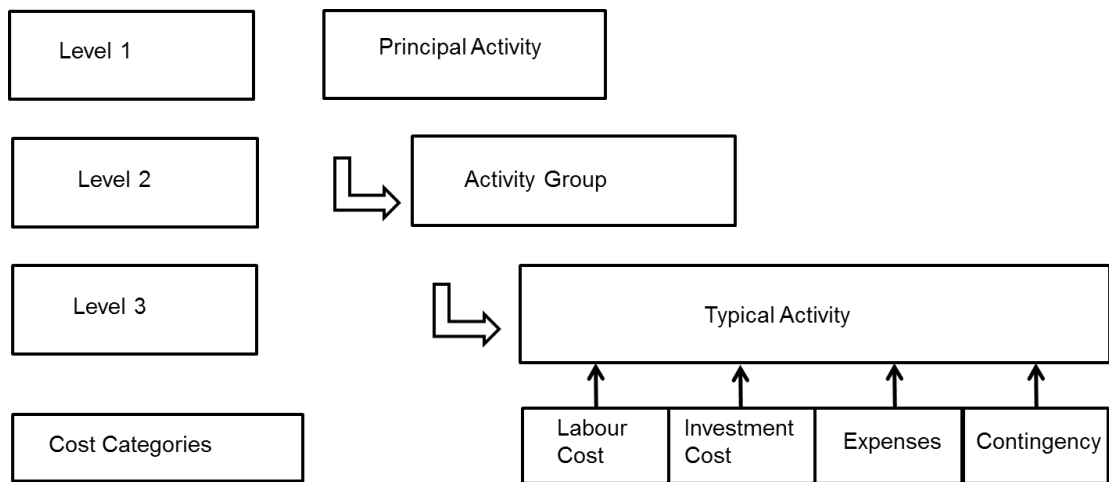
When developing a decommissioning cost estimate, consideration should be given to the presentation of cost estimate. The method most widely used as a platform for presenting the cost

estimation for establishing the funding for decommissioning is the work breakdown structure (WBS).

The WBS elements are arranged in a hierarchal format. The first level identifies the principal activities of the decommissioning project as listed in section 10 of this document. The second level presents the cost of activity groupings under which project costs would be gathered. The first and second levels are usually aggregations of the typical activities identified in the third level. The cost associated with each activity could be subdivided according to the four cost categories shown in figure 1.

An example of the hierarchal cost structure used by the International Structure for Decommissioning Costing (ISDC) is presented in figure 1 [6].

**Figure 1: Hierarchal cost structure as per International Structure for Decommissioning Costing**



Subsequent levels to the cost structure could be added in order to distinguish costs related to specific parts of the facility or specific periods of decommissioning project. The ISDC summary of cost item hierarchy is presented in Appendix D. The detailed itemization presented in the appendix provides general guidance on cost to be included in the estimate. The applicants and licensees should ensure that costs for all activities described in the decommissioning plan are reflected.

The approaches to cost estimation vary depending on the primary objective of the cost estimate, the facility lifecycle stage and the advancement of decommissioning planning. A brief description and comparison of those estimating methods is provided in table 1 in [Appendix E](#).

### 13. Elements of Cost Estimates

When developing a decommissioning cost estimate, the four basic elements to a cost estimate should be considered: basis of estimate, structure of estimate (work breakdown structure [WBS]), schedule and uncertainty analysis. These four elements are described in detail in the following sections.

### 13.1 Basis of estimate

The basis of estimate (BOE) is the foundation upon which the cost estimate is developed. A BOE should fully reflect the current decommissioning plan prepared in accordance with REGDOC-2.11.2, *Decommissioning* [1]. The BOE should be based on the following:

- assumptions and exclusions
- boundary conditions and limitations – legal and technical (e.g., regulatory framework)
- decommissioning strategy description
- end state of the facility
- stakeholder, public and indigenous input/concerns
- facility description and site characterization (radiological/hazardous material inventory)
- waste management (packaging, storage, transportation, and disposal)
- used fuel management (activities included in a decommissioning project)
- sources of data used (actual field data vs. estimating judgment)
- cost estimating methodology used (e.g., bottom-up)
- basis for determining contingency, estimating uncertainty and risk
- discussion of techniques and technology to be used
- schedule analysis
- uncertainty analysis

The cost estimate for decommissioning should provide that, if impacts of proposed operations are difficult or impossible to estimate with precision, a credible worst-case scenario must be used. The cost estimate should not assume drawdown of nuclear substances or hazardous waste during operations. A “decommissioning tomorrow approach” must be applied, assuming that the facility is shutting down overnight, and the cost estimate must be based on the state of the facility and inventories at the time of shutdown. A credit for salvage of materials or equipment is not allowed. For the purpose of the cost estimate, they must be considered as waste.

The cost estimate for decommissioning must cover the entire decommissioning project, including, as applicable, the need for post-closure licensing, monitoring, surveillance and maintenance, and institutional control.

### 13.2 Structure of estimate

The WBS is used to categorize cost elements and work activities into logical groupings that have a direct or indirect relationship to each other and to determine how they affect the overall cost of the project. To that end, the work scope cost elements are broken down into activity-dependent, period-dependent, and collateral costs as defined in the following paragraphs.

#### 13.2.1 Activity-dependent costs

Activity-dependent costs are costs associated directly with performing decommissioning activities. Examples of such activities include decontamination; removal of equipment; demolition of buildings; and waste packaging, shipping and disposal. These activities lend themselves to the use of unit cost and work productivity factors (or work difficulty factors) applied against the facility, activity and structure’s inventories to develop the decommissioning cost and schedule.

