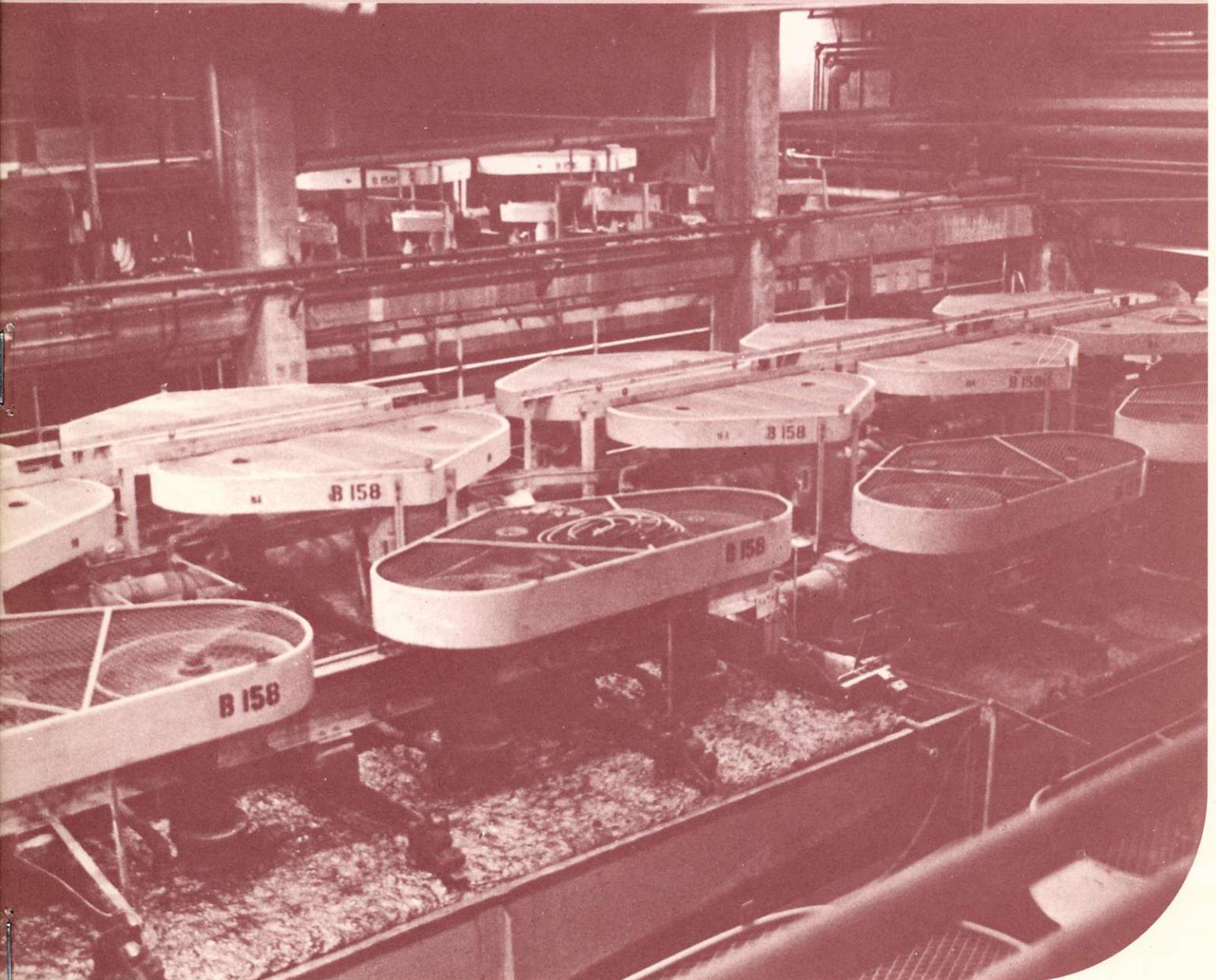


# A Brief Submitted to the Royal Commission of Inquiry

Health and Environmental Protection  
Uranium Mining

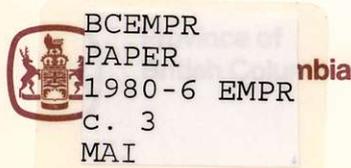
September, 1979



PAPER 1980-6

Milling and Chemical Extraction

BY THE INSPECTION AND  
ENGINEERING DIVISION  
MINERAL RESOURCES BRANCH



Ministry of  
Energy, Mines and  
Petroleum Resources



0005063169

BCEMPR  
PAPER  
1980-6  
C.3

**SUBMISSION OF MINISTRY OF ENERGY  
MINES AND PETROLEUM RESOURCES TO  
ROYAL COMMISSION ON HEALTH AND ENVIRONMENTAL  
PROTECTION – URANIUM MINING**

---

**PHASE IV – MILLING AND CHEMICAL EXTRACTION**

**October 1979  
Inspection and Engineering Division  
Mineral Resources Branch**

# TABLE OF CONTENTS

	Page
<b>I. INTRODUCTION</b> .....	5
1.1 General Introduction to Phase IV .....	5
<b>II. FROM EXPLORATION TO PRODUCING MINE</b> .....	6
2.1 Introductory Note .....	6
2.2 Metal Mine Development .....	6
<b>III. LEGISLATIVE FRAMEWORK AS IT APPLIES TO PRODUCING MINES</b> .....	7
3.1 Mineral Act .....	7
3.2 Mines Regulation Act .....	7
3.3 Other Provincial Legislation .....	8
3.4 Federal Legislation or Regulations and National Standards .....	8
<b>IV. ADDITIONAL CONSIDERATIONS RELATED TO MILLING</b> .....	9
4.1 General Remarks .....	9
4.2 Recycling of Waste Waters in the Milling Process .....	9
4.3 Emergency Procedures in the Mill .....	10
4.4 Regulations Governing the Use of Chemical Reagents .....	11
4.5 Seismic Concerns in the Design of Mills .....	11
4.6 Decommissioning of a Mill .....	12
<b>V. ENFORCEMENT</b> .....	13
<b>APPENDIX</b>	
5.1 Report of District Inspector of Mines, Crushing and Concentrating Works .....	17

## **I. INTRODUCTION**

### **1.1 General Introduction to Phase IV**

The Ministry's submission in Phase IV will describe the following:

- (a) the processes which have been developed in conjunction with other Ministries to monitor proposed and existing metal concentrator developments to ensure compliance with all provincial requirements;
- (b) the legislative framework already referred to in the Ministry's submission in Phase II – Exploration, but with special reference to the application of this legislation to the safety of mill workers;
- (c) some brief discussion on various other concerns related to milling, for example, recycling of waste waters, decommissioning of mills, emergency procedures in mills, regulations governing the use of chemical reagents, and mill design.

## II. FROM EXPLORATION TO PRODUCING MINE

### 2.1 Introductory Note

As was noted in the Ministry's submission to Phase III, page 7, major mine development and associated processing will change the environmental, social, and economic conditions in the region of development.

The *Procedures for Obtaining Approval of Metal Mine Development* (see submission, Phase III, Appendix 2.3.1, page 71) apply equally to the concentrator or mill as they do to the development of the mine. For the development of the milling complex, the Inspection and Engineering Division acts as a part of the steering committee.

The Uranium Mining Steering Committee would function in matters of concentration in the same way as it would for development of the mine (see Phase III, page 11, for a description of its presently envisaged role). The Technical Coordinating Group, also mentioned in Phase III on page 14, will, in addition to matters concerning mining, deal with matters concerning milling.

### 2.2 Metal Mine Development

Reference should be made to the fact that procedures outlined in our Phase III submission for the *Procedures for Obtaining Approval of Metal Mine Development*, the Uranium Steering Committee and the Technical Coordinating Group apply in total to the development of the milling operation of any uranium mine.

