McArthur River Uranium Mine Project

Report of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan

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In accordance with the mandate announced in April, 1991, the Joint Federal/Provincial Panel on Uranium Mining Developments in Northern Saskatchewan is pleased to submit the attached report. Our review has been completed under the terms of reference provided at the time of our appointment in August, 1991. The McArthur River Environmental impact Statement, submitted by Cameco Corporation, has been subjected to a thorough review and public meetings have been held in Pinehouse, La Ronge, Saskatoon and Regina.

The project is being developed in an area to which aboriginal people are historically and spiritually attached. Our philosophy, therefore, has been to assess as thoroughly as possible the impacts on northern people, as well as on the northern environment, and to make recommendations that will maximize benefits to people and minimize environmental damage.

This project, because it will involve the mining of very high grade uranium ore, has required the proponent to provide solutions to two primary technical problems - how to get the ore safely out of the ground and how to securely dispose of the mill tailings. In response to these technical challenges, Cameco has proposed to use non-entry mining methods and remotely controlled machines to protect miners from excessive radiological exposures, and to dispose of the tailings underground in the mined-out Deilmann pit at Key Lake.

Saskatchewan

Canada

In recommending cautious approval of this project, subject to the conditions described within the report, we are emphasizing two ongoing requirements — monitoring of impacts over the long-term and public participation in any major decisions that must be made as the development proceeds. Monitoring, to assess the impact of the project on both the environment and on local people, will be required for a much longer time than suggested in the Environmental Impact Statement. The proponents and governments should recognize from its inception that this project will require perpetual monitoring to protect northern food and water supplies from contamination.

On behalf of the panel, I am pleased to submit this report for your consideration.

Sincerely,

Donald G. Lee
Chairperson

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EXECUTIVE SUMMARY

In August 1991, the governments of Canada and Saskatchewan appointed a joint federal-provincial environmental assessment panel. The panel was established to review several proposed uranium mining developments in northern Saskatchewan, including the McArthur River Project with Cameco Corporation as the proponent. The mandate of the panel is summarized in Section 1.2.2 and the terms of reference given to the panel have been reproduced in Appendix B. This is the third report submitted by the panel.

Developments, even if located in the sparsely populated northern regions of our country, do not occur in isolation. People, as well as the environment, are affected by the opening of a new mine such as the one proposed at McArthur River. Our philosophy in completing this review has, therefore, been to assess as thoroughly as possible the impacts of the project on northern people, as well as on the northern environment. In our view, impacts on the vitality of northern communities, for example, are as significant as impacts on the biota. Both are important; both must be protected and, if possible, enhanced by the development of this project.

Approval of the McArthur River Project is recommended, with certain conditions. The primary conditions are summarized here; detailed justification for these conditions and additional requirements are found in the body of the report.

It is recommended that approval for mining, as described in the Environmental Impact Statement, be granted, subject to the following conditions:

- that the "as low as reasonably achievable" (ALARA) principle be rigorously enforced to protect workers from unnecessary radiation exposures in all stages of the project - development, operation and decommissioning;
- that research continue into methods for reducing effluent volume and contaminant concentrations;
- that improved monitoring of environmental impacts be required at, and downstream from, the release sites; and
- that improved methods for distinguishing between barren and mineralized waste rock be required.

It is recommended that cautious approval be given to the proposal to deposit tailings from the milling of the McArthur River ore, in the Deilmann Tailings Management Facility, as described in the Environmental Impact Statement. The following conditions are attached to this recommendation:

- that rigorous performance requirements be part of the approval;
- that procedures for mitigating any potential malfunctions be identified before deposition of the McArthur River tailings begins;
- that performance monitoring procedures for all stages of the operation of this facility be developed and monitoring initiated before deposition of McArthur River tailings begins. If monitoring identifies that the established performance requirements are not being met, mitigation measures must be implemented; and
- that conceptual plans for monitoring of the decommissioned facility in perpetuity be developed before deposition begins.

It is recommended that approval be given to the construction of a haul road from McArthur River to Key Lake, subject to the following conditions:

- that environmental damage be minimized by following the power line as closely as possible; and
- that clean mine waste rock be used as a primary road-building material.

It is important to recognize that this project is being developed in an area to which aboriginal people are attached historically and spiritually. We are of the opinion that northern people, because they must bear the greatest environmental risk associated with this project and because of their traditional roots in this part of Canada, deserve to share more generously than other Canadians in the benefits produced by the McArthur River Project. To assist in the achievement of this objective, the following additional conditions should be attached to the approval of this project:

- that local people be continuously consulted throughout the duration of the project;

- that adequate financial support be provided by provincial and federal governments for the Environmental Quality Committees;
- that regulatory agencies support the Environmental Quality Committees actively and invite their participation in, and observation of, regulatory activities;
- that agreements reached by the Athabasca Working Group be established as part of a legal document;
- that Cameco be required to report annually on its public involvement programs;
- that an objective of obtaining at least 35% of all required goods and services from northern suppliers be established for the McArthur River project;
- that employment objectives for the participation of northerners in the mine and mill work force be increased from the present level (about 50%) by 1% per year until they reach at least 67%;
- that Cameco be required to report annually on the commitments it made in the Environmental Impact Statement with respect to employment and business opportunities for northerners; and
- that the government agencies and departments providing services in northern Saskatchewan adopt human resources objectives that would lead to a substantial increase in northern participation on their staffs.

It is evident from their words and actions that northern leaders wish to have the issue of revenue sharing resolved in a political forum rather than as part of the environmental review process. We agree with that approach and urge both levels of government to become involved with northern leaders in a multipartite discussion of revenue sharing.

The effects of mining on the northern environment and on the vitality of northern communities will require rigorous long-term monitoring regimes. The monitoring requirements for each component of this project must not be underestimated, either with respect to their scope or their duration. The Deilmann Tailings Management Facility, in particular, will require perpetual monitoring and arrangements should be made, prior to approval, for the monitoring of this facility in perpetuity. Approval should be granted only if the returns from the project are expected to be sufficient to bear the estimated costs of a monitoring program that is of adequate scope and duration to fully protect northern people and the environment.

The recommendations are described in greater detail in Chapter 4 of the report, with the supporting rationale in Chapters 5-I 3.

Finally, we wish to acknowledge the positive responses that the federal and provincial governments have made to recommendations in our previous reports. Their meticulous attention to the contents of those reports is an indication of their commitment to the environmental assessment process.

1 .O INTRODUCTION

1.1 Review Process

In April, 1991, the governments of Canada and Saskatchewan announced a joint federal-provincial environmental review of several proposed uranium mine developments in northern Saskatchewan. The Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan was appointed in August, 1991, to conduct a public review of the proposed developments. Included in the review was a proposal to mine the McArthur River ore body with Cameco Corporation as operator.

After consultation with interested stakeholders, the joint panel issued *Guidelines for the Preparation of Environmental Impact Statements and Government Information Requests for the Cigar Lake and McArthur River Projects (Guidelines)* in September of 1992.

Prior to preparation of its environmental impact statement (EIS), Cameco indicated a need to assess the nature of the McArthur River ore body at depth, and on October 29, 1992, the panel was asked to conduct a separate review of the proposed underground exploration program. Following public hearings held in December, 1992, the panel submitted a report with recommendations to the federal and provincial governments in January, 1993. In accordance with the panel's recommendations, the exploration program was given approval to proceed.

Responding to the *Guidelines,* Cameco submitted its EIS for full-scale mining at McArthur River on December 11, 1995. The panel conducted an information meeting with the proponent in March of 1996 to discuss the adequacy of the information submitted in the EIS. This meeting supplemented the comments received from members of the public, from organizations and from provincial and federal government departments and agencies. To facilitate a complete understanding of the proposal, the panel requested additional information from Cameco on April 17, 1996.

When sufficient information to adequately review the project was available, the panel, as required by its terms of reference, conducted public hearings in September and October of 1996. The panel accepted locations for the community hearings in northern Saskatchewan based on the advice of the Environmental Quality Committees.[1] However, scheduling arrangements which had been confirmed with several of the communities were subsequently retracted by their chiefs and mayors a few days before the sessions were to take place. The panel rescheduled all sessions, and held hearings in Regina, Saskatoon, La Ronge, and Pinehouse. After the public hearings, the panel prepared the following report.

The governments of Saskatchewan and Canada made $75,000 available for participant funding to help the public take part effectively in the review. The funds were intended to assist recipients in reviewing the EIS and in preparing for and participating in the public hearings. The allocation of funding was done by an independent committee, with no involvement by the panel. A summary of the participant funding allocations is found in Appendix F.

1.2 Panel

1.2.1 Membership

The Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan was appointed on August 22, 1991. Donald Lee, Professor of Chemistry at the University of Regina, is Chairperson of the panel. Other panel members are:

- James Archibald, Professor of Mining Engineering at Queen's University;
- Richard Neal, Professor of Biology and Associate Dean (Academic) of the College of Arts and Science, University of Saskatchewan.

Annalee Yassi, Associate Professor and Director of the Occupational and Environmental Health Unit, University of Manitoba, remained as a panel member until her resignation on August 15, 1996. John Dantouze, Vice-Chief of the Prince Albert Grand Council, served as a panel member until October 1, 1996, when he resigned.

1.2.2 Mandate

The mandate of the panel is three-fold: to review the environmental, health, safety and socio-economic impacts of the proposed McArthur River Project; to determine from its review whether the project is acceptable or unacceptable; and to provide full opportunities for public consultation and review. Complete terms of reference for the panel are contained in Appendix B.

[1] 'Environmental Quality Committees consist of representatives appointed by the communities that are impacted by uranium developments in Northern Saskatchewan.

2.0 PROJECT DESCRIPTION AND SITE MAP

2.1 Proposal

The McArthur River project is located within the Athabasca region of northern Saskatchewan, about halfway between the Key Lake and Rabbit Lake mines, 620 air kilometres north of Saskatoon. The site is accessible by aircraft or, during winter, by the Fox Lake winter road from Highway 914. See Figure 1.

The ore body was first surveyed in 1984. Subsequent diamond drilling in 1985 and 1988 intersected sandstone-hosted mineralization. Between 1993 and 1995, Cameco completed an underground exploration program to delineate the size and location of the ore body more clearly. The detailed information from that exploration program was used to design suitable mine facilities, select appropriate mining technologies, and prepare the Environmental Impact Statement, which was submitted in December, 1995.

The ore body which Cameco proposes to develop is approximately 550 metres below surface, and is comprised of ore reserves estimated at 416 million pounds of U_3O_8. The average grade of the ore is 15% U_3O_8. The ore would be mined using a variety of methods, depending on the configuration of the ore body and on the ground and water conditions existing locally.

The three primary mining methods proposed are boxhole boring, remote boxhole stoping and raise boring. The use of any of the methods would be preceded by ground freezing and/or grouting to control the flow of ground water. With all methods, mining equipment would be operated by remote control, enabling workers to be located a safe distance from the highly radioactive ore body.

In preparation for mining, chambers would be developed above and below the ore zone. In boxhole boring, a reaming head would be driven up from one of the lower chambers, with the broken ore falling into an ore containment chute leading to a mobile crusher on a lower level. Remote boxhole stoping would be similar, except additional ore would be broken by conventional blasting, achieved by drilling blast holes from an upper chamber. The broken ore would fall down the reaming path, as in boxhole boring. In raise boring, a pilot hole would be drilled from an upper chamber through the ore body to a lower chamber. A reaming head would then be pulled up through the pilot hole with the broken ore again falling down the reaming path through an ore containment chute to the crusher system.

Cameco plans to crush and grind the McArthur River ore underground, before pumping it to the surface as a slurry. To reduce the potential for radiation exposure, ore would be contained at all times in the crushing and grinding circuit, and pumped to surface in vertical piping dedicated exclusively to that purpose. On surface, the ore slurry would be thickened to a paste, before being trucked in special vessels to the Key Lake site.