### 13.2.2 Period-dependent costs

Period-dependent costs include those activities associated primarily with the project duration: engineering, project management, dismantling management, licensing, health and safety, security, energy and quality assurance. These are primarily management staffing level costs, developed by estimating the manpower loading and associated overhead costs based on the scope of work to be accomplished during individual phases within each period of the project.

### 13.3 Collateral and special item costs

In addition to activity and period-dependent costs, there are costs for special items, such as for procurement of construction or dismantling equipment, site preparation, insurance, property taxes, health physics supplies, liquid radioactive waste processing and independent verification surveys. Such items do not fall in either of the other categories.

#### 13.3.1 Contingency

Contingency is a work scope element of cost and it should be applied to the base cost to account for unforeseen elements of cost that are likely to occur. Because of the unique nature of this element of cost, the application of contingency is further described in [section 13.5](#) of this document.

### 13.4 Schedule

The project schedule is an integral part of a cost estimate.

The preparation of a schedule is a well-developed process for which proven software programs are available.

The breakdown by project phase ties together all related activities in a chronological sequence to better define the work scope and schedule. The schedule's work breakdown structure should be the same as the cost estimate work breakdown structure.

Activity sequencing requires the determination and documentation of the relationship between activities. Work process flow charts should be used to structure the relationship between activities.

At the early stages of decommissioning planning and cost estimation, a less detailed schedule summarizing the principal activities may be provided, and a more detailed schedule should be provided later based on the detailed decommissioning planning.

### 13.5 Uncertainty analysis

The BOE should fully define the boundaries of the decommissioning project scope and set out the basis for estimating the base cost and the associated uncertainties.

Contingencies are defined as unforeseeable elements of cost **within** the defined project scope.

The base cost is first calculated on the basis of standard conditions where activities are performed within the defined project scope, without delays, interruptions, inclement weather, tool or equipment breakdown, labour strikes, waste shipment problems, disposal facility waste acceptance criteria changes, or changes in the anticipated shutdown conditions.



The following three approaches for applying contingency could be used:

- for the entire decommissioning project
- for groups of decommissioning activities
- for individual decommissioning activities

Applicants or licensees should add contingencies to the base cost as a specific provision for any unforeseeable elements of cost within the defined project scope that may occur. Applicants or licensees must provide a justification of the contingencies applied to the cost estimates and link them to the cost estimate category. Contingencies are an integral part of the cost estimate.

## **14. Development of the Financial Guarantee**

Cost estimates are first prepared in current dollars assuming that the decommissioning will be executed at the time the cost is estimated. However, the time required to fully decommission can vary widely and has a significant impact on the calculation of the cost of decommissioning. Various factors must therefore be outlined in the estimate of the financial guarantee requirement:

**Inflation rate:** The forecasted percentage increase in the price of goods and services annually. The rate of inflation used should be from a reasonable and credible source, such as from the Bank of Canada. Applicants or licensees must factor in inflation to ensure that there are sufficient funds reserved even when price increases are factored in.

**Discount rate (or expected rate of return on investment):** In cases where the funds are invested, the expected rate of return that will be earned by the funds over time must be estimated. This expected rate of return should be supported by assumptions such as historical performance of the fund over time, the risk of the portfolio etc.

Another element that is important when performing this calculation is an estimate of when various elements of the work will be performed. Disbursements or planned spending must be factored in.

Starting with current value of the money, then applying the inflation rate and the discount rate, results in the net present value of funds required to be invested today, to ensure there are sufficient funds available for decommissioning in the future.

### **14.1 Constant dollars**

Liabilities for decommissioning activities are reported in the present value of the underlying obligation, thereby expressing estimates in constant dollars to reflect changes in underlying funding obligations over time.

### **14.2 Cash flow and planned disbursements**

A schedule of cash flow and planned disbursements for decommissioning must also be submitted in order to calculate the net present value of decommissioning requirements

### **14.3 Net present value**

The net present value presents the current dollar value of estimated future cash expenditures. It depends on the timing of decommissioning activities and expected expenditure profile.

In order to determine how much money is required today to pay for future liability, economic assumptions with respect to inflation and interest rate must be considered. Applicants and licensees must indicate the inflation rate and interest or discount rate used in calculations and justify the validity of the selected rates and assumptions.

As stated above, many decommissioning activities take place over a number of years, so it is important to ensure there are sufficient funds available today to cover costs that will be incurred years into the future.

## **15. Review of Financial Guarantees**

Applicants or licensees must ensure that the financial guarantee remains valid, in effect and sufficient to meet decommissioning needs according to the most up-to-date decommissioning plan. Therefore, licensees must revise their financial guarantee at a minimum every five years or earlier when requested by the Commission. Applicants or licensees may request a review of their financial guarantees by the CNSC at any time.

Applicants or licensees must submit the updated financial guarantee for review by CNSC staff and acceptance by the Commission.

## **Part II: Financial Guarantees for Termination of Licensed Activities**

### **16. Introduction**

#### **16.1 Scope**

Part II of this document applies to holders of nuclear substances and radiation devices, prescribed equipment, and Class II facilities licensees. These licensees must ensure that they are financially responsible for the termination of the activities authorized by their licence. The CNSC has developed an insurance-based financial guarantee program to ensure that the Crown is not held financially responsible in the situation where a licensee has failed to properly terminate licensed activities.