### III. LEGISLATIVE FRAMEWORK AS IT APPLIES TO PRODUCING MINES

#### 3.1 Mineral Act

There is no direct reference to milling under the *Mineral Act*.

#### 3.2 Mines Regulation Act

As was stated in the Phase III submission, page 18, it is the responsibility of the mine operators to adhere to the requirements of the *Mines Regulation Act*. However, the Act is considerably less specific in its Rules and regulations pertaining to milling than it is to mining, though the powers of the Chief Inspector and the Inspectors are of course the same in relation to mining as to milling. This flows from the definition of mining in the *Mines Regulation Act*, section 2.

Milling is somewhat similar to a factory process. For many operations it produces the final product, the recovery of which determines the profit or loss of the operation. Partly because of this, the state of the art has developed over many years without the necessity of a great number of rules and regulations. It is also generally a safer operation than is mining.

Though many regulations and rules which apply to factory operations do not apply directly to milling, District Inspectors, using their powers under the *Mines Regulation Act*, turn to appropriate rules and regulations, apply them to milling operations, and enforce them. This practice was subject of a directive from the Chief Inspector (see Phase III, Appendix 3.2.1, page 171). Examples of aspects of milling governed in this way are the handling of toxic materials and their identification, the provision of safety sprays, adequate ventilation, noise suppression, and adequate lighting. In addition to applying rules and regulations applying to operations similar to milling, recognized standards are applied and enforced to control and regulate dust exposure limits, noise levels, lighting standards, electrical standards, construction standards, and equipment standards. Application of recognized standards was discussed in Phase III, page 22. Some matters such as guarding of moving machinery are dealt with directly by the *Mines Regulation Act* [see, for example, Rules 282, 284, and 289(e)].

Regulation regarding some forms of protection is not always apparent. An Inspector will order remedial action or provision if, after investigation, he is of the opinion that a mill or part thereof is dangerous to the safety or health of any person in or about the mill [see *Mines Regulation Act*, section 7(1)]. The remedial action or provision would be dependent on the Inspector's judgment or advice provided by a specialist or consultant.

### **3.3 Other Provincial Legislation**

There are many instances where provincial legislation other than the *Mines Regulation Act* applies to the milling process. Examples are certain regulations of the Workers' Compensation Board, especially in instances where there is no specific coverage by the *Mines Regulation Act* (*see again* Phase III, Appendix 3.2.1, page 171). Certain requirements of the Pollution Control Branch are applied, such as those pertaining to sewage, waste water effluents, and gas emissions. These requirements are generally made part of the plan of the system of mining referred to in *Mines Regulation Act*, section 10. Making these requirements part of the plan for mining permits District Inspectors to enforce the Pollution Control Branch requirements. The Pollution Control Branch regional staff also make inspections of mills and enforce Branch requirements. These requirements often include portions of the *Mines Regulation Act*, section 10 mining plans, which have been incorporated into the terms and conditions of Pollution Control permits.

The design and location of tailings ponds and dams are referred to both the Water Rights Branch and the Pollution Control Branch. Certain regulations of the Ministry of Health and the Ministry of Labour are also applied.

### **3.4 Federal Legislation or Regulations and National Standards**

Federal legislation or regulation and national standards such as the Canadian Electrical Code, Part V and the Canadian Building Code are applied except where the Inspector does not consider those standards suitable or adequate.

It is recognized that the Atomic Energy Control Board would have a role to play in the development of any uranium milling operation in British Columbia, and that provisions such as Licensing Guide No. 31 must be taken into account (*see* Phase II, Appendix 4.1.5, following page 72). The role of federal legislation in governing uranium milling will be discussed further in Phase X, Jurisdiction.