The waste rock produced in mining would be classified according to its U_3O_8 content and acid-generating potential. Uranium-bearing waste would be trucked to Key Lake, for blending with ore, or for deposition in the Deilmann Tailings Management Facility (DTMF). Acid-generating waste would be returned underground as backfill, or trucked to the DTMF. Barren waste would be used as underground backfill or stockpiled on surface.

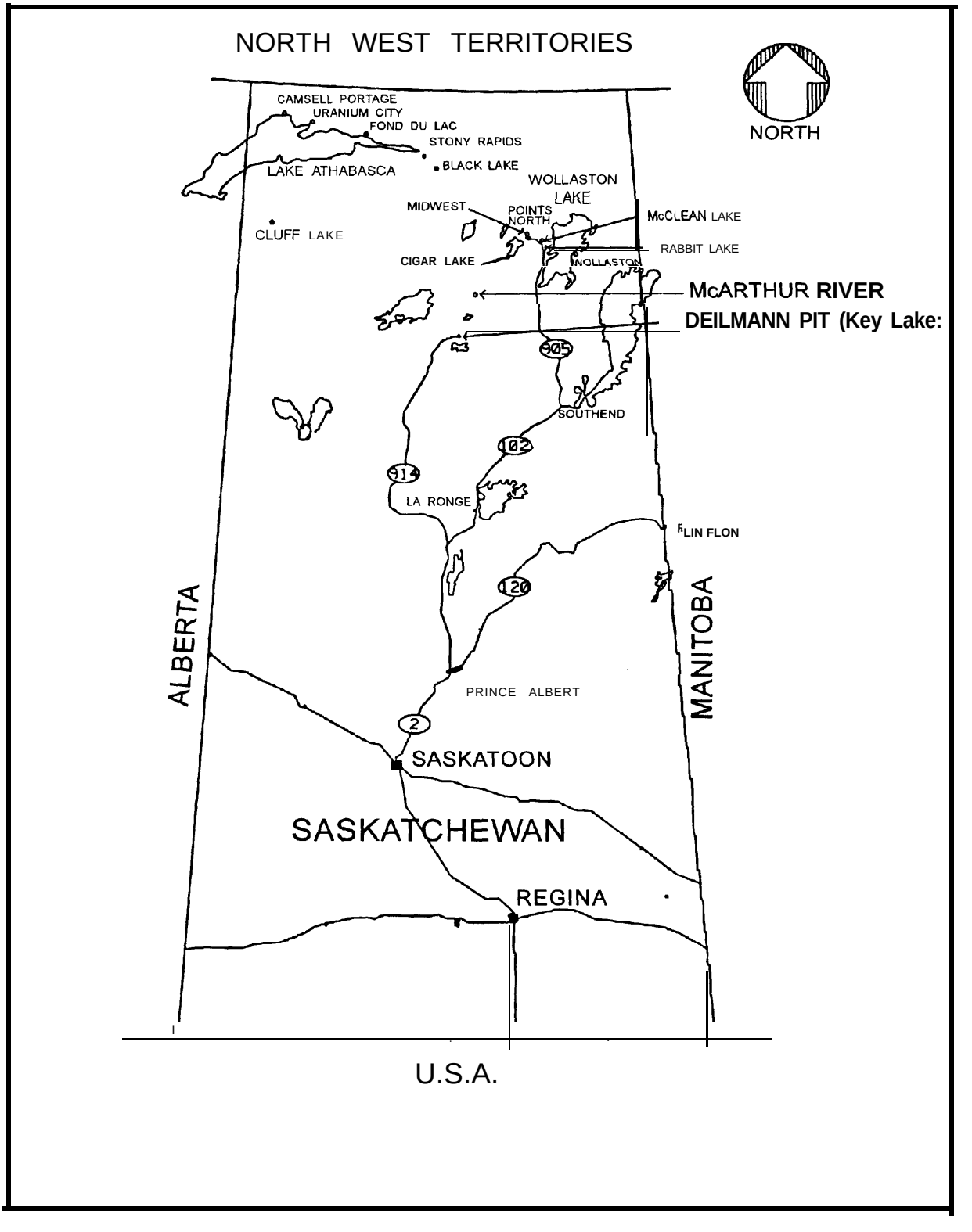
Transportation of the ore and waste rock would be along an 80-km all-weather gravel road. The route, chosen to be as direct as possible, given the terrain, would follow the existing Key Lake powerline corridor as closely as possible. The ore-containing vessels would be similar in design to those used by Cameco's uranium refining and conversion operations in Ontario. The design would be required to meet government standards for transporting uranium ore.

Cameco proposes to process McArthur River ore in the Key Lake mill, which would be expanded from its current capacity of 14 million pounds U_3O_8 per year to handle an additional 4 million pounds. The McArthur River ore would be blended with special waste from the Key Lake ore bodies to produce an average mill feed grade of 4% U_3O_8. Milling of this blended ore would require only minor modifications to the existing mill at Key Lake.

The most significant change required at Key Lake to accommodate the McArthur River ore would be the construction of a new plant to receive and unload the ore vessels. The plant would provide for remote-control handling of the vessels, washing of the vehicles and emptied vessels, storage of the ore slurry, and pumping of the ore slurry to the ore-blending areas of the mill.

When the ore processing is completed, the proponent would pipe the resultant tailings to the Deilmann Tailings Management Facility which is located in an open pit that was mined out as part of the Key Lake project. It was approved for construction in May, 1995, and is designed to contain the remainder of the Key Lake tailings. The Key Lake tailings are being deposited in the pit using pervious surround technology. The tailings resulting from the processing of the blended McArthur River ore would

FIGURE 1
Location of the Proposed McArthur River Project



be deposited under a water cover, but without the benefit of a pervious surround, on top of the Key Lake tailings. The subaqueous method proposed for the McArthur River tailings is intended to reduce radon emissions, eliminate airborne radioactive dust, and prevent the build-up of ice lenses in the tailings.

The project proposal includes the building of surface facilities, the excavation of a second and third shaft, and the development of an underground mine at the McArthur River site, and the building of an 80-kilometre road to the Key Lake mill. Temporary facilities, erected to support the underground exploration program, would be replaced, improved or expanded, to ensure their adequacy for the proposed 20-year life of the mine. See Figure 2.

Decommissioning of the McArthur River site would include the return of all remaining special waste underground and the sealing of shafts and other openings. All structures would be removed and the water treatment ponds filled. The site would be contoured and revegetated to return the landscape to a condition as close as possible to its predevelopment state. It is proposed that monitoring would continue for at least three years to ensure that the site is left in a stable, non-polluting state.

Decommissioning of the Key Lake site will be a much more complex process because of the existence of two tailings management facilities. Plans for achieving acceptable closure for this site will evolve over the next 20 years. Cameco has indicated that interested stakeholders will be invited to participate in the discussions of future decommissioning plans. Financial assurances to cover decommissioning costs will be provided in accordance with regulatory requirements.

The McArthur River project would maintain employment levels near those which exist for the Key Lake work force. The jobs lost at Key Lake by the cessation of open-pit mining would be offset by new jobs at McArthur River. There would also be some new employment opportunities during the two-year construction phase at McArthur River.* Overall, however, the project would result in only a slight increase in the combined McArthur River/Key Lake work forces over the long-term.[3]

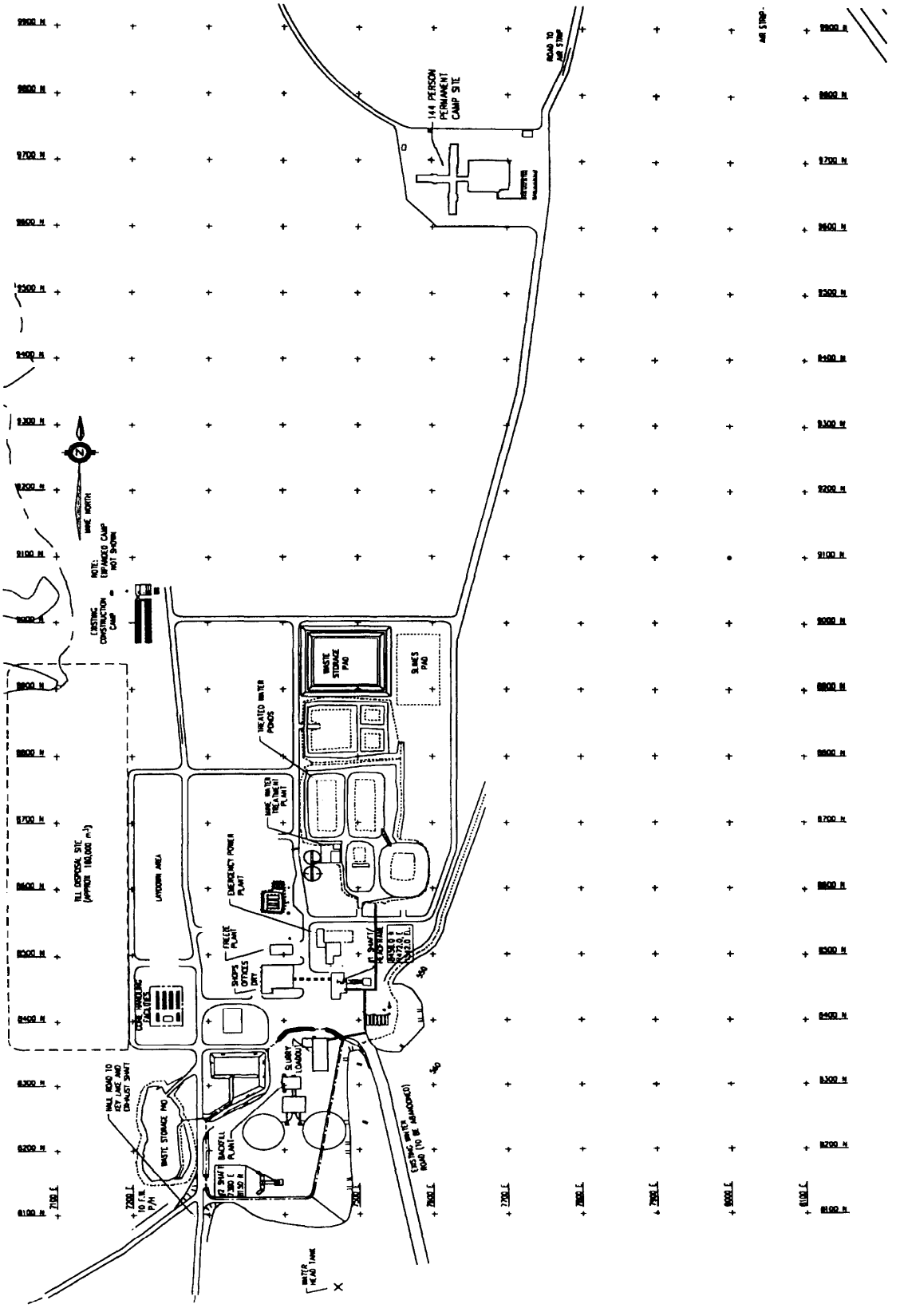
The production phase of the new mine would result in business opportunities associated with the provision of goods and services, and direct and indirect revenues in the form of royalties and taxes. Cameco anticipates purchases of $1.2-billion of goods and services during the production phase. It also predicts that the Government of Saskatchewan could receive net revenues of approximately $1.5-billion, and the Government of Canada, of approximately $950-million, over 15 years of production.

2.2 Ownership

Cameco Corporation is the proponent for the McArthur River Project, and owns 53.991%; the other owners are Uranerz Exploration and Mining Limited (29.775%) and Cogema Resources Inc. (16.234%). At production, 2.444% will transfer from Uranerz to Cameco Corporation.