### **17. Financial Guarantee Program**

Under the insurance-based program, the CNSC is the insured party and the beneficiary. Licensees that participate in this program contribute to the cost of the insurance policy, in proportion to their liability. Liability is calculated on the basis of a formula that prescribes an estimated liability for each unit of prescribed equipment and sealed source as well as a room or laboratory where open source material is used.

Additional information on financial guarantees for [nuclear substances and radiation devices](#) and [prescribed equipment and Class II facilities](#) can be found on the CNSC website.

### **18. Alternatives to Financial Guarantee Program**

The financial guarantee program is flexible in situations where a licensee's activities do not meet the prescribed formula. In these situations a licensee has the option to propose its own financial guarantee for review and acceptance by the Commission following the established principles of section 3 and 4 of this document.

### **19. Review of Financial Guarantees**

Financial guarantees for licences are assessed annually by the CNSC staff or when required by the Commission, to ensure that coverage is sufficient for the licensed activities.

## Appendix A: Example of Letter of Credit

The following provides an example of letter of credit<sup>2</sup>. This template may be used by licence applicants or licensees when submitting a letter of credit to the CNSC.

1. The undersigned, hereinafter called the Guarantor, irrevocably guarantees to pay to the Beneficiary an amount not exceeding xxx Canadian dollars, including interest, costs and accessories, upon receipt of a written demand by the Beneficiary certifying that the Applicant has failed to fulfill its obligations with respect to decommissioning resulting from, or under the *Nuclear Safety and Control Act*, its regulations or licence no. xxx.
2. This Guarantee is effective from its issuance and must terminate and automatically expire on the expiry date.
3. Upon expiry of this Guarantee, by payment in favour of the Beneficiary or by lapse of time, the Beneficiary must return to the Guarantor the original of the Guarantee, bearing clear mention of its cancellation.
4. This Guarantee must be deemed to be automatically extended without amendment for a further one (1) year period from the present or any future expiration date hereof, unless at least thirty (30) days prior to the present or any future expiration date, the bank notifies you, the Beneficiary, in writing by courier or registered mail, that the bank elect not to consider this Guarantee to be renewable for any additional period. If the Applicant fails to provide a replacement financial guarantee acceptable to the Beneficiary within ten (10) days after receipt of this notification, the full face value of this Guarantee, less any partial drawings made hereunder, must be paid to the Beneficiary, or to a trustee acceptable to the Beneficiary, prior to the expiration date, with no proof of forfeiture required.
5. Partial draws by the Beneficiary are permitted hereunder. The amount of the partial draw shall be paid by the Guarantor to the Beneficiary, and the full face value of this Guarantee (i.e., the Guarantor's maximum liability under this Guarantee) shall be automatically reduced by the amount of any partial drawings made hereunder.
6. Any demand for payment must be signed by a person authorized to act on the behalf of the Beneficiary
7. The Guarantor will honour the demand of the Beneficiary without enquiring whether the Beneficiary has the right as between itself and the Applicant to make such demand and without acknowledging any claim of the Applicant.
8. The Guarantor's liability under this Guarantee must in no event exceed the sum mentioned in paragraph 1 herein, and such liability must terminate if a demand for payment made strictly in accordance with the requirements of these presents has not been received at the above branch no later than on the expiry date.
9. This Guarantee is not assignable.

---

<sup>2</sup> Note: This is an example only and not the form of any specific financial institution. In any specific case additional or varied clauses may be used or required.

10. This Guarantee is governed by the laws of xxx, and the Courts of that province must have exclusive jurisdiction on all matters relating to this Guarantee and all recourses resulting therefrom.
11. This Guarantee sets forth in its entirety all of the obligations of the Guarantor and these obligations cannot be modified, interpreted or increased by any document or agreement mentioned herein, and any reference to any such document or agreement must not be construed as incorporating same to this Guarantee.

## Appendix B: Cost Estimate Grades and Classification

A universally accepted standard for developing decommissioning cost estimates has not been established. However, organizations such as the Association for the Advancement of Cost Engineering (AACE International) have developed guidelines for estimation cost for different industries [5].

### General

AACE International and the Construction Industry Institute have established guidelines and procedures for estimating costs [5]. These guidelines rank cost estimates as Grades A, B, or C, depending on their level of accuracy.

### Grade C (accuracy of $\pm 25\%$ to $30\%$ )

Grade C cost estimates are known as order-of-magnitude cost estimates. They are performed quickly by using shortcut techniques such as

- a) escalating and/or scaling up from previous estimates
- b) cost curves
- c) preliminary process design and equipment sizing without plot plans or major equipment quotations

It is likely that the overall scope of the project has not been defined.

### Grade B (accuracy of $\pm 15\%$ to $20\%$ )

Grade B cost estimates are known as budgetary cost estimates. They can be developed when the scope of the project has been defined but the detailed planning has not been performed. For large projects, they can be developed as soon as the preliminary process flow diagrams, preliminary plot plans, and equipment sizing have been completed. On smaller projects, estimates are developed when approximately 10% of the engineering is completed.

### Grade A (accuracy of $\pm 10\%$ )

Grade A cost estimates are known as definitive cost estimates. They can be developed when the scope of the project is well defined and the detailed planning is prepared. For large projects, a Grade A estimate are prepared when the engineering flow diagrams, facility plans, and equipment lists are completed, and design has progressed to the stage required for the bidding process. For small projects, more engineering detail is necessary, and 30% to 50% of the engineering might be required to be completed.