## IV. ADDITIONAL CONSIDERATIONS RELATED TO MILLING

### 4.1 General Remarks

While, to date, there is no uranium milling in British Columbia, it is relevant to suggest that the milling of uranium ores would have a general similarity to that of many other ores now being processed in British Columbia.

Common to both would be such things as coarse-ore storage, crushing, grinding, fine-ore storage, reagent addition, flotation, and filtering. There are certain restrictions in force now on some forms of reagent handling, for example, reagents such as highly poisonous cyanide [*see Mines Regulation Act*, Rules 303 (a) to (f) and 305 (b)].

Of major concern to our normal inspection staff, and our environmental inspectors, is the adequate ventilation of all mills and the strict control of dust and flume concentrations. Permissible mine air standards (*see* Phase II, Appendix 4.5.1, page 152) are applied to mills. The ventilation and dust level control necessary at an asbestos mine such as Cassiar in the north of the province is probably about the most demanding in the world. With the aid of monitoring by our Environmental Control Inspectors the Cassiar mill has nearly completed a \$90 million revision. It is already below (in the sense of better than) the world standard for asbestos fibre count in the atmosphere.

It is anticipated that this Commission will advise on environmental standards to be used in uranium mills. The Inspection and Engineering Division would have no difficulty in accepting and enforcing such standards.

### 4.2 Recycling of Waste Waters in the Milling Process

It is almost mandatory in today's modern milling operations that waste waters be recirculated. Many operations could not survive economically without doing so. Often waste water requires treatment with a neutralizing reagent such as lime before it can be recycled and generally solids must be allowed to settle out.

Other than those operations in British Columbia which discharge their mill effluent to bodies of water, there is not a major operation which does not recycle its water. Examples of major operations which do so include Lornex, Bethlehem Copper, Endako, and Newmont. Most planned new operations are required to do so.

The containment of mill effluents (tailings) generally involves ponding and settlement of the solids, sometimes chemical treatment, and a floating pumping capacity to pump the water back to the mill for inclusion in the milling process. Many tailings systems for metal mines also

include a small catchment system below the main tailings impoundment to catch seepage water. Any seepage water so caught is pumped back into the main tailings pond, thus ensuring that water used in milling is contained in a closed system. It is recognized that in uranium mining a more rigorous self-containment of the mill water system may be required, for example, the tailings pond may require an impermeable seal under the pond.

As part of meeting the requirements of *Mines Regulation Act*, section 10, recycling proposals are submitted to the Division along with the proposals for the general tailings or milling waste impoundments. Prior to final review by the Chief Inspector, these are currently being reviewed by the District Inspector concerned, and by A. J. Richardson, J. D. McDonald, and by consultants if the system is large and complex.

The discharge of mill effluents is, of course, under the jurisdiction of the Pollution Control Branch (*see Pollution Control Act*, section 5).

In the matter of tailings impoundments systems, the Inspection and Engineering Division advises the Pollution Control Branch as to the stability of the proposed impounding structures. For existing systems these are reviewed yearly and the companies concerned are required to submit a consultant's report each year. Where water diversion may be involved, then the approval of the Water Rights Branch is required.

#### **4.3 Emergency Procedures in the Mill**

Of major concern in current milling practice is the containment of leaking process fluids from pipelines and vessels of major and minor proportions. It is virtually common to all mills that escaping fluids are trapped or contained in basement sumps. These are usually separated so that escaping fluids from various sections of the mill go to specific sumps and are prevented from mixing with fluids from another section of the milling process.

All mills must have emergency procedures in the event of fire.

All belt conveyor systems must have emergency stop pull cords installed throughout their length. This is provided for in the Canadian Electrical Code.

Where poisonous or caustic reagents are in use it is required there be antidotes and emergency wash facilities readily available (*see Rule 16*).

In the event of poisonous or noxious gas accumulations operating crews are trained in the use of suitable respirators or self-contained breathing apparatus. Training is given as part of the mine-rescue program of the Division which will be referred to in more detail in Phase VII – Public and Worker Health Protection.