[2] *McArthur River Project Environmental Impact Statement, Main Volume,* Cameco Corporation, 1995, p. 2.9.1.
[3] Ibid, p. 2.9.2.

FIGURE 2
Mine Site Layout and Surface Facilities



3.0 HISTORICAL EXPERIENCE WITH THE MCARTHUR RIVER PROPONENT

The McArthur River proponent, **Cameco Corporation, was** formed in 1988 by the merger of the **Saskatchewan** Mining Development Corporation, a provincial Crown Corporation, and Eldorado Nuclear Limited, a federal Crown Corporation. At the time of the merger, Saskatchewan received $400-million and a 61.5% share of the new company, while Canada received $250-million and a 38.5% share. Today Cameco is a publicly traded company with only 9.6% of its shares retained by the Government of Saskatchewan and none by the Government of Canada.

Cameco has a partnership interest in three operating uranium mines, at Key Lake, Saskatchewan (66.67%), Rabbit Lake, Saskatchewan (66.67%) and Crow Butte, Nebraska (32.309%), and in two proposed mines currently under environmental review - McArthur River (55.844%, when operational) and Cigar Lake (48.75%; voting 50.75%). It has an interest in two gold mines, one at Contact Lake, Saskatchewan (66.67%), and the other at Kumtor in the Republic of Kyrgyzstan (33.33%).[4] Cameco also owns and operates uranium refining and conversion facilities at Blind River and Port Hope, Ontario.

Cameco Corporation, with its head office in Saskatoon, Saskatchewan, is the world's largest publicly traded uranium company; it is a dominant member of the global uranium industry. In 1995, it reported revenues of $395-million, with about 95% coming from uranium and the remainder from its gold operations. On December 31, 1995, it had 1,237 employees.[5]

3.1 Royalties, Taxes, Fees and Dividends

In Saskatchewan, ***The Crown Mineral Royalty Schedule*** **sets** the rate at which royalties are paid to the province and ensures that the value of uranium sold represents fair market value for Crown royalty purposes. The total royalties paid consist of a basic royalty (5% of the gross sales revenue) and graduated royalties,[6] less the Saskatchewan Resources Credit (1% of gross sales revenue).

All uranium mining companies are also required to pay various taxes to both the federal and provincial governments These include property taxes, surface lease fees, mine property taxes, corporate capital taxes and surcharges, federal and provincial sales taxes and large corporation taxes. In addition, the proponent would pay the employer's portion of payroll taxes, such as unemployment insurance premiums and Canada pension plan payments. Fees are also paid to the Atomic Energy Control Board for regulatory services and to the Workers' Compensation Board for accident and disability insurance.

Cameco has indicated that, over the past decade, it and its partners in the McArthur River Project (Cogema Resources, Inc. and Uranerz Exploration and Mining Limited) have returned to governments the amounts summarized in Table 1. The provincial and federal governments realized $893.8-million and $333.3-million, respectively, in share divestitures during the same time period. Cameco also indicated that it has contributed over the past decade to various educational programs to the extent of: $252,000 for scholarships to residents of Saskatchewan's north; $88,000 for scholarships to southern residents, primarily dependents of Cameco employees; $34,500 to the Athabasca Education Awards Program, which is designed to encourage students from grades 7-l 2 in the Athabasca region to stay in school; $1,289,000 to the Multi-Party Training Plan and $1,500,000 to the University of Saskatchewan. Its current policy is to provide an annual budget for donations and sponsorships equal to 0.5% of its annual net earnings, which were $102-million in 1 995.[7]

Cameco also supports a large number of other programs ranging from cross-country skiing competitions to multiple sclerosis research. In many respects, Cameco appears to have been an exceptionally good corporate citizen, particularly of the northern part of the province.

3.2 Benefits to Northern Saskatchewan

The primary benefits to northern people from mining developments are jobs and business opportunities. There have also **been indirect benefits** in the form of infrastructure improvements, particularly with respect to additional transportation facilities, and employment training programs.

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[4] Cameco Corporation, ***Annual Report, 7995,*** pp. 18-l 9.

[5] Ibid, p. 3.

'Graduated royalties, calculated on the basis of operating profit as a percentage of capital investment, are collected only when the operating profit exceeds 15% of the capital investment. For details, see, ***Final Report,*** Saskatchewan Environment and Resource Management, May 1996, Section 2, pp. 74-75.

[7] Cameco Corporation, ***Annual Report,*** 7995, p. 37.

TABLE 1: Royalties, Taxes, Fees and Dividends
Paid to the Governments of Saskatchewan and Canada, 1986-I 995[8]
($Millions)

	Cameco	Uranerz	Cogema
Federal Large Corporation Tax	16.8	3.3	3.7
Federal Fuel Tax	4.0	a	
AECB Fees	5.8	a	3.2
Federal Income Tax (corporate)		6.7	b
CPP and UIC (employer portion)	11.5	0.6	4.2
Federal Income Tax, UIC, CPP (employee portion)	70.9	5.4	28.0
Provincial Capital Tax (including resource surcharge)	45.8	22.8	12.3
Basic and Graduated Royalties	101.1	76.9	21.5
Provincial Sales Tax		0.5	
Surface Lease Payment	7.5	a	5.4
Provincial Education and Health Tax	57.9	a	12.9
Provincial Fuel Tax	10.6	a	2.2
Provincial Income Tax (corporate)	0.0	5.9	b
Provincial Income Tax (personal)	34.6	2.3	11.9
Provincial Property and Business Tax	10.1	0.1	3.4
Workers' Compensation Board	2.5	0.4	0.7
Provincial Dividend Revenue	105.1		
Federal Dividend Revenue	15.2		
Total	**499.4**	**124.9**	**109.4**

a-Amounts included in Cameco estimates as operator of joint venture projects.
b-Not Available.

[8] ***McArthur River Project Environmental Impact Statement, Addendum,*** Cameco Corporation, 1996, Tables 2.6.4.1, 2.6.4.2 and 2.6.4.3.

It is estimated that there are about 9,000-11,000 employable people in northern Saskatchewan. Of these, about 750 (or 7%) currently work in mining. In addition, approximately 250 workers, who no longer live in northern Saskatchewan but are still counted as northerners,[9] also work in mining.

In 1990, Cameco announced a corporate objective of obtaining at least 50% of its mine-site work force from residents of Saskatchewan's North, a goal that was achieved for the first time in March of 1995. The company has also made a future commitment to maximize the number of northern residents working on its sites, both as employees of Cameco and of its associated contractors.'[10]

Cameco has attempted to maximize business opportunities for northerners by tendering contracts solely in the north whenever possible; by giving preferential bidding opportunities to northerners; by packaging projects within the capabilities of northern contractors; by encouraging joint ventures between northern contractors and well-established southern firms for large contracts; by maintaining a Northern Affairs Office in La Ronge where contract information can be obtained and northerners can receive advice on contracting procedures; and by monitoring all of its contracts to ensure that northern content is maximized. The value of Cameco's northern contracts has increased substantially from $10.6-million in 1991, to about $48-million in 1995."

During the past decade, uranium mining has contributed an estimated 1,400 person-years of work annually.[12] About one-half of these have been held by northerners.

It is the panel's observation that the people who represented Cameco at the public hearings were strong advocates of northern development and articulated a genuine desire to ensure that northern people benefitted from northern development.

3.3 The Underground Exploration Program

The McArthur River site was subjected to an environmental review in 1992 prior to the start of an underground exploration program.[13] The purpose of the underground exploration program was to provide additional information concerning the physical nature of the ore, since difficulties had been encountered when attempts were made to delineate the ore body by drilling from the surface. It was concluded that a single shaft and drift at depth would have less adverse environmental impact than would the use of numerous, longer drill holes from the surface.[14]

Terrestrial, aquatic and atmospheric baseline studies completed for the Underground Exploration Program provided data against which impacts of the current project can be judged. The underground exploration, in addition to confirming the existence of the so-called "P2 ore body", revealed an additional substantial ore block, the "Pelite Ore". The proponent also obtained information concerning the geology, rock mechanical character and hydrogeology of the site that may be useful for mining purposes.

The explorations revealed that the P2 ore body consists of discrete areas of high-grade mineralization and discontinuous zones of lower grade material. Ore is associated with the unconformity and nose of the P2 fault and with the P2 fault itself. The previously unknown Pelite Ore is associated with the P2 fault in the basement rock. See Figure 3. Observations resulting from the exploration program form the basis for selecting the mining methods proposed by Cameco.

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[9] A resident of Saskatchewan's North is defined in the Key Lake human resources agreement as ***a person who has been a resident of Saskatchewan's North for 10 years or one-half of his/her life or three years immediately prior to making an application for employment, as based on Saskatchewan Health records.***

[10] ***McArthur River Project Environmental Impact Statement, Main Volume,*** Cameco Corporation, 1995, p. 3.1 1.10.

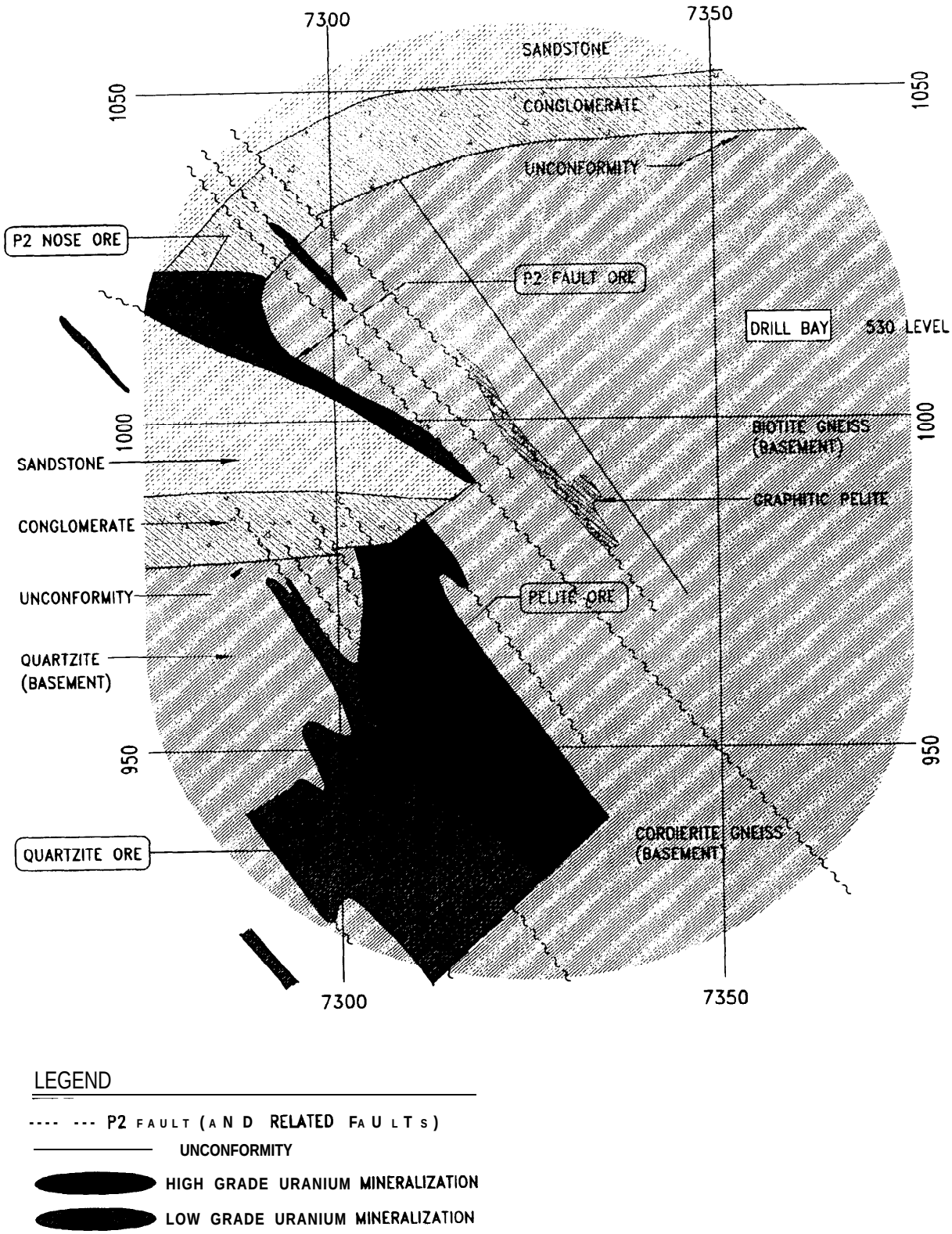
"Cameco Corporation, ***Submission to the McArthur River Project Public Hearings,*** La Ronge, Saskatchewan, October 2, p. 3.