### Cost estimate classes

AACE International describes a classification system for cost estimates in the process industry (see table 1). In general, the accuracy of the cost estimate increases as the level of project definition increases. Decommissioning cost estimates prepared for the PDP are typically prepared as Class 4 study-type cost estimates. For additional information refer to the AACE International's *Required Skills and Knowledge of Cost Engineering* [5].

**Table 1: AACE International cost estimate classification for process industries**

<b>Estimate class</b>	<b>Level of definition, % of complete definition</b>	<b>End usage (typical purpose of estimate)</b>	<b>Methodology (typical estimating method)</b>	<b>Expected accuracy (typical variation in low and high ranges), %</b>	<b>Preparation effort (typical degree of effort relative to lowest cost index of 1)</b>
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	Low: -20% to -50% High: +30% to +100%	1
Class 4	1% to 15%	Study of feasibility	Equipment factored or parametric models	Low: -15% to -30% High: +20% to +50%	2-4
Class 3	10% to 40%	Budget, authorization of control	Semi-detailed unit costs with assembly level line items	Low: -10% to -20% High: +10% to +30%	3-10
Class 2	30% to 70%	Control or bid/tender	Detailed unit cost with forced detailed take-off	Low: -5% to -15% High: +5% to +20%	4-20
Class 1	50% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	Low: -3% to -10% High: +3% to +15%	5-100

## Appendix C: Standardized Definitions for Cost Categories

This appendix provides information on standardised definitions for cost categories for all major activities. These definitions have been developed by the International Structure for Decommissioning Costing (ISDC) [6].

For each cost item, four cost categories have been defined:

1. labour costs
2. investment costs (capital, equipment and material costs)
3. expenses
4. contingency

### 1. Labour costs

Labour costs are defined as costs calculated on the basis of the workload for a particular cost item and the labour cost unit rate, including:

- salaries
- contributions to social security and health insurance
- company contributions to pension scheme and fringe benefits
- overheads

### 2. Investment costs (capital, equipment and material costs)

Investment costs are defined as costs for:

- equipment
- machinery

### 3. Expenses

Expenses are defined as costs for consumer items or expendable items, or as costs for other expenditures related to decommissioning cost items where applicable, such as:

- consumables
- spare parts
- protective clothing
- travel expenses
- legal expenses
- taxes
- value added tax
- insurance
- consultants costs
- quality assurance costs
- rents
- office material
- heating costs
- water costs



- electricity costs
- computer costs
- telephone/fax costs
- cleaning
- interest
- public relation
- licences/patents
- decommissioning authorisation
- income from asset recovery (“negative expenses”)

#### **4. Contingency**

Contingency, added to individual cost items of the standardised listing, is a specific provision for unforeseeable elements of costs within the defined project scope. Any impacts on cost outside of the scope of the decommissioning project are not considered.

## **Appendix D: International Structure for Decommissioning Costing Cost Item Hierarchy**

This appendix provides information from the International Structure for Decommissioning Costing (ISDC) [6]. The ISDC was developed as a presentation platform for standardized listing of costs within the scope of decommissioning planning. Note that cost estimation for decommissioning of nuclear facilities can vary widely in format, content and practice.

### **ISDC Summary of cost item hierarchy**

#### **Principle activity 01: Pre-decommissioning actions**

- 01.0100 Decommissioning planning
  - 01.0101 *Strategic planning*
  - 01.0102 *Preliminary planning*
  - 01.0103 *Final planning*
- 01.0200 Facility characterisation
  - 01.0201 *Detailed facility characterisation.*
  - 01.0202 *Hazardous-material surveys and analyses*
  - 01.0203 *Establishing a facility inventory database*
- 01.0300 Safety, security and environmental studies
  - 01.0301 *Decommissioning safety analysis*
  - 01.0302 *Environmental impact assessment*
  - 01.0303 *Safety, security and emergency planning for site operations*
- 01.0400 Waste management planning
  - 01.0401 *Establish waste management criteria*
  - 01.0402 *Develop a waste management plan*
- 01.0500 Authorisation
  - 01.0501 *License applications and license approvals*
  - 01.0502 *Stakeholder involvement*
- 01.0600 Preparing management group and contracting
  - 01.0601 *Management team activities*
  - 01.0602 *Contracting activities*

#### **Principle activity 02: Facility shutdown activities**

- 02.0100 Plant shutdown and inspection
  - 02.0101 *Termination of operation, plant stabilisation, isolation and inspection*
  - 02.0102 *Defueling and transfer of fuel to spent-fuel storage*
  - 02.0103 *Cooling down of spent fuel*
  - 02.0104 *Management of fuel, fissile and other nuclear materials*
  - 02.0105 *Isolation of power equipment*
  - 02.0106 *Facility reuse*
- 02.0200 Drainage and drying of systems
  - 02.0201 *Drainage and drying of closed systems not in operation*
  - 02.0202 *Drainage of spent-fuel pool and other open systems not in operation*
  - 02.0203 *Removal of sludge and products from open systems*
  - 02.0204 *Drainage of special process fluids*
- 02.0300 Decontamination of closed systems for dose reduction
  - 02.0301 *Decontamination of process installations using operational procedures*
  - 02.0302 *Decontamination of process installations using additional procedures*

