



# Management of Uranium Mine Waste Rock and Mill Tailings

RD/GD-370

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## **Management of Uranium Mine Waste Rock and Mill Tailings**

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## Preface

Regulatory document RD/GD-370, *Management of Uranium Mine Waste Rock and Mill Tailings* sets out the requirements of the Canadian Nuclear Safety Commission (CNSC) for the sound management of mine waste rock and mill tailings resulting from site preparation, construction, operation and decommissioning of new uranium mine or mill projects in Canada, to ensure the protection of the environment and the health and safety of people.

This regulatory document also provides guidance to applicants regarding CNSC's expectations for new mining projects throughout Canada on the management of waste rock and tailings generated by uranium mining and milling operations. Canadian Nuclear Safety Commission (CNSC) staff use this regulatory document when making regulatory decisions regarding the management of mine waste.

Applicants for new uranium mine and/or mill projects are required to submit an application to the CNSC. The application includes a description of the management method for safe long-term storage of uranium mine waste rock and mill tailings. CNSC staff reviews the information contained in the application, and makes recommendations to the Commission on the acceptability of the proposed management method.

This regulatory document should be applied in conjunction with CNSC policy documents P-290, *Managing Radioactive Waste* and P-223, *Protection of the Environment*.



## Table of Contents

<b>1</b>	<b>Introduction.....</b>	<b>1</b>
1.1	Purpose .....	1
1.2	Scope.....	1
1.3	Relevant regulations .....	1
1.4	National and international standards.....	2
<b>2</b>	<b>Requirements for Managing Mine Waste.....</b>	<b>3</b>
<b>3</b>	<b>Guidance on Managing Mine Waste.....</b>	<b>3</b>
3.1	Guidance on selecting a mine waste management option.....	3
3.2	Assessment of alternatives.....	4
3.3	Monitoring .....	4
<b>4</b>	<b>Performance Measurement.....</b>	<b>4</b>
	<b>Glossary .....</b>	<b>7</b>
	<b>References.....</b>	<b>9</b>



# Management of Uranium Mine Waste Rock and Mill Tailings

## 1 Introduction

### 1.1 Purpose

This regulatory document sets out the requirements of the Canadian Nuclear Safety Commission (CNSC) for the sound management of mine waste rock and mill tailings resulting from site preparation, construction, operation and decommissioning of new uranium mine or mill projects in Canada, to ensure the protection of the environment and the health and safety of people.

### 1.2 Scope

Applicants for new uranium mine and/or mill projects are required to submit an application to the CNSC. The application includes a description of the management method for safe long-term storage of uranium mine waste rock and mill tailings. CNSC staff reviews the information contained in the application, and makes recommendations to the Commission on the acceptability of the proposed management method.

In addition to setting out the requirements, this regulatory document provides guidance to applicants regarding CNSC's expectations for new mining projects throughout Canada on the management of waste rock and tailings generated by uranium mining and milling operations. CNSC staff use this regulatory document when making regulatory decisions regarding the management of mine waste.

Note that prospecting for uranium or surface exploration activities are not licensed by the CNSC.

### 1.3 Relevant regulations

The following provisions of the *Nuclear Safety and Control Act* (NSCA) and regulations made under the NSCA are relevant to this regulatory document:

- paragraph 3(a) of the NSCA states “The purpose of this Act is to provide for (a) the limitation, to a reasonable level and in a manner that is consistent with Canada’s international obligations, of the risks to national security, the health and safety of persons and the environment that are associated with the development, production and use of nuclear energy and the production, possession and use of nuclear substances, prescribed equipment and prescribed information”
- paragraph 24(4)(b) of the NSCA states “No licence may be issued, renewed, amended or replaced unless, in the opinion of the Commission, the applicant (b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed”
- paragraph 3(1)(j) of the *General Nuclear Safety and Control Regulations* states “An application for a licence shall contain the following information:  
(j) the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste”

- paragraph 3(1)(n)(1.1)(b) of the *General Nuclear Safety and Control Regulations* states “The Commission or a designated officer authorized under paragraph 37(2)(c) of the Act, may require any other information that is necessary to enable the Commission or the designated officer to determine whether the applicant  
(b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed”
- paragraph 5(1)(h) of the *Uranium Mines and Mills Regulations* (UMMR) states “An application for a licence to prepare a site for and construct a uranium mine shall contain the following information in addition to the information required by section 3 and subsection 4(2):  
(h) the anticipated quantities and grade of ore and waste rock that will be removed, their proposed storage location, and the proposed method, program and schedule, for their removal and disposal”

Regulatory policies P-223, *Protection of the Environment* [1], and P-290, *Managing Radioactive Waste* [2], also apply to the management of uranium mine waste rock and mill tailings.