'*Jane Forster, ***Transcript of Public Hearings,*** La Ronge, Saskatchewan, October 2. 1996., p. 55.

[13] ***McArthur River Project Underground Exploration Program Environmental Impact Statement,*** Cameco Corporation, 1992.

[14] D.G. Lee, J.F. Archibald, J. Dantouze, R. Neal and A. Yassi, ***McArthur River Underground Exploration Program,*** Supply and Services Canada, 1993, p. 7.

FIGURE 3
Idealized Cross-Section of the P-Z Ore Body



4.0 RECOMMENDATIONS AND CONDITIONS

The major recommendations resulting from a review of the McArthur River Project are summarized in this chapter. The information supporting these recommendations, along with other findings, conclusions and secondary recommendations, is presented in Chapters 5 - 13.

4.1 The McArthur River Mine

The non-entry mining methods proposed for use at the McArthur River mine have been designed to protect workers from unacceptable radiological exposure during the mining of the extremely high-grade ore. The methods are well developed and likely achievable by current industry standards. Possible environmental risks are more than compensated for by potential socio-economic benefits and it is therefore recommended that approval for mining be granted, subject to the following conditions:

- that the "as low as reasonably achievable" (ALARA) principle be rigorously enforced to protect workers from unnecessary radiation exposures. In dealing with very rich, highly radioactive ores there is a temptation to become complacent once it has been demonstrated that exposures are below legislated limits. However, the ALARA principle demands that the proponents and regulators seek ways to reduce exposures to the lowest levels that are reasonably attainable, rather than simply meeting regulated standards. This principle must be attached to approvals for mining of the McArthur River ore and rigorously applied to all stages of this project - development, operation and decommissioning;

- that research continue into methods for reducing effluent volume and contaminant concentrations;

- that improved monitoring of environmental impacts be required at, and downstream from, the release sites, as described in Chapters 6 and 10; and

- that improved methods for distinguishing between barren and mineralized waste rock be required. If satisfactory methods cannot be established, all stockpiles should be placed on liners that will permit the collection and treatment of leachate.

4.2 The Deilmann Tailings Management Facility

It is recommended that cautious approval be given to the proposal to deposit tailings from the milling of the McArthur River ore in the Deilmann Tailings Management Facility (DTMF). In-pit disposal is more acceptable, in principle, than above-ground storage, but caution must be exercised because the facility will eventually contain millions of tonnes of waste that is both toxic and radioactive. If not managed properly, this waste could, in the future, contaminate a large area of northern Saskatchewan. It will never be possible to completely walk away from this or similar uranium tailings disposal facilities. The proponents and governments should recognize from the inception of this project that perpetual monitoring will be required to determine if contaminants are leaking from the facility at unacceptable rates. Mitigative actions would be required if the facility does not perform as well as predicted. It is, therefore, imperative that extensive monitoring protocols and appropriate mitigative procedures be identified before the project is approved. If assurances of monitoring for the foreseeable future, along with any required mitigation, cannot be provided, the project should not be given approval.

The following conditions are attached to this recommendation:

- that rigorous performance requirements be part of the approval;

- that procedures for mitigating any potential malfunctions of the DTMF be identified before deposition of the McArthur River tailings begins;

- that performance monitoring procedures for all stages of the operation of this facility be developed and monitoring initiated before deposition of McArthur River tailings begins. If monitoring identifies that the established performance requirements are not being met, mitigation measures must be implemented; and

- that conceptual plans for monitoring of the decommissioned facility in perpetuity be developed before deposition begins.

4.3 The McArthur River-Key Lake Road

It is recommended that approval be given for the construction of a haul road from McArthur River to Key Lake. During the construction of this road, environmental damage should be minimized by following the power line as closely as possible and by using clean mine waste rock as a primary road-building material.

4.4 Northern Benefits and Local Participation

The McArthur River Project, including the mine, the mill, the DTMF and the road, are on land that has traditionally

been used by local inhabitants for hunting and gathering purposes. The entire project is situated on Crown land; however, the local people have an historical and spiritual attachment to the land it will occupy. Determined efforts must, therefore, be made by the proponent and federal and provincial governments to ensure that they derive the maximum possible benefits from the project. In particular, it is imperative that employment and business opportunities for northern people be increased.

Many decisions related to this project must necessarily be made in the future. It is not possible to know in advance what decisions will be required as the project develops. The regulators, who will represent the people of Canada and Saskatchewan in these future decisions, are competent and capable of carrying out their responsibilities; they should, however, ensure that local people are given an opportunity to participate in all significant future decisions. The regulators and proponent cannot afford to deprive themselves of the advice that northerners can give with respect to these projects. In the body of the report, we have made several suggestions for ways in which the participation of northerners in these future decisions can be encouraged; other approaches will undoubtedly be developed over time. What is needed now, before approval is granted, is a commitment on the part of the proponent, of the governments, and of their agencies to actively encourage local participation.

The Environmental Quality Committees and the Athabasca Working Group provide avenues through which governments and the proponent can consult with representatives from the local communities on a regular basis. However, it is also essential that these consultations be expanded periodically to include entire communities.

The long-term viability of the uranium mining industry is dependent upon an improved acceptance by northerners. Both the proponent and governments are obliged to listen more carefully to the wisdom of the local people and to organize northern developments in ways that bring maximum benefits to northern people.

To assist in the achievement of these objectives, the following minimum conditions should be attached to the approval of this project:

- that adequate financial support be provided by provincial and federal governments for the Environmental Quality Committees;
- that regulatory agencies support the Environmental Quality Committees actively and invite their participation in, and observation of, regulatory activities;
- that agreements reached by the Athabasca Working Group be established as part of a legal document;
- that Cameco be required to report annually on its public involvement programs;
- that an objective of obtaining at least 35% of all required goods and services from northern suppliers be established for the McArthur River project;
- that employment objectives for the participation of northerners in the mine and mill work force be increased from the present level (about 50%) by 1% per year until they reach at least 67%;
- that Cameco be required to report annually on its commitments made in the EIS with respect to employment and business opportunities for northerners; and
- that the government agencies and departments providing services in northern Saskatchewan adopt human resources objectives that would lead to a substantial increase in northern participation on their staffs.

4.5 Monitoring

The effects of mining on the northern environment and on the vitality of northern communities will require rigorous long-term monitoring regimes. Although many possible environmental impacts can be predicted and minimized by the use of modelling and careful planning, the actual impacts can be determined only by monitoring as development occurs. The monitoring requirements must not be underestimated, either with respect to their scope or their duration. An attempt has been made in this report to indicate the extent to which each of the components of this project (mine, mill, DTMF and road) will require monitoring. We have also indicated that it will be necessary to monitor this project for a far longer time than anticipated in the EIS. The DTMF, in particular, will require perpetual monitoring and arrangements should be made, prior to approval, for the monitoring of this facility in perpetuity.

Approval should be granted only if the returns from the project are expected to be sufficient to bear the estimated costs of monitoring programs that are of adequate scope and duration to fully protect northern residents and the environment, as discussed throughout the report.

5.0 SOCIO-ECONOMIC BENEFITS

The environmental damage and potential social disruption caused by the McArthur River Project can be justified only if the project returns certain benefits to Canadian society. To be acceptable, resource development must bring benefits to Canadians in general and to local residents in particular. The major quantifiable benefits take two forms - taxes/royalties paid to governments, and employment/ business opportunities for citizens.

5.1 Benefits to the Governments of Canada and Saskatchewan

5.1.1 Project Viability

A project that lacks economic viability is unlikely to provide significant benefits to governments. In fact, projects that suffer economic failure and leave unmitigated environmental damage are likely to create an economic burden. The Province of Saskatchewan, therefore, included a viability assessment in its submission to the panel.[15] Noting that McArthur River is one of the largest and richest uranium deposits in the world, the province concluded that:

- **positive cash flows would be realized across the forecast price ranges;**
- **the rate of return would be higher than the industry threshold for project viability;**
- **the use of Monte Carlo simulation techniques to evaluate a range of scenarios indicated that the probability of economic loss from the McArthur River Project is less than one in a hundred; and**
- **the project owners (Cameco, Uranerz and Cogema) are the three largest uranium-producing companies in the world, each with potential customers for their share of the products.**

All indications, therefore, are that the project is economically viable.

5.1.2 Economic Impact

Public revenue from this project would be obtained in the form of Crown royalties, corporate taxes and surcharges, surface lease fees, property taxes, sales taxes, income taxes and fuel taxes. Other fees paid by the proponents provide no net income to the public treasury. These include costs such as those incurred for providing workers with insurance and pensions through UIC, CPP or WCB payments, and those associated with licensing and regulating the project.

> ***The industry plays an important role in our economy - in direct jobs, economic spin-offs, resource revenues and taxes.***
>
> Henry Feld kamp, ***Transcripts of McArthur River Public Hearings, Saskatoon,*** Saskatchewan, September 11, 1996, p. 90.

The level of public income expected from this project would depend substantially on its profitability, which in turn would directly depend on the selling price of the product, yellowcake. Using various scenarios, as required by the *Guidelines,* the proponent has concluded that provincial royalties would be in the range of $337-million to $1.36-billion and that provincial corporation taxes could range from $451-million to $979-million.[16] The province indicated that its independent evaluation agrees generally with these figures and estimated that other provincial revenue would include sales taxes on goods and services of about $51 -million, fuel taxes of about $22-million, and income taxes on labour income of about $32-million.[17]

In addition, revenue from the surface lease fees and property taxes would contribute an estimated $23-million for the Northern Revenue Sharing Trust Account (NRSTA). These revenues do not go into the province's general revenue fund, but are injected directly into the northern economy through the NRSTA. A description of NRSTA is found in the *Final Report* that the province submitted to the panel."

In total, it is estimated that the provincial revenues from the McArthur River Project would range from about $900 million to $2.5-billion. Similar estimates indicate that total federal income would range from about $500-million to $1 .2-billion.[19] Table 2 presents a

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[15] Jane Forster, ***Government of Saskatchewan, Opening Presentations,*** Regina, Saskatchewan, September 5, 1996, p. 2.

[16] All estimates are in 1995 Canadian dollars.

[17] Jane Forster, ***Government of Saskatchewan, Opening Presentations,*** Regina, Saskatchewan, September 5, 1996, p. 4.

[18] ***Final Report,*** Saskatchewan Environment and Resource Management, 1996, Section 2, p. 81.

[19] ***McArthur River Project Environmental Impact Statement, Appendix 1F, Table 8,*** Cameco Corporation, 1995.