- 02.0400 Radiological inventory characterisation to support detailed planning
  - 02.0401 *Radiological inventory characterisation*
  - 02.0402 *Underground water monitoring*
- 02.0500 Removal of system fluids, operational waste and redundant material
  - 02.0501 *Removal of combustible material*
  - 02.0502 *Removal of system fluids (water, oils, etc.)*
  - 02.0503 *Removal of special system fluids*
  - 02.0504 *Removal of waste from decontamination*
  - 02.0505 *Removal of spent resins*
  - 02.0506 *Removal of specific operational waste from fuel cycle facilities*
  - 02.0507 *Removal of other waste from facility operations*
  - 02.0508 *Removal of redundant equipment and materials*

**Principle activity 03: Additional activities for safe enclosure**

- 03.0100 Preparation for safe enclosure
  - 03.0101 *Decontamination of selected components and areas to facilitate safe enclosure*
  - 03.0102 *Zoning for long-term storage*
  - 03.0103 *Removal of inventory not suitable for safe enclosure*
  - 03.0104 *Dismantling and transfer of contaminated equipment and material to containment structure for long-term storage*
  - 03.0105 *Radiological inventory characterisation for safe enclosure*
- 03.0200 Site boundary reconfiguration, isolating and securing structures
  - 03.0201 *Modification of auxiliary systems*
  - 03.0202 *Site boundary reconfiguration*
  - 03.0203 *Construction of temporary enclosures, stores, structural enhancements, etc.*
  - 03.0204 *Stabilisation of radioactive and hazardous waste pending remediation*
  - 03.0205 *Facility controlled area hardening, isolation for safe enclosure*
- 03.0300 Facility entombment
  - 03.0301 *Facility entombment as end state of decommissioning strategy*
  - 03.0302 *Institutional control and monitoring of the entombment end state*

**Principle activity 04: Dismantling activities within the controlled area**

- 04.0100 Procurement of equipment for decontamination and dismantling
  - 04.0101 *Procurement of general site-dismantling equipment*
  - 04.0102 *Procurement of equipment for decontamination of personnel and tools*
  - 04.0103 *Procurement of special tools for dismantling the reactor systems*
  - 04.0104 *Procurement of special tools for dismantling in fuel cycle facilities*
  - 04.0105 *Procurement of special tools for dismantling other components or structures*
- 04.0200 Preparations and support for dismantling
  - 04.0201 *Reconfiguration of existing services, facilities and site to support dismantling*
  - 04.0202 *Preparation of infrastructure and logistics for dismantling*
  - 04.0203 *Ongoing radiological characterisation during dismantling*
- 04.0300 Pre-dismantling decontamination
  - 04.0301 *Drainage of remaining systems*
  - 04.0302 *Removal of sludge and products from remaining systems*
  - 04.0303 *Decontamination of remaining systems*
  - 04.0304 *Decontamination of areas in buildings*
- 04.0400 Removal of materials requiring specific procedures
  - 04.0401 *Removal of thermal insulation*
  - 04.0402 *Removal of asbestos*
  - 04.0403 *Removal of other hazardous materials*

- 04.0500 Dismantling of main process systems, structures and components
  - 04.0501 *Dismantling of reactor internals*
  - 04.0502 *Dismantling of reactor vessel and core components*
  - 04.0503 *Dismantling of other primary loop components*
  - 04.0504 *Dismantling of main process systems in fuel cycle facilities*
  - 04.0505 *Dismantling of main process systems in other nuclear facilities*
  - 04.0506 *Dismantling of external thermal/biological shields*
- 04.0600 Dismantling of other systems and components
  - 04.0601 *Dismantling of auxiliary systems*
  - 04.0602 *Dismantling of remaining components*
- 04.0700 Removal of contamination from building structures
  - 04.0701 *Removal of embedded elements in buildings*
  - 04.0702 *Removal of contaminated structures*
  - 04.0703 *Decontamination of buildings*
- 04.0800 Removal of contamination from areas outside buildings
  - 04.0801 *Removal of underground contaminated pipes and structures*
  - 04.0802 *Removal of contaminated soil and other contaminated items*
- 04.0900 Final radioactivity survey for release of buildings
  - 04.0901 *Final radioactivity survey of buildings*
  - 04.0902 *Declassification of buildings*

**Principle activity 05: Waste processing, storage and disposal**

- 05.0100 Waste management system
  - 05.0101 *Establishing the waste management system*
  - 05.0102 *Reconstruction of existing facilities for decommissioning waste management system*
  - 05.0103 *Procurement of additional equipment for management of historical/legacy waste*
  - 05.0104 *Maintenance, surveillance and operational support for waste management system*
  - 05.0105 *Demobilisation/decommissioning of waste management system*
- 05.0200 Management of historical/legacy high-level waste
  - 05.0201 *Characterisation*
  - 05.0202 *Retrieval and processing*
  - 05.0203 *Final conditioning*
  - 05.0204 *Storage*
  - 05.0205 *Transport*
  - 05.0206 *Disposal*
  - 05.0207 *Containers*
- 05.0300 Management of historical/legacy intermediate-level waste
  - 05.0301 *Characterisation*
  - 05.0302 *Retrieval and processing*
  - 05.0303 *Final conditioning*
  - 05.0304 *Storage*
  - 05.0305 *Transport*
  - 05.0306 *Disposal*
  - 05.0307 *Containers*