#### 4.4 Regulations Governing the Use of Chemical Reagents

Rules 16, 303, and 305 of the *Mines Regulation Act* govern the use of poisons, dangerous compounds, solutions, or gases. The rules require that where such materials are used there must be a sufficient supply of antidotes and washes nearby for treating possible injuries received. There must be clearly visible directions for the use of such antidotes and washes.

Clearly visible notices warning of the danger from poisonous or harmful substances must be posted at suitable places (*see* Rules 303 and 305).

There are specific rules dealing with reagents such as cyanide. Protective clothing must be provided and well-vented and hooded area provided where cyanide is introduced into the milling process.

Separate distribution systems and sumps are provided for the various chemical reagents so that there is no possibility of inadvertent mixing, for example, between acid and cyanide.

Certain reagents such as Xanthate are sometimes flammable or even explosive so containers are opened with special non-sparking tools.

The Workers' Compensation Board regulations governing the use of corrosive materials and the wearing of protective clothing are adhered to where they are applicable.

In most major mills the control of the use of reagents is also an internal matter; that is, operators publish handbooks or directives advising on the proper use and handling of reagents.

#### 4.5 Seismic Concerns in the Design of Mills

There is increasing concern in modern mill design about the foundation stability. Modern grinding mills of say up to 35 feet in diameter allow drive gear tolerances of about 10 thousandths of an inch. This has resulted in extensive testing of the earth's structure below proposed mill sites and in some cases considerable grouting of the surface substructure has taken place before mill construction has commenced.

The relative seismic activity potential of the mill and tailings structure location is carefully noted and design criteria is used appropriate to the area of location. This is based on the advice of consultants and is noted by the Inspection and Engineering Division. As noted previously, all buildings are constructed in accordance with the National Building Code of Canada as amended from time to time except where the Inspector does not consider these standards suitable (Rule 315).

#### 4.6 Decommissioning of a Mill

Decommissioning is done under the authority of sections 11 and 12 of the *Mines Regulation Act*. These sections deal with reclamation and the closure of openings. A reclamation plan and bonding is required before operations commence. Both the plan and the bonding are updated with the passage of time and are kept in review by the Reclamation Section of the Division.

In the case of buildings and mills in particular it is generally required that they be levelled to the ground with the possible exception of major foundations. Equipment contained within the mill is usually dismantled and sold. Equipment that is impregnated with toxic solutions or materials is either washed free of such contamination or else it is burned or otherwise suitably disposed of. It might, for example, be buried in the tailings.

When reclamation is complete to the satisfaction of the Division then bonding is returned to the company concerned.

## **V. ENFORCEMENT**

District Inspectors of Mines and Inspectors with special functions (for example, Environmental Control Inspectors) are responsible for inspecting mills. The comments already made in Phase II, Part 4.2, page 23 and Phase III, Parts 4.3 and 4.4, pages 25 to 28, apply to inspection of milling.

The form used to record inspections of mills is marked as Appendix 5.1.

## APPENDIX



Province of British Columbia  
Ministry of Energy, Mines and Petroleum Resources

**REPORT OF DISTRICT INSPECTOR OF MINES**

*(Issued pursuant to sections 6 and 7 of the Mines Regulation Act.)*

**CRUSHING AND CONCENTRATING WORKS**

Name of concentrator, etc. .... Locality .....

Owner or operator ..... Manager .....

Superintendent ..... Address .....

Number employed .....

Method of concentration followed .....

Reagents used .....

Remarks (I, Dust control; II, Lighting; III, Precautions against poisoning; IV, Condition of machinery; V, Fire protection; VI, First aid; VII, Other observations):

.....  
*Inspector of Mines.*

.....  
*(Address.)*

Date of inspection....., 19.....

o



Queen's Printer for British Columbia ©  
Victoria, 1980



**Province of  
British Columbia**

Ministry of  
Energy, Mines and  
Petroleum Resources