TABLE 2

Projected Government Revenues From McArthur River - Key Lake Project
($Millions - 1995)

Revenues	Government of Saskatchewan	Government of Canada
	Medium Price Scenario	Medium Price Scenario
Royalties	$677"	N/A
Corporate Taxes	$636[b]	**$736"**
Additional Revenues		
Surface Lease, Licence and Permit Fees	$12	N/A
Property/Business Taxes	**$11**	N/A
Employer UIC/CPP	N/A	$18
AECB Fees	N/A	$10
From Labour Income		
Income Taxes	$97	$128
Provincial Sales & Other Taxes	$24	$60
From Purchases		
Sales Taxes	$40	Offset by GST Rebate to Proponent
Fuel Taxes	$22	$1
Totals	**$1,519**	$953

Based on range of low-high price scenarios:

"$337 - [redacted]
[redacted] - [redacted]
"$490 - [redacted] 88-million.

summary of the projected government revenues from the McArthur River Project.

5.2 Benefits to Residents of Saskatchewan's North

5.2.1 Employment

Although mining is often regarded as the industrial sector which provides the most jobs in northern Saskatchewan, only about seven per cent (7%) of employable northerners work directly in mining. It is, therefore, clear that uranium mining cannot provide a complete solution to the need for greater employment opportunities in northern Saskatchewan. Even if allowance were made for a possible expansion of the industry in the future, uranium mining could not be expected to bear sole responsibility for the number of jobs that are needed to provide the current generation of northerners with employment. However, the industry can be expected to contribute an important number of jobs in return for the privilege of developing one of the province's most valuable resources.

Because of the size of the McArthur River deposit, it is expected that almost two decades of steady work would be available for about 520-530 people.[20] In the present climate, where high unemployment is endemic, particularly in northern Saskatchewan, long-term employment must be considered as one of the major benefits of this project.

During the public hearings, Cameco was careful to point out that the McArthur River Project would be a replacement for the Key Lake mine and, therefore, would generate only a limited amount of new employment. It would, however, preserve approximately 380 jobs for many people currently employed at Key Lake,[21] an objective that is of equal importance to the creation of new jobs. Underground mining would be the main source of new employment because not all of the surface miners at Key Lake would wish to work underground at McArthur River. Modifications to the surface facilities at both Key Lake and McArthur River would also be expected to create about 100 additional short-term jobs.[22]

Cameco has committed to a policy of maximizing the opportunities for residents of northern Saskatchewan to fill any positions that become available. Specifically, Cameco has undertaken to:

- monitor and review the qualifications and experience required for all jobs in its operations to ensure that northerners are not pre-empted by unreasonable or unnecessary qualification requirements;
- provide incentives to encourage northern students to improve their qualifications by staying in school. These incentives include an expansion of its northern summer student employment program, increased support for career education programs in the north and the implementation of a more focused northern scholarship and education award program; and
- place a permanent Employee Relations Counsellor in the Athabasca Region.[23]

> ***That counsellor is hired specifically to work with employees and their families to try and find out what those stresses are and what we can do to mitigate those stresses.***
>
> Jamie McIntyre, Cameco Corporation, ***Transcript of McArthur River Public Hearings, La Ronge, Saskatchewan,*** October 2, 1996, p. 143.

In addition, Cameco has committed to the development and implementation of a comprehensive education and training plan for all employees that includes:

- expanded supervisory and management training;
- productivity improvement, personal development, team learning and communication training;
- major improvements in northern on-site training including more than forty supernumerary positions to accommodate the training of northerners for technical and trade positions;
- cross-cultural training to ensure that site employees establish and maintain positive working relationships;
- a workplace literacy program;

[20] J. McIntyre, ***Cameco Presentation, Panel-Proponent Information Meeting,*** La Ronge, Saskatchewan, March 22, 1996, Slide 6.

[21] ***McArthur River Project Environmental Impact Statement, Main Document,*** Cameco Corporation, 1995, p. 3.1 1.27.

[22] Ibid, p. 3.1 1.28.

[23] ***McArthur River Project Environmental Impac t Statement, Addendum,*** Cameco Corporation, 1996, p. 2.6.18.

- financial and operational support for an enhanced pre-employment training program in the north;[24] and

- retraining Key Lake employees when that operation closes, to enable them to take advantage of employment opportunities offered at McArthur River.[25]

> ***It will, however, secure the employment future for most Key Lake employees. Our first priority, therefore, will be to retain our existing skilled work force and retrain those that are interested for the new opportunities available through this development.***
>
> Jamie McIntyre, Cameco Corporation, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 5, 1996, p. 49.

In response to an employee consultation program, Cameco has also committed to various measures to enhance on-site services available to employees. These include:

- improved employee counselling services through expanded employee assistance programs;

- enhanced supervisory and management development training;

- a review and updating of radiation safety training programs;

- road traffic research;

- the design and implementation of a new orientation program;

- scheduling of vacation leave to coincide with traditional harvesting activities for employees from the Athabasca region;

- the addition of a northern radio signal to the mine sites; and

- an improvement in telephone services for better communication between employees and their families.[26]

> ***Wives feel very left out of their husbands' careers because they don't know where they work; they don 't know who they work with; they don 't know where they eat, where they sleep,. ..***
>
> Penny Gurney, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 2, 1996, p. 141.

These commitments are important undertakings that enhance the acceptability of this project. In the absence of such commitments, it would be difficult to justify the intrusion of this project into the lives of northern people. The panel, therefore, recommends that provisions be added to the surface lease for the McArthur River Project that require Cameco to report annually to the Government of Saskatchewan on the progress being made on each of these commitments.

If these measures are diligently pursued, it would be reasonable to expect northern participation in the workplace to increase progressively. The McArthur River Human Resources Development Agreements should, therefore, reflect this expectation. The panel recommends that the employment objective for the participation of northerners in the mine and mill work force be increased by 1% per year until it reaches at least 67%. Sixty-seven per cent has been identified as the target because it appears to be an objective that is attainable in the long term, while at the same time requiring the proponent to remain committed to maximizing northern participation. It is also consistent with participation objectives used in other jurisdictions, such as the Northwest Territories where the BHP diamond mine has a similar human resources agreement.[27]

5.2.2 Business Opportunities

Business opportunities at the McArthur River site are expected to include contracts for:

- ventilation shaft sinking and mine development;

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[24] ***McArthur River Project Environmental Impact Statement, Addendum,*** Cameco Corporation, 1996, p. 2.6.19.

[25] J. McIntyre, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 5, p. 49.

[26] Ibid, p. 2.6.20.

[27] The Globe and Mail, ***"'Mine Deal Would Secure Jobs for Natives",*** October 21, 1996, p. 1 A (Western Edition).

- construction of the permanent McArthur River camp, offices and other surface facilities;
- construction of the road from McArthur River to Key Lake;
- maintenance and on-going surface work for the road;
- ore and aggregate haulage;
- Key Lake mill modifications;
- catering; and
- operation of the new McArthur River facilities.[28]

Suppliers would also be required for a variety of consumables, including chemicals (lime, barium chloride, ferric sulphate and flocculant), fuel (propane, diesel and gasoline), and building materials.

Cameco has committed to maximizing opportunities for northern businesses.[29] In the past, it has done this by tendering many contracts solely in the north, employing a system of preferential bidding, packaging contracts within the capabilities of northern contractors, providing advice through its Northern Affairs Office in La Ronge, and encouraging joint ventures for very large contracts.

During the current hearings, the company promised to undertake three additional initiatives to improve northern business participation in this project.[30] First, contractors are now expected to describe, in detail, their northern participation objectives as part of the proposal and tendering process. Significant weight will be given to these factors when contracts are awarded. Secondly, Cameco will use its considerable purchasing and distribution clout to improve northern access to high quality products and services. This includes the use of its transportation network, where feasible, to transport goods produced in the north to markets in the south. Thirdly, Cameco will cooperate, where possible, with federal and provincial agencies and northern businesses to improve northern infrastructure including the highway system, health services, institutional training, tourism, recreation opportunities and air services.

Because northern business opportunities are some of the most important socio-economic benefits cited by the proponent, the McArthur River Project should be monitored to ensure that northerners are being given priority and that Cameco is carrying through on the business principles it has committed to during this environmental review. The panel, therefore, recommends that provisions be added to the surface lease for the McArthur River Project that require Cameco to report annually to the Government of Saskatchewan on the progress being made with respect to each of these commitments.

Furthermore, as their business expertise develops, northerners will be able to provide an increasing portion of the goods and services required for this project. To ensure that northern capabilities are encouraged, the surface lease agreement should contain objectives for business opportunities similar to those established for the employment of northerners. A goal of obtaining at least 35% of all required goods and services from northern suppliers would be a reasonable objective at this time.

> ***...when the mining stops in northern Saskatchewan...at least the mining companies can turn around and say, "Look, we have got four or five different northern companies out there, successful, healthy companies that we are going to leave behind".***
>
> Rene Rediron, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 11, 1996, p. 200.

> ***There are limits to the kinds of businesses that can be generated by the mining industry and the second part of that is that those businesses may or may not be sustainable.***
>
> Angus Pratt, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 159.

5.3 Government Policy

Uranium mining companies are required to secure surface leases which contain human resources agreements specifying the employment objectives for the project. In northern Saskatchewan these have, typically, required the companies to maximize the employment opportunities for northerners, and the two current operators (Cameco and Cogema) now have mine-site work forces with 50% or more northerners. In fact, it was reported during the

[28] ***McArthur River Project Environmental Impac t Statement, Main Volume,*** Cameco Corporation, 1996, p. 3.1 1.29.
[29] Ibid, p. 3.1 1.28.
[30] Ibid, p. 3.1 1.20.

hearings that this is a greater percentage of northern participation than for any other industry in Canada.[31] This remarkable and admirable achievement is due in no small measure to the willingness of the industry to accept and vigorously pursue the employment objectives contained in the human resources agreements. Without such objectives, it is doubtful if the current rates of northern employment would have been realized.

During the hearings, the panel also learned that the government agencies and departments responsible for regulating the mines and doing other work in the north have a much smaller northern participation in their work forces. The same departments that require the industry to maximize northern employment appear not to have taken this as a serious responsibility for themselves. By failing to take advantage of the knowledge and skills of northern people, governments may be depriving themselves of opportunities to integrate into the communities and to find northern solutions to northern problems. For example, mine regulators (AECB, SERM and Saskatchewan Labour) would likely have greater credibility in northern Saskatchewan if more of their personnel came from that region, and other agencies working in northern Saskatchewan could also benefit from the employment of culturally-sensitive northern people. It is recommended, therefore, that federal and provincial government departments and agencies providing services in northern Saskatchewan adopt human resources objectives for themselves that are similar to those applied to the uranium mining industry.

5.4 Conclusions and Recommendations

The panel concludes that the McArthur River project would likely be economically viable and that it would produce substantial public revenues for the Governments of Canada and Saskatchewan. It is also expected that revenues derived from surface lease fees and property taxes would contribute approximately $23-million to the Northern Revenue Sharing Trust Account.

During the hearings, Cameco committed to a number of specific measures designed to maximize employment and business opportunities for northerners. It is recommended that provisions be added to the surface lease for the McArthur River Project that require Cameco to report annually to the Government of Saskatchewan on the progress being made on each of these commitments.

It is recommended that employment objectives for the participation of northerners in the mine and mill work force be increased by 1% per year until they reach at least 67%.

It is recommended that an objective of obtaining at least 35% of all required goods and services from northern suppliers be added to the surface lease.

It is recommended that federal and provincial government departments and agencies that provide services in northern Saskatchewan adopt human resource objectives similar to those applied to the uranium mining industry.