- 05.0400 Management of historical/legacy low-level waste
  - 05.0401 *Characterisation*
  - 05.0402 *Retrieval and treatment*
  - 05.0403 *Final conditioning*
  - 05.0404 *Storage*
  - 05.0405 *Transport*
  - 05.0406 *Disposal*
  - 05.0407 *Containers*
- 05.0500 Management of historical/legacy very low-level waste
  - 05.0501 *Characterisation*
  - 05.0502 *Retrieval, treatment and packaging*
  - 05.0503 *Transport*
  - 05.0504 *Disposal*
- 05.0600 Management of historical/legacy exempt waste and materials
  - 05.0601 *Retrieval, treatment and packaging*
  - 05.0602 *Clearance measurement of exempt waste and materials*
  - 05.0603 *Transport of hazardous waste*
  - 05.0604 *Disposal of hazardous waste at dedicated waste dumps*
  - 05.0605 *Transport of conventional waste and materials*
  - 05.0606 *Disposal of conventional waste at conventional waste dumps*
- 05.0700 Management of decommissioning high-level waste
  - 05.0701 *Characterisation*
  - 05.0702 *Processing*
  - 05.0703 *Final conditioning*
  - 05.0704 *Storage*
  - 05.0705 *Transport*
  - 05.0706 *Disposal*
  - 05.0707 *Containers*
- 05.0800 Management of decommissioning intermediate-level waste
  - 05.0801 *Characterisation*
  - 05.0802 *Processing*
  - 05.0803 *Final conditioning*
  - 05.0804 *Storage*
  - 05.0805 *Transport*
  - 05.0806 *Disposal*
  - 05.0807 *Containers*
- 05.0900 Management of decommissioning low-level waste
  - 05.0901 *Characterisation*
  - 05.0902 *Processing*
  - 05.0903 *Final conditioning*
  - 05.0904 *Storage*
  - 05.0905 *Transport*
  - 05.0906 *Disposal*
  - 05.0907 *Containers*
- 05.1000 Management of decommissioning very low-level waste
  - 05.1001 *Characterisation*
  - 05.1002 *Treatment and packaging*
  - 05.1003 *Transport*
  - 05.1004 *Disposal*

- 05.1100 Management of decommissioning very short-lived waste
  - 05.1101 *Characterisation*
  - 05.1102 *Treatment, storage, handling and packaging*
  - 05.1103 *Final management of decommissioning very short-lived waste*
- 05.1200 Management of decommissioning exempt waste and materials
  - 05.1201 *Treatment and packaging*
  - 05.1202 *Clearance measurement of exempt waste and materials*
  - 05.1203 *Transport of hazardous waste*
  - 05.1204 *Disposal of hazardous waste at dedicated waste dumps*
  - 05.1205 *Transport of conventional waste and materials*
  - 05.1206 *Disposal of conventional waste at conventional waste dumps*
- 05.1300 Management of decommissioning waste and materials generated outside controlled areas
  - 05.1301 *Recycling of concrete*
  - 05.1302 *Treatment and packaging of hazardous waste*
  - 05.1303 *Treatment and recycling of other materials.*
  - 05.1304 *Transport of hazardous waste*
  - 05.1305 *Disposal of hazardous waste at dedicated waste dumps*
  - 05.1306 *Transport of conventional waste and materials*
  - 05.1307 *Disposal of conventional waste at conventional waste dumps*

**Principle activity 06: Site infrastructure and operation**

- 06.0100 Site security and surveillance
  - 06.0101 *Procurement of general security equipment*
  - 06.0102 *Operation and maintenance of automated access control systems, monitoring systems and alarms*
  - 06.0103 *Security fencing and protection of remaining entrances against trespassing*
  - 06.0104 *Deployment of guards/security forces*
- 06.0200 Site operation and maintenance
  - 06.0201 *Inspection and maintenance of buildings and systems*
  - 06.0202 *Site upkeep activities*
- 06.0300 Operation of support systems
  - 06.0301 *Electricity supply systems*
  - 06.0302 *Ventilation systems*
  - 06.0303 *Heating, steam and lighting systems*
  - 06.0304 *Water supply systems*
  - 06.0305 *Sewage/waste water systems*
  - 06.0306 *Compressed air/nitrogen systems*
  - 06.0307 *Other systems*
- 06.0400 Radiation and environmental safety monitoring
  - 06.0401 *Procurement and maintenance of equipment for radiation protection and environmental monitoring.*
  - 06.0402 *Radiation protection and monitoring.*
  - 06.0403 *Environmental protection and radiation environmental monitoring*

**Principle activity 07: Conventional dismantling, demolition and site restoration**

- 07.0100 Procurement of equipment for conventional dismantling and demolition
  - 07.0101 *Procurement of equipment for conventional dismantling and demolition*

- 07.0200 Dismantling of systems and building components outside the controlled area
  - 07.0201 *Electricity generating system*
  - 07.0202 *Cooling system components*
  - 07.0203 *Other auxiliary systems*
- 07.0300 Demolition of buildings and structures
  - 07.0301 *Demolition of buildings and structures from the formerly controlled area*
  - 07.0302 *Demolition of buildings and structures outside the controlled area*
  - 07.0303 *Dismantling of the stack*
- 07.0400 Final cleanup, landscaping and refurbishment
  - 07.0401 *Earthworks, landworks*
  - 07.0402 *Landscaping and other site finishing activities*
  - 07.0403 *Refurbishment of buildings*
- 07.0500 Final radioactivity survey of site
  - 07.0501 *Final survey*
  - 07.0502 *Independent verification of the final survey*
- 07.0600 Perpetuity funding/surveillance for limited or restricted release of property
  - 07.0601 *Routine maintenance*
  - 07.0602 *Surveillance and monitoring*