The following federal legislation is also relevant to the control of mine waste and mill tailings:

- the *Canadian Environmental Protection Act, 1999* (CEPA 1999) [3], particularly paragraphs 2(1)(a), (a.1), (b) and (i), and paragraphs 2(1.1)(a), (b) and (c)
- the *Canadian Environmental Assessment Act* (CEAA) [4], particularly paragraphs 5(1)(d), 16(1)(a) and (d), and 16(2)(b)
- the *Fisheries Act* (FA) [5], particularly subsections 36(3), 36(6), 38(5), and paragraphs 36(4)(a) and (b)
- the *Metal Mining Effluent Regulations* (MMER) [6], particularly subsections 5(1) and 27.1(1)

In order for a natural water body to be designated as a tailings impoundment area, it must be added to Schedule 2 of the MMER, which requires an amendment to the MMER. This regulatory amendment triggers a federal Environmental Assessment according to the CEAA. The federal Environmental Assessment must undertake an analysis of alternative options for the disposal of the mine waste, based on environmental, technical, economic and socio-economic criteria.

#### 1.4 National and international standards

This regulatory document is consistent with the philosophy of modern national and international guides and standards for the management of mine waste. In particular, this regulatory document is based in part on the following national and international publications:

- *Guidance for Mining Proponents: Federal Process for Designating Metal Mines Tailings Impoundment Areas and Undertaking an Assessment of Alternatives for Mine Waste Disposal*, Environment Canada (EC) [7]
- *Environmental Code of Mining Practices*, Environment Canada (EC) [8]
- *Management of Radioactive Waste from the Mining and Milling of Ores, Safety Guide WS-G-1.2*, International Atomic Energy Agency (IAEA) [9]
- *Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities*, the European Commission (EU) [10]
- *Best Practices in Environmental Management of Uranium Mining, Nuclear Energy Series No. NF-T-1.2*, IAEA [11]

## 2 Requirements for Managing Mine Waste

The use of natural water bodies frequented by fish shall be avoided to the extent practicable for the long-term management of waste rock and tailings.

Licenses shall manage waste rock and tailings:

- to maximize the use of:
  - mine workings such as open pits and underground developments
  - natural and/or engineered barriers between the waste materials and the environment
  - controls designed to minimize releases to the environment
- with due consideration of the characteristics of the waste rock or tailings, and best management practices
- to ensure the long-term protection of Canada's terrestrial and aquatic environment, as well as the protection of current and future generations

Overburden and clean rock shall be used as construction material, and/or as a resource, and/or managed on surface through effective rock segregation programs, to the extent practicable and in a manner that is consistent with the concept of waste minimization.

Reliance on institutional controls in the design of waste rock and tailings management systems shall be minimized.

## 3 Guidance on Managing Mine Waste

This section clarifies the CNSC's expectations on selecting a mine waste management option and on avoiding, to the extent practicable, the use of natural water bodies frequented by fish for the long-term management of mine waste.

### 3.1 Guidance on selecting a mine waste management option

In general, the use of water bodies frequented by fish for the management of mine waste requires:

- authorization by the Governor in Council by listing the water body on Schedule 2 of the MMER
- approval of a habitat compensation plan by Fisheries and Oceans Canada (DFO)
- a licence from the CNSC

Environment Canada has published guidance [7] on the assessment of alternatives for mine waste disposal in water bodies frequented by fish. This guidance should be used for all metal mining operations, including the uranium mining sector.

The CNSC expects applicants to select the most suitable mine waste disposal alternative from an environmental, technical, economic and socio-economic perspective, and obtain input and strive to achieve consensus on the decision from a broad stakeholder group. In order to do so, CNSC staff recommends applicants conduct an appropriate assessment of all mine waste disposal alternatives pursuant to EC 2011 [7]; thereby enabling EC, DFO and the CNSC to make decisions based on a single process and a single analysis of options.

### **3.2 Assessment of alternatives**

An assessment of alternatives objectively and rigorously considers all available options for mine waste disposal. The assessment considers predicted quality and quantity of releases to the environment, and the predicted effects on the environment. The assessment of alternatives should also consider the full cost of each alternative throughout the project lifecycle and its associated benefits.