[31] Jane Forster, *Transcript of Public Hearings, La Ronge, Saskatchewan, October 2, 7996,* p. *56* and p. *62.*

6.0 MINING AT THE MCARTHUR RIVER SITE

6.1 Introduction

The existing McArthur River underground workings were developed as part of the 1993-95 exploration program. They are accessible via a concrete-lined shaft, with an inside diameter of 5.5 metres, through which ventilating air, water, power and other supplies are introduced into the underground work sites. To accommodate full-scale mining, this shaft would be deepened to 645 metres and three production drifts would be developed at the 530-,580- and 640-metre levels. The production drifts would be interconnected by an underground ramp, developed between the 530- and 640-metre levels.

Cameco plans to use the deepened original shaft as the main service shaft. A second shaft, 6.0 metres in diameter, would be sunk to provide additional fresh air to the mine, a path for exhausting contaminated air, and an emergency evacuation route for workers. A third shaft, also 6.0 metres in diameter, would be constructed as a ventilation shaft. The ventilation system and airflow distribution plans described in the EIS have been designed to provide sufficient ventilating capacity to handle any upset conditions that might occur.

The EIS provides a comprehensive assessment of rock strength and the pre- and post-mining ground stress conditions expected to be characteristic of the McArthur River mine site. Based on the data presented, stress conditions would not adversely affect mine safety during development and production activities.[32]

The proposed mining methods have been designed to reduce water inflow, maximize rock support capabilities, and protect mine workers from direct exposure to the high-grade uranium ore body. The principal mining methods are boxhole boring, raise boring and remote boxhole stoping. Such methods would be supported by ground freezing and grouting to reduce water inflow. Because these proposed mining methods could be directed by remote control, workers would be protected from direct exposure to the ore. The variety of methods proposed gives the proponent flexibility in dealing with variable ore geometry and ground conditions.

> ***. . . the proponents, throughout the underground exploration program, have demonstrated the priority placed on radiation protection measures in dealing with high grade ore and high radon-bearing groundwater.***
>
> Fred Ashley, AECB, ***Transcripts of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 11, ***1996,*** p. 73.

6.1.1 Ground Freezing and Grouting

Each of the three proposed mining methods would use ground freezing and/or grouting to reduce the flow of radon-laden water into active mining areas. Both grouting, which involves the pressurized filling of existing rock fractures with cement, and ground freezing would improve excavation stability by strengthening the rock mass from which the ore would be extracted.

Ground freezing, which has been successfully demonstrated at the Cigar Lake test mine, would be the method chosen at sites such as the Pelite Ore zone where extensive rock fracturing precludes effective grouting. Cameco would apply the technique either by establishing a curtain of frozen rock around the ore or by freezing the entire zone containing the ore. Sets of parallel freeze galleries would be developed below the ore body in non-mineralized basement rock. From this level, rows of parallel, vertical holes would be drilled upward through the ore zones. Chilled brine at -35°C would then be circulated up through concentric tubes in the vertical holes to freeze ore zones.

In more competent, less fractured rock, grouting would be used to prevent water inflow. Grouting operations would be conducted from access openings located in non-mineralized rock, above and/or beside the ore zones.

The presence of many exploration drill holes, and the expected addition of more as a result of further exploration and production activities, will require attention. To protect against the flow of water and/or air through the drill holes into occupied work sites, all bore holes that intersect underground excavations should be sealed expeditiously.

[32] ***McArthur River Project Environmental Impact Statement, Addendum,*** Cameco Corporation, June, 1996, Section 2.2.

6.1.2 Boxhole Boring

When boxhole boring is deemed to be the most appropriate mining method, drilling would be upward from the production drift, through inert basement rock and into the ore zones above. Ore and waste rock extraction would be accomplished solely by the action of drilling, without the use of explosives to fracture the rock. As rock is drilled, it would fall through the excavated borehole into sealed chutes and containers, located within the production drift, and be transported by gravity to the primary crushing level below. After crushing and grinding, it would be mixed with water and pumped to surface as a slurry in a dedicated pipeline. The production drift would be located within non-mineralized basement rock where the water inflow rates are expected to be low and manageable.[33]

A variable-diameter boring head, rather than the customary fixed-diameter bit, would be used. The variable-diameter boring head can be expanded once contact has been made with the ore zone overhead. Its successful use has been demonstrated in underground mining trials at the Cigar Lake test mine.

Studies at the Cigar Lake test mine showed that the boxhole extraction technique is effective for isolating drilled rock fragments and process water from the workers on the production and primary crushing levels. Thus, the boxhole boring method, combined with the segregated transport of ore to primary crushing levels, would limit exposure of workers to radiation. To provide additional protection against radiation, the air surrounding the chutes, pipes and crushing chambers would be vented directly via secondary ventilation networks. The operator would also maintain rock stability within the ore body by rapidly backfilling each excavated borehole with cement after ore extraction.

Based on the history of boxhole boring, and the successful testing of the variable-diameter boring head at Cigar Lake, it is concluded that this mining method should provide satisfactory mine stability and adequate radiation shielding for workers at McArthur River.

6.1.3 Raise Boring

In circumstances where raise boring would be the most appropriate ore extraction method, pilot holes would be drilled from an upper chamber downward through the ore, to intersect a production level below the ore. A large diameter cutting head would then be attached to the drill and pulled upward to create larger diameter excavations. As with boxhole boring, ore and waste extraction would occur solely through the action of drilling, without requiring the use of explosives. Ore and waste rock cuttings produced by drilling would drop to the lower production drift where they would be crushed, mixed with water, and transported as a slurry to the surface through dedicated pipelines. Drilling and crushing sites as well as the production drift would be located within non-mineralized rock, remote from the ore.

> *I fee/ we have got to realize what we are talking about. We are talking about developing uranium with 20 to 30 percent ore grades.*
>
> Maisie Shiell, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 9, 1996, p. 27.

As with boxhole boring, radiation protection would be enhanced by full enclosure of ore in the extraction, crushing, and piping circuits and by the direct venting of air through a secondary ventilation system. Mine stability would be improved by the use of small excavation spans and the rapid backfilling of excavated boreholes.

When the area above ore zones is composed of structurally competent rock suitable for the development of upper chambers for drilling sites, raise boring would be an acceptable extraction technique for mining McArthur River ore.

6.1.4 Remote Boxhole Stoping

Remote boxhole stoping would combine boxhole boring, from production drifts in non-mineralized basement rock below ore zones, and blasthole mining. As with conventional boxhole boring, fixed-diameter boxholes would be drilled upward from a lower drilling level to the top of the ore zone. The boxhole drilling head would then be retracted downward and blast holes would be drilled from an upper level to intersect the boxholes at an angle. Portions of each blasthole would be loaded with explosives, which would be detonated to fragment the adjacent ore. The broken ore would fall into the boxholes and pass to a lower production level through sealed chutes and pipes where it would be crushed,

[33] ***McArthur River Project Environmental Impact Statement, Main Document,*** Cameco Corporation, 1995, p. 2.3.18.

mixed with water, and transported to surface as a slurry.

This mining method offers safety measures similar to those described for boxhole boring to enhance radiation protection and mine stability. However, the use of explosives to fragment the ore would increase the potential for endangering nearby mechanical equipment, and the stability of the surrounding rock. Consequently, the proponent does not plan to use remote boxhole stoping in ore zones requiring ground freezing where blasting might damage freeze pipes. Therefore, remote boxhole stoping would only be suitable in ore zones where grouting, rather than ground freezing, will be used to reduce water inflow.

6.2 Liquid Effluent

The process water necessary for mine operation would be obtained from shaft inflow sources, thereby reducing the demand on nearby Toby Lake.

Tests done during the exploration program demonstrated that grouting significantly reduced the quantities of water inflow around the shaft. Also, very low inflow rates were observed in basement rock excavation sites.[34] Should zones of high water inflow be encountered during the development of production drifts, the proponent anticipates that grouting would provide sufficient control. The maximum quantities of mine water expected to be pumped to surface for treatment would be approximately 4,800 m^3/day. Mine water pumping capacity, estimated at 16,400 m^3/day, would, therefore, be more than adequate to handle normal and overflow dewatering needs.[35]

Underground pretreatment of mine water during mine trials involved the use of aeration and chlorination at the sump.[36] This pretreatment resulted in a reduction in radon and lead-21 0 contamination in collected water. Application of similar techniques during production mining would result in a reduction in the amount of treatment required to mitigate effluent water impacts on the surface.

The mine water treatment plant would be designed to process water at rates of approximately 17,280 m^3/day, using accepted industry procedures.[37] Treated water would be held in three storage ponds for testing prior to release into the muskeg adjacent to Boomerang Lake, near its outlet.

Water and sediment quality data collected during the 1993-l 995 exploration phase of the project generally reflect those predicted using the IMPACT model[38] in the original environmental impact statement. From this correlation it is reasonable to assume that treated mine water discharged would have a minor effect on surface water quality, with Saskatchewan Surface Water Quality Objectives (SSWQO) being met near the point of release. However, as noted by Environment Canada and others, the SSWQO were developed to address water quality conditions in southern prairie water, and may not be suitable for assessing northern water quality. The development of alternative standards that would be more appropriate for assessing northern site conditions is required. The panel agrees with Environment Canada that, *"Site-specific water quality objectives should be proposed which are some rational combination of SSWQO, CWQG, baseline water quality conditions, and scientific requirements for protecting aqua tic ecosystems."*[39]

Hydrogeological modelling indicates a potential for a lowering of the water table by up to 8 m in the area of the mine, with a cone of depression extending to Toby Lake where the water level could drop by 1 m.[40] This cone of depression would not be fully developed for several years, well after all four production areas are active. Thus, the actual lowering of the water table could be monitored. The impact of lowered water levels on Toby Lake could be mitigated by discharging the treated mine water into that watershed instead of into the muskeg adjacent to Boomerang Lake. This proposal is acceptable, provided an alternative source of potable water is found, and provided the proposed site of effluent discharge is monitored to obtain baseline information. Treated effluent released into the Toby Lake watershed would flow directly into Boomerang Lake, with minimal change in the overall impact.

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[34] ***McArthur River Project Environmental Impact Statement, Main Document,*** Cameco Corporation, October, 1995, p. 2.3.18.

[35] Ibid, p. 2.3.31.

[36] Ibid, p. 2.3.32.

[37] Ibid, p.2.4.2.

[38] ***McA rthur River Project En vironmen tal Impac t Statement, Addendum,*** Cameco Corporation, June, 1996, pp. 2.1.2 - 2.1.6.

[39] Environment Canada (Prairie and Northern Region), ***Submission to the McArthur River Uranium Project Public Hearings,*** Regina, Saskatchewan, September 6, 1996, p. 32.

[40] ***McArthur River Project Environmental Impact Statement, Addendum,*** Cameco Corporation, June 1996, Section 3.3.

6.3 Waste Rock Disposal

The proponent predicts that 215,000 tonnes of mineralized waste and 900,000 tonnes of non-mineralized waste would be produced by the McArthur River Project. Waste would be characterized as mineralized waste if it contained between **0.03%** and 0.14% U_3O_8, or if it contained less than **0.03%** U_3O_8 but was potentially acid-generating. Cameco proposes to store mineralized waste on a lined pad designed to retain fluids for pumping to the water treatment facility. At the time of mine decommissioning, mineralized waste would be disposed of either underground or in the tailings management facility at Key Lake. Non-mineralized waste rock, defined as waste containing less than 0.03% U_3O_8 with no potential to generate acid, would be placed on an unlined pad and used to manufacture aggregate material for backfill or road construction. Any non-mineralized waste rock not so utilized would remain on surface and be decommissioned in place.