**Principle activity 08: Project management, engineering and support**

- 08.0100 Mobilisation and preparatory work
  - 08.0101 *Mobilisation of personnel*
  - 08.0102 *Establishment of general supporting infrastructure for decommissioning project*
- 08.0200 Project management
  - 08.0201 *Core management group*
  - 08.0202 *Project implementation planning, detailed ongoing planning*
  - 08.0203 *Scheduling and cost control*
  - 08.0204 *Safety and environmental analysis, ongoing studies*
  - 08.0205 *Quality assurance and quality surveillance*
  - 08.0206 *General administration and accounting*
  - 08.0207 *Public relations and stakeholders involvement*
- 08.0300 Support services
  - 08.0301 *Engineering support*
  - 08.0302 *Information system and computer support*
  - 08.0303 *Waste management support*
  - 08.0304 *Decommissioning support including chemistry, decontamination*
  - 08.0305 *Personnel management and training*
  - 08.0306 *Documentation and records control*
  - 08.0307 *Procurement, warehousing, and materials handling*
  - 08.0308 *Housing, office equipment, support services*
- 08.0400 Health and safety
  - 08.0401 *Health physics*
  - 08.0402 *Industrial safety*
- 08.0500 Demobilisation
  - 08.0501 *Demobilisation of project infrastructure for decommissioning*
  - 08.0502 *Demobilisation of personnel*
- 08.0600 Mobilisation and preparatory work by contractors (if needed)
  - 08.0601 *Mobilisation of personnel*
  - 08.0602 *Establishment of general supporting infrastructure for decommissioning project*

- 08.0700 Project management by contractors (if needed)
  - 08.0701 *Core management group*
  - 08.0702 *Project implementation planning, detailed ongoing planning*
  - 08.0703 *Scheduling and cost control*
  - 08.0704 *Safety and environmental analysis, ongoing studies*
  - 08.0705 *Quality assurance and quality surveillance*
  - 08.0706 *General administration and accounting*
  - 08.0707 *Public relations and stakeholder involvement*
- 08.0800 Support services by contractors (if needed)
  - 08.0801 *Engineering support*
  - 08.0802 *Information system and computer support*
  - 08.0803 *Waste management support*
  - 08.0804 *Decommissioning support including chemistry, decontamination.*
  - 08.0805 *Personnel management and training*
  - 08.0806 *Documentation and records control*
  - 08.0807 *Procurement, warehousing, and materials handling*
  - 08.0808 *Housing, office equipment, support services*
- 08.0900 Health and safety by contractors (if needed)
  - 08.0901 *Health physics*
  - 08.0902 *Industrial safety*
- 08.1000 Demobilisation by contractors (if needed)
  - 08.1001 *Demobilisation of project infrastructure for decommissioning.*
  - 08.1002 *Demobilisation of personnel*

**Principle activity 09: Research and development**

- 09.0100 Research and development of equipment, techniques and procedures
  - 09.0101 *Equipment, techniques and procedures for characterisation*
  - 09.0102 *Equipment, techniques and procedures for decontamination*
  - 09.0103 *Equipment, techniques and procedures for dismantling*
  - 09.0104 *Equipment, techniques and procedures for waste management*
  - 09.0105 *Other research and development activities*
- 09.0200 Simulation of complicated works
  - 09.0201 *Physical mock-ups and training*
  - 09.0202 *Test or demonstration programmes*
  - 09.0203 *Computer simulations, visualisations and 3D modelling*
  - 09.0204 *Other activities*

**Principle activity 10: Fuel and nuclear material**

- 10.0100 Removal of fuel or nuclear material from facility to be decommissioned
  - 10.0101 *Transfer of fuel or nuclear material to external storage or to treatment facilities*
  - 10.0102 *Transfer of fuel or nuclear material to dedicated buffer storage*
- 10.0200 Dedicated buffer storage for fuel and/or nuclear material
  - 10.0201 *Construction of buffer storage*
  - 10.0202 *Operation of buffer storage*
  - 10.0203 *Transfer of fuel and/or nuclear material away from the buffer storage*
- 10.0300 Decommissioning of buffer storage
  - 10.0301 *Decommissioning of buffer storage*
  - 10.0302 *Management of waste*



**Principle activity 11: Miscellaneous expenditures**

- 11.0100 Owner costs
  - 11.0101 *Implementation of transition plans*
  - 11.0102 *External projects to be performed as a consequence of decommissioning*
  - 11.0103 *Payments (fees) to authorities*
  - 11.0104 *Specific external services and payments*
- 11.0200 Taxes
  - 11.0201 *Value added taxes*
  - 11.0202 *Local, community, federal taxes*
  - 11.0203 *Environmental taxes*
  - 11.0204 *Taxes on industrial activities*
  - 11.0205 *Other taxes*
- 11.0300 Insurances
  - 11.0301 *Nuclear related insurances*
  - 11.0302 *Other insurances*

## Appendix E: Approaches to Cost Estimation

The Nuclear Energy Agency document [\*The Practice of Cost Estimation for Decommissioning of Nuclear Facilities\*](#) [7] provides a comparative overview of the cost estimation methods and their advantages and disadvantages. It is summarized in the following table.