The major steps of the assessment include:

- development of a list of all possible candidate waste disposal alternatives, with the input from stakeholders and without prior judgments
- screening of options to a reduced number of alternatives and assurance that any of the remaining alternatives could prove to be the preferred alternative
- characterization of the remaining alternatives to ensure proper consideration of every aspect and nuance and the comparison of alternatives in a clear and concise format to ensure complete transparency of the decision process
- identification of evaluation criteria that are linked to an effect and that easily differentiate the alternatives
- inclusion of quantitative value judgment in the decision process by scoring and weighting all evaluation criteria under the environmental, technical, economic and socio-economic characteristics of each alternative
- an assessment of the sensitivity of the decision-making process

Results of the assessment of alternatives are documented and submitted to CNSC staff as part of a license application. The submission should provide a clear and concise summary of the findings of each step, using comparative tables and clear descriptive text. Detailed supporting information related to cost estimate breakdowns, geochemical assessment and contaminant transport modeling should also be included.

### **3.3 Monitoring**

The applicant should also conduct follow-up monitoring and develop an ongoing characterization plan to ensure the chosen mine waste management method(s) are undertaken and verified through the lifecycle of the project. For example, clean materials should be sorted and stored separate from the contaminated waste rock and tailings. Commitments to establish this type of quality control and verification should be made initially, and further detailed in subsequent phases of the project – during siting, construction and operation.

## **4 Performance Measurement**

Adaptive management is essential to the sound management of mine waste management projects. Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning from their outcomes. It may not always result in changes to the mine waste management system in place, but may help improve the design of future waste management projects, ensuring that best management practices improve as science evolves with time. In an adaptive management process, environmental managers monitor the effects of the selected management action, and adjust the action based on the monitoring results.

Monitoring programs should be designed to effectively evaluate the performance of the waste management approach against predicted or required outcomes; this will help to ensure that long-term objectives can be met. Actual field-scale data resulting from the performance monitoring program should be used to refine and calibrate models used in the design of waste management facilities.

Performance indicators should be used to reflect how well elements of the management plan are performing against expectations. Examples of performance indicators include:

- fluxes of contaminants from the waste facility compared to anticipated quality
- percolation through a cover or liner system compared to estimated values
- concentrations of contaminants in specific environmental media (for example, groundwater quality as compared to anticipated quality)

If performance indicators vary significantly from the expectations, then the management plan may need to be modified to achieve the desired performance. Performance indicators should be presented by the licensee and used to determine what will be monitored, how long the monitoring will be conducted and when contingency measures and adaptive management should be initiated.



## Glossary

**adaptive management**

A planned and systematic process for continuously improving environmental management practices by learning from their outcomes.

**assessment**

The process, and the result, of systematically evaluating the hazards associated with sources and practices, and associated protection and safety measures, aimed at quantifying performance measures for comparison with criteria. Assessment should be distinguished from analysis and is aimed at providing information that forms the basis of a decision, regardless of whether something is satisfactory. Various kinds of analysis may be used as tools in doing this; therefore, an assessment may include a number of analyses.

**best practice**

An industry-accepted design, process or procedure that consistently produces superior results.

**control**

Environmental management procedures or engineering techniques that reduce the release of hazardous and radiological substances to the environment.

**institutional control**

The control of residual risks at a site after it has been decommissioned. Institutional controls can include active measures (requiring activities on the site such as water treatment, monitoring, surveillance and maintenance) and passive measures (that do not require activities on the site, such as land use restrictions, markers, etc.).

**long term**

In waste rock and tailings disposal, any period of time after active institutional controls can be expected to cease.

**overburden and clean rock**

Soil horizon and organic material, and mined rock that does not contain hazardous and/or nuclear substances, or that will not release hazardous or nuclear substances that will affect the environment. This material and clean rock does not require direct regulatory control.

**pollution prevention**

The use of processes, practices, materials, products, substances or energy that avoid or minimize the creation of pollutants and waste and reduce the overall risk to the environment or human health.

**project lifecycle**

Includes all ongoing activities during the main licence granted by the CNSC: preparing the site, constructing, operating, and decommissioning of a mine project.

**tailings**

The waste material and water mixture that is left over after the mill removes the valuable rock. The rock material in tailings is usually the size of sand grains or smaller.

**waste rock**

Rock that does not contain any minerals in sufficient concentration to be considered ore, but which must be removed in the mining process to provide access to the ore.



## References

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