Concerns regarding waste rock disposal were expressed by members of the public, by Environment Canada,[41] by the Atomic Energy Control Board,[42] and by the Government of Saskatchewan.[43] Of principal concern is the practical difficulty of accurately identifying and segregating mineralized from non-mineralized waste, in a timely fashion, on the basis of chemical or radiological testing. The procedures described by the proponents for assessing and identifying the uranium ore grade and acid-generating characteristics of rock materials[44] may not be sufficiently rapid to prevent unintentional mixing of mineralized and non-mineralized waste in the stockpile. Should this happen, contaminated leachate might be released from the waste rock stored on unlined pads. If such releases occurred during the mining phase, facilities would still be present for water treatment; however, if the contaminated leachate is released following decommissioning, the water treatment plant would no longer be operative. For this reason, it is imperative that the proponent demonstrate a satisfactory method for differentiating between mineralized and non-mineralized waste rock before mining starts. If this cannot be done, all waste rock pads should be lined and provided with seepage controls.

> ***The Department.. . continues to be concerned over the proposed surface disposal of waste rock at McArthur River, given the potential for perpetual contaminated seepage.. ..***
>
> Dr. Dennis Lawson, ***Transcript of McArthur River Public Hearings,*** Regina, Saskatchewan, September 6, 1996, p. 38.

6.4 Conclusions and Recommendations

The mining procedures proposed for the McArthur River Project are well developed and likely achievable by current industry standards. The shielding of production galleries from the ore body by several metres of barren rock; the use of non-entry mining methods; the use of freezing and/or grouting methods to eliminate or reduce water inflow; the venting of potentially radon-laden air through secondary ventilation networks; and the use of sealed ore slurry transport methods to remove ore from the mine should provide adequate shielding for underground workers from exposure to radioactive ore and contaminated water or air.

The decision to release treated mine water into the muskeg adjacent to Boomerang Lake is an acceptable procedure.

The development of site-specific water quality objectives similar to those described by Environment Canada is recommended. These should combine elements of the Saskatchewan Surface Water Quality Objectives and other water quality standards to provide standards more appropriate to the protection of the aquatic ecosystems found in northern Saskatchewan.

We recommend that more rigorous rock screening procedures be developed to improve the accuracy and efficiency of separating mineralized from non-mineralized waste rock. If a fail-safe method for distinguishing between mineralized and non-mineralized waste cannot be demonstrated, non-mineralized waste pads should be lined to provide containment of contaminants that might result from the imprecise screening of waste rock, and the subsequent leachate.

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[41] Ibid, p. 46.

[42] Atomic Energy Control Board, ***Submission to the McArthur River Uranium Project Public Hearings, La Ronge, Saskatchewan,*** October 1, 1996, p. 4.

[43] Government of Saskatchewan, ***Submission to the Cigar Lake and McArthur River Projects Public Hearings, La Ronge, Saskatchewan,*** October 1, 1996, p. 2.

[44] ***McArthur River Project Environmental Impact Statement, Main Document,*** Cameco Corporation, October, 1995, pp. 2.3.28-2.3.30.

7.0 TRANSPORTATION

The proponent proposes to construct and maintain an 80-km haul road between the McArthur River and Key Lake sites, utilizing wherever possible an existing electrical transmission line corridor. Cameco would ship ore as a slurry from the McArthur River mine to the Key Lake mill in specially designed vessels, loaded four at a time, on large trucks designed in a B-train configuration. The existing Fox Lake winter road would be decommissioned.

In spite of the strictest precautions, road accidents do occur and for many reasons. The possibility of ore spills during transport, in particular at stream crossings, is of great concern to the public. Mitigation procedures and compensation arrangements in the event of environmental damage should be identified before the road opens.

> ***We talk lots about roads, lots about trucks, talk about truck safety and if one of those trucks was to tumble.. .it is going to cause a lot of damage.***
>
> Martin Smith, ***Transcript of McArthur River Public Hearings,*** Pinehouse, Saskatchewan, October 7, 1996, **p.** 15.

7.1 Ore Transport Vessels

The design of the vessels to be used for ore transportation under northern conditions is of paramount importance. It is essential that the vessels not release radioactive material in the event of an accident during ore transport. The design of the vessels must also consider difficulties which might arise during the unloading of the ore slurry. Unforeseen situations, such **as** blockages due to freezing, or segregation of ore while it is stored in vessels, are likely to arise. The vessels should be designed to ensure that such occurrences would not require manual mitigation, which could expose workers to high levels of radiation.

During its licensing process, the AECB will address the safe packaging and transport of the McArthur River ore. The regulations administered by the AECB require that the packaging standards for radioactive material match the hazards posed by the material being transported. The panel understands that existing standards for packaging high grade uranium ore are to be upgraded. These new standards would be incorporated into the licensing conditions for the packaging of McArthur River ore. As uncertainty might be created by this change in standards, the panel emphasizes the importance of public consultation by AECB during its licensing process.

7.2 Transportation Routes

7.2.1 McArthur River - Key Lake Road

The source of material to be used for road construction purposes is not identified in the EIS. Use of local till is one possibility, but only if sufficient deposits exist in proximity to the proposed road. If till collection from multiple sites remote from the road is necessary, considerable environmental disturbance to the surrounding area might result. Alternatively, the use of clean waste rock from the mine site would not require any new excavation and would have the added benefit of reducing the size of the non-mineralized waste rock stockpile. This option, which would be regulated through the licensing process, is recommended.

A major issue voiced by local northerners is whether the proposed haul road would be a public or private road. The road would originate and terminate within the surface leases of the McArthur River and Key Lake sites, respectively, and a gate house situated at the **Key** Lake site could control and monitor road traffic. Although government policy requires that all access roads be public roads, restriction of access could be permitted for various reasons, including safety and conservation.

Some local residents indicated that they would wish to use the road to access adjacent areas for resource harvesting purposes. However, if access by the general public is permitted, pressure could be put on existing wildlife resources. **The local communities expressed the wish to be consulted on the issue of public access to the proposed road; a willingness to further discuss this concern was indicated by both the proponent and government. These issues should be resolved before permission to build the road is granted.**

Concerns were also expressed with respect to the need for early community consultation whenever new roads are planned. Local contractors also indicated a wish to participate in the construction of the road. It is recommended that businesses located in the local area, and using local labour, be given preference when contracts to construct the road are issued.

> ***The McArthur River to Key lake road construction should be awarded to northern communities.. . to provide employment and on-the-job training experience in construction.***
>
> Greg Ross, Mayor of Pinehouse, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 70.

7.2.2 Fox Lake Road

The current government permit requires the Fox Lake winter road to be decommissioned if the haul road between McArthur River and Key Lake is constructed. However, the Fox Lake road is used for resource harvesting purposes by members of local communities who wish to continue using at least parts of it as a means of access. The possible decommissioning of bridges along the road is of particular concern. Suggestions to resolve this issue included the possibility of local access to portions of the Fox Lake road from the proposed haul road. It is recommended that the bridges on the Fox Lake road be left in place for the time being and that an assessment of the need to decommission be made in consultation with the local communities only after the new road has been open for at least two years.

7.2.3 Highway 914

The panel heard that, although Highway 914 is used by both the general public and multi-axle vehicles carrying dangerous goods, it is not maintained at grid road standards. Rocks on the shoulder of the road were of particular concern. In addition, since many of the trucks using the road must travel at speeds lower than officially posted limits because of the nature of their loads, passing lanes are desired for traffic moving at regular speed. Northerners expressed the conviction that the Department of Highways should be required to maintain northern grid roads to the same standard as those in the southern part of the province. The contracting of local businesses for road maintenance is widely viewed as an effective way to ensure that such standards are upheld.

There is also concern in northern communities about the ability of municipal emergency services to respond appropriately to road accidents involving hazardous materials.

> ***When you find a rock 30 inches across right on the shoulder of the road, the dust conditions in the summer on our roads and now an increase of traffic, . . . is the Department of High ways, or the mines, going to see to the safety of our roads and at least bring them up to a grid road standard that would be acceptable in the part of Saskatchewan south of P.A. ?***
>
> Mervyn Abrahamson, ***Transcript of McArthur River Public Hearings,*** Pinehouse, Saskatchewan, October 7, 1996, p. 35.

7.3 Conclusions and Recommendations

The panel recommends that Cameco be given permission to construct the proposed haul road from McArthur River to Key Lake. Clean waste rock from the McArthur River site should be used for road construction purposes as extensively as is practicable.

Local contractors, using local labour, should be given preference when contracts to construct and/or maintain northern roads are issued.

It is recommended that the public be consulted by federal and provincial authorities on several transportation-related decisions: on the development of accident contingency plans; on the licensing of transportation vessels and vehicles; on decisions regarding the proposed road between Key Lake and McArthur River, particularly public access; and on the decommissioning of the Fox Lake road. These consultations should take the form of public meetings and be held in the northern communities impacted significantly by transportation-related activities.

8.0 MILLING AND TAILINGS DISPOSAL

Cameco proposes to transport the McArthur River ore to Key Lake for milling and tailings disposal. The mill was built to handle the Key Lake ore with its average grade of 2% U_3O_8. The McArthur River ore, because it is much richer, averaging 15% U_3O_8, would be blended with special waste to produce an acceptable mill feed grade. It is expected that the mill will process approximately 200,000 tonnes of this blended ore annually over a period of about 15 years.

8.1 Ore Dilution

Cameco proposes annually to blend about 50,000 tonnes of McArthur River ore with approximately 150,000 tonnes of Key Lake special waste, to produce a mill feed with an average grade of 4% U_3O_8.[45] As a result of this blending, only minor modifications would be required to the existing mill, and the proponent predicts negligible changes in radiological doses for workers involved in the milling process.[46] The exposures currently recorded for workers at the Key Lake mill and tailings disposal facility are acceptably low when compared to the regulatory limits, confirming that the operator is exercising appropriate health and safety controls.

The proponent's decision to mill McArthur River ore at Key Lake has environmental and economic benefits. The environmental damage associated with construction of a new mill site would be avoided; the inventory of contaminated waste on the surface at Key Lake would be decreased; and the operating life of the existing mill, and its attendant employment, would be extended.

8.2 The Deilmann Tailings Management Facility

The Deilmann Tailings Management Facility (DTMF) is located 4 km east of the Key Lake mill. It is a mined-out pit, 1300 m long, 600 m wide and 170 m deep. Cameco has received approval for the disposal of approximately 2 million cubic metres of Key Lake ore tailings and special waste within the DTMF.[47] The placement of Key Lake tailings began on December 31, 1995, using subaerial deposition within a pervious surround of crushed rock and sand. The system depends on in-pit dewatering, a side-drain, and on a ring of dewatering wells, placed about the pit perimeter. During operation of the DTMF, the water collected in the under-drain would be pumped to surface and treated to remove contaminants.

The facility would be modified to receive the tailings from the milling of McArthur River ore, when the milling of the Key Lake ore has been completed. At that time, it is estimated that about 30 metres of tailings would be in the bottom of the pit; i.e. the pit would be filled to a level 412 metres above sea level. Subaerial deposition would then cease, with the pervious surround sealed by tailings. Groundwater pumping would then be reduced to permit the pit to flood above the consolidated tailings.

> ***The tailings potentially represent the greatest long term threat.***
>
> Steve Lawrence, ***Written Submission,*** Received September 19, 1997, p. 1.

The tailings obtained from milling the richer McArthur River ore would be thickened and deposited under the water cover on top of the Key Lake tailings. This subaqueous placement of tailings would be done from a barge, using a tremie pipe injection system, as shown in Figure 4. There would not be a pervious surround envelope in the portion of the pit used for subaqueous disposal. The water cover would provide protection for workers against gamma radiation, radon and radioactive dust. It would also protect the tailings from freezing.

After 15 years of milling McArthur River ore, consolidated tailings would occupy approximately 4.5 million cubic metres of the DTMF. The final elevation of the deposited tailings would reach approximately 448 metres above sea level, leaving an excess storage capacity of approximately 8.5 million cubic metres in the DTMF.

During disposal of the McArthur River tailings, pumping from the pit would be regulated to maintain a water cover above the rising tailings column. The water elevation in the flooded pit would be maintained at a minimum of 5 metres below the groundwater surface to ensure that groundwater flow would always be directed into the pit. Upon completion of tailings deposition, a cover of 2 metres of sand or till would be placed on top of the tailings mass. The cover layer would promote

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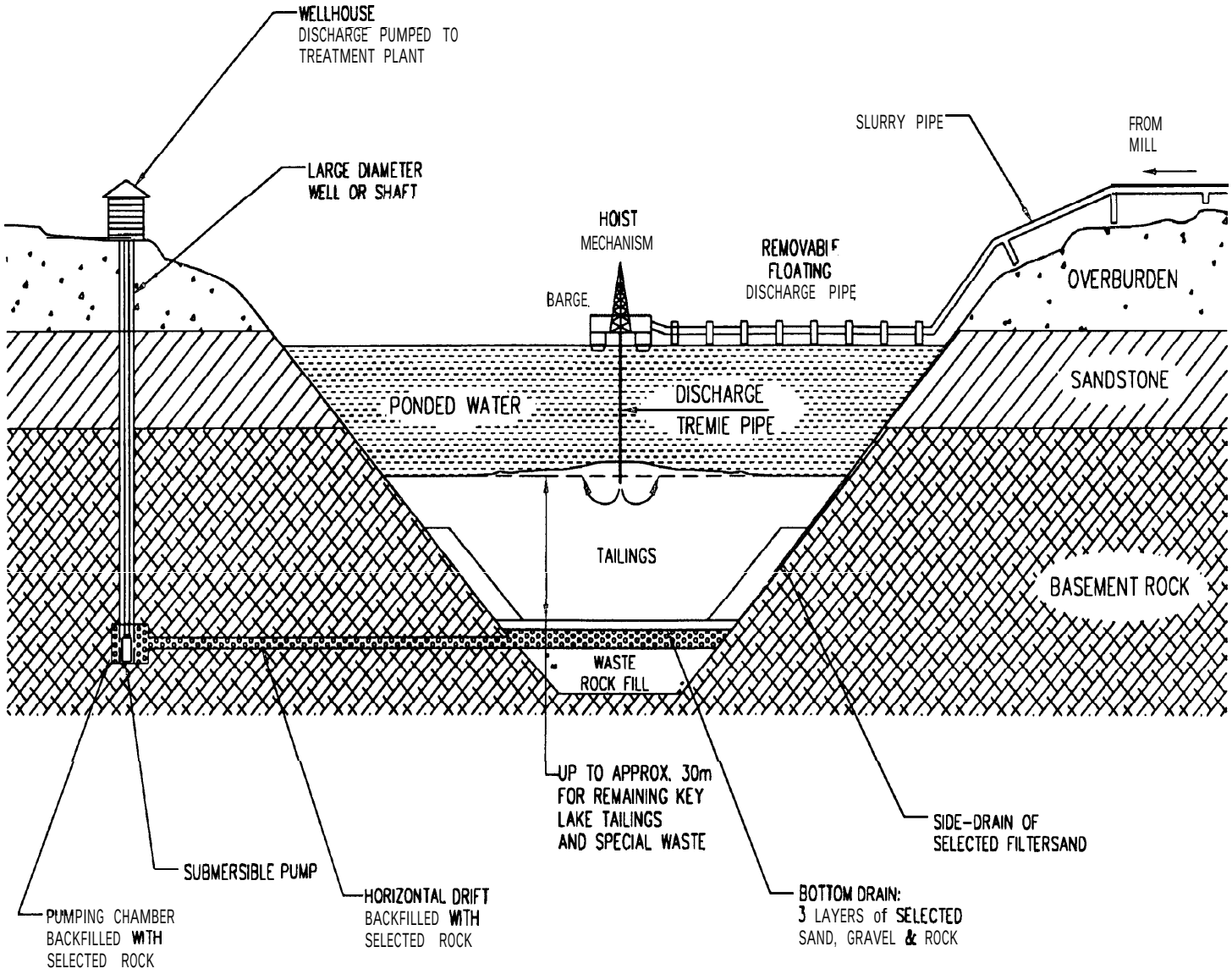
[45] ***McArthur River Project Environmental Impact Statement, Executive Summary,*** Cameco Corporation, October, 1995, pp. 3-7.

[46] ***McArthur River Project Environmental Impact Statement, Main Document,*** Cameco Corporation, October, 1995, pp. 2.7.1-2.7.4.

[47] Government of Saskatchewan, ***Submission to the McArthur River Public Hearings,*** Regina, Saskatchewan, September 5, 1996, p. 29.

FIGURE 4

Deilmann Tailings Management Facility: Subaqueous Tailings Deposition



further tailings consolidation and act as a diffusion barrier against contaminant release. Treatment of the water in the pond above the tailings mass would continue until it was of acceptable quality. The pit would then be permitted to flood to a depth of approximately 60 metres above the tailings cover, matching the natural groundwater surface.

Following long-term consolidation, Cameco predicts that the tailings would be frost-free, with an average hydraulic conductivity of 1 0^{-7} m/s or less.[48] The permeability of the consolidated tailings would then be approximately two orders of magnitude less than that of the surrounding Athabasca Basin sandstone. Such conditions would ensure the effective diversion of groundwater flow around, rather than through, the consolidated tailings.

These predictions are based on computer modelling. During the hearings, much of the experimental data used in modelling protocols was questioned and it is not possible to have a great deal of confidence in these predictions. For this reason, the DTMF will have to be carefully monitored to ensure that it is performing to specifications. Because it will eventually contain an enormous amount of waste that is both toxic and radioactive, this facility, if it is not managed carefully, could be very destructive to the northern environment. If seepage from the DTMF into the surrounding groundwater were to occur, extensive contamination of the now pristine northern rivers and lakes could develop. It is, therefore, important that monitoring be carefully done and that any malfunction be mitigated. These requirements are expanded upon in Chapters 10 and 12.

Despite the reservations mentioned above and in Chapters 10 and 12, subaqueous tailings placement in the DTMF does have some potential advantages, both with respect to protection of the environment in the long term and for concerns associated with the need to protect workers' health during operations. These include:

- a reduction in the volume of water discharged from the DTMF to groundwater;
- the elimination of consolidation problems associated with frozen tailings;
- a decrease in worker exposure to radiation; and
- a reduction in the surface inventories of special waste which have accumulated at Key Lake since 1983.

[48] *McArthur River Project Environmental Impact Statement, Main Document,* Cameco Corporation, October, 1995, pp. 2.8.8-2.8.17.

The proposed tailings management program received support during the public review. The Province of Saskatchewan stated that:

> *The Key Lake h ydrogeologic regime is better defined than any other uranium mine in Saskatchewan . . . The Department is confident that the technology exists and is constantly improving such that impacts associated with the DTMF can be quantified and mitigated throughout operations and during decommissioning.*[49]

The Atomic Energy Control Board voiced a similar opinion:

> *The staged sub-aerial and sub-aqueous deposition methods proposed are acceptable in concept ... The under-drain system has functioned as designed during the sub-aerial Key Lake tailings deposition period to date ...*[50]

However, the AECB also emphasized the need for monitoring to confirm that its confidence in the system had not been misplaced:

> *The on-going monitoring and evaluation of the operation of the system is an essential element for feedback control and facility adjustments to meet requirements.*[51]

Environment Canada was even more clearly of the opinion that continuous monitoring, and redesign if necessary, was essential:

> *... the assumptions and engineering judgment used in the design and modelling of the proposed impacts must be validated through instrumentation, research and re-running of the impact models at regular intervals throughout the operational and decommissioning phases of the mine to ensure the environment is adequately protected.*[52]

[49] Government of Saskatchewan, *Submission to the McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 17, 1996, p. 11.

"Atomic Energy Control Board, *Submission to the McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 17, 1996, pp. 2-3.

[51] Ibid, p. 6.

[52] Saskatchewan Environment and Resource Management, *Submission to the McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 17, 1996, p. 15.

It appears that the potential benefits of the DTMF could compensate adequately for the associated risks and the panel recommends that cautious approval of the facility be granted. We are, however, keenly aware that this is a new technology in an experimental stage of development and our recommendation should not be taken as a general endorsement of natural surround in-pit tailings disposal facilities. Another panel's acceptance of the Rabbit Lake pervious surround tailings disposal facility was used to justify approval of a similar facility for the JEB pit.[53] Our recommendation for the DTMF is site-specific and should not be used in a similar way to justify another project.

It will be possible to evaluate the performance of the DTMF only after it has been in operation for many years. The technology cannot be considered to be fully proven until it has been shown, by actual measurements, that the tailings have consolidated to yield a material of low permeability, and that any migration of contaminants falls within acceptable levels.

It is apparent that rigorous performance monitoring will be required during all stages of development and operation of the DTMF. At a minimum, monitoring should include regular assessment of tailings consolidation characteristics and water quality conditions, as evaluated at both the peripheral dewatering wells and at the main pit over a long period of time. It is not likely that it will ever be possible to completely walk away from this pit once it has been filled with tailings.

> ***As you know and have heard over and over, our greatest concern is our environment and the environment that we are going to leave behind for our future generations.***
>
> Pierre Robillard, Elder, Black Lake, ***Transcript of Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 35.

8.3 Conclusions and Recommendations

Significant environmental benefits could result from the decision to mill the McArthur River ore at the Key Lake site. Past performance of the mill suggests that health and safety controls'are sufficient to protect the workers and that the environment can be protected from unacceptable contamination in the long term.

The proposed tailings management regime has the potential to offer significant benefits; however, because of the experimental nature of combining subaerial with subaqueous deposition within the same tailings management facility, careful monitoring will be essential. Deposition of tailings should be permitted to proceed only as long as all modelling predictions are met, or appropriate mitigation is implemented.

The panel recommends cautious approval of the Deilmann Tailings Management Facility as described in the EIS, with the understanding that rigorous performance monitoring will be undertaken during all stages of development, operation, decommissioning and postdecommissioning.

[53] ***The Government's Position on Proposed Uranium Mining Developments in Northern Saskatchewan,*** Government of Saskatchewan, December, 1993, p. 29.

9.0 WORKER HEALTH AND SAFETY

9.1 Jurisdictional Ambiguity

The administration of occupational health and safety in uranium mines comes under federal jurisdiction by virtue of provisions in the *Atomic Energy Control Act.* The enabling legislation for radiological protection is the *Uranium and Thorium Mining Regulations (79881,* soon to be revised under the proposed *Canadian Nuclear Safety Act.* This legislation is implemented by the Atomic Energy Control Board (AECB). Conventional occupational health and safety is governed by the *Canada Labour Code,* and its regulations under *Part //* of the *Code.* The responsibility for its implementation lies with the Labour component of Human Resources Development Canada.

In practice, however, radiological protection is monitored by both federal and provincial regulators, whereas conventional worker health and safety is monitored only by Saskatchewan Labour. The provincial government acquires its authority through requirements attached to the surface lease agreements negotiated with each uranium mine. Specifically, the Saskatchewan *Occupational Health and Safety Act, 7993,* and *The Radiation Health and Safety Act, 7985,* and their attendant regulations, are the legislative instruments applied at the uranium mines.[54]

It is apparent that the provincial Mines and Radiation Safety Branch is the government body most active in providing conventional occupational health and safety inspections at uranium mine sites. Accordingly, this organization should be provided with the authority for initiating prosecution to enforce compliance of regulations. There should be a formal clarification of jurisdictional accountability for conventional health and safety in uranium mines. The Province of Saskatchewan should be given the legislated authority and responsibility for the regulation and enforcement of conventional occupational health