**Table 1: Estimating method comparison**

Estimating Method	Description	Advantages	Disadvantages
Bottom-up	In this building blocks technique, a work statement and set of drawings or specifications are used to extract material quantities required for executing each discrete task performed in accomplishing a given activity. From these quantities, direct labour, equipment and overhead costs can be derived.	Most accurate as it accounts for site-specific radiological and physical inventory. Relies on unit cost factors (UCFs).	Requires detailed description of inventory and site specific labour, material and equipment costs for the UCFs.
Specific analogy	Specific analogies depend upon the known cost of an item used in prior estimates as the basis for the cost of a similar item in a new estimate. Adjustments are made to known costs to account for differences in relative complexities of performance, design and operational characteristics.	Accurate if prior estimates are appropriately adjusted for size differences, inflation and regional differences in labour materials and equipment.	Adjustments as noted may require detailed documentation and introduce approximations that reduce accuracy.
Parametric	Parametric estimating requires historical databases on similar systems or subsystems. Statistical analysis is performed on the data to find correlations between cost drivers and other system parameters, such as design or performance. The analysis produces cost equations or cost estimating relationships that may be used individually or grouped into more complex models.	Suitable for use for large sites where detailed inventory is not readily available. Suited for Order of Magnitude estimates.	Approximations based on areas or volumes introduce additional inaccuracies. There is no way to track actual inventory. Not suited for project planning of work activities.

<b>Estimating Method</b>	<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>
Cost review and update	An estimate may be constructed by examining previous estimates of the same or similar projects for internal logic, completeness of scope, assumptions and estimating methodology.	Suitable for large sites where detailed inventory is not available. Suited for update of previous estimates, or order of magnitude estimates.	There is no way to track actual inventory. Generally not suited for project planning of work activities.
Expert opinion	An expert opinion technique may be used when other techniques or data are not available. Several specialists may be consulted iteratively until a consensus cost estimate is established.	An expert opinion technique may be used when other techniques or data are not available. Several specialists may be consulted iteratively until a consensus cost estimate is established.	Expert opinion may not be specific to the work activities. May not reflect the radiological limitations of the decommissioning project.

## 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. REGDOC-3.6 is provided for reference and information.

## References

The CNSC may include references to information on best practices and standards such as those published by CSA Group. With permission of the publisher, CSA Group, all nuclear-related CSA standards may be viewed at no cost through the CNSC Web page “[How to gain free access to all nuclear-related CSA standards](#)”.

1. Canadian Nuclear Safety Commission (CNSC). [REGDOC-2.11.2, Decommissioning](#), Ottawa, 2021.
2. CSA Group. CSA N294, *Decommissioning of Facilities Containing Nuclear Substances*, Toronto, 2019.
3. CNSC, [REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills](#), Ottawa, 2018.
4. CNSC. [REGDOC-3.1.3, Reporting Requirements for Waste Nuclear Substance Licensees, Class II Nuclear Facilities and Users of Prescribed Equipment, Nuclear Substances and Radiation Devices](#), Ottawa, 2020.
5. Association for Advancement of Cost Engineering (AACE International), [Skills and knowledge of cost engineering, 6th edition](#), USA, 2015.
6. Nuclear Energy Agency (NEA), Organization for Economic Co-Operation and Development (OECD), [International Structure for Decommissioning Costing \(ISDC\) of Nuclear Installations](#), France, 2012.
7. Nuclear Energy Agency (NEA) Organization for Economic Co-Operation and Development (OECD), [The Practice of Cost Estimation for Decommissioning of Nuclear Facilities](#), France 2015.

### **Additional Information**

The following documents provide additional information that may be relevant and useful for understanding the requirements and guidance provided in this regulatory document:

- CNSC, [REGDOC-3.1.1, Reporting Requirements: Reporting Requirements for Nuclear Power Plants](#). Ottawa, 2016.

## CNSC Regulatory Document Series

Facilities and activities within the nuclear sector in Canada are regulated by the CNSC. In addition to the *Nuclear Safety and Control Act* and associated regulations, these facilities and activities may also be required to comply with other regulatory instruments such as regulatory documents or standards.

CNSC regulatory documents are classified under the following categories and series:

### 1.0 Regulated facilities and activities

- |        |     |  |
|--------|-----|--|
| Series | 1.1 | Reactor facilities                       |
|        | 1.2 | Class IB facilities                      |
|        | 1.3 | Uranium mines and mills                  |
|        | 1.4 | Class II facilities                      |
|        | 1.5 | Certification of prescribed equipment    |
|        | 1.6 | Nuclear substances and radiation devices |

### 2.0 Safety and control areas

- |        |      |  |
|--------|------|--|
| Series | 2.1  | Management system                        |
|        | 2.2  | Human performance management             |
|        | 2.3  | Operating performance                    |
|        | 2.4  | Safety analysis                          |
|        | 2.5  | Physical design                          |
|        | 2.6  | Fitness for service                      |
|        | 2.7  | Radiation protection                     |
|        | 2.8  | Conventional health and safety           |
|        | 2.9  | Environmental protection                 |
|        | 2.10 | Emergency management and fire protection |
|        | 2.11 | Waste management                         |
|        | 2.12 | Security                                 |
|        | 2.13 | Safeguards and non-proliferation         |
|        | 2.14 | Packaging and transport                  |

### 3.0 Other regulatory areas

- |        |     |                                  |
|--------|-----|----------------------------------|
| Series | 3.1 | Reporting requirements           |
|        | 3.2 | Public and Indigenous engagement |
|        | 3.3 | Financial guarantees             |
|        | 3.4 | Commission proceedings           |
|        | 3.5 | CNSC processes and practices     |
|        | 3.6 | Glossary of CNSC terminology     |

**Note:** The regulatory document series may be adjusted periodically by the CNSC. Each regulatory document series listed above may contain multiple regulatory documents. Visit the CNSC's website for the latest [list of regulatory documents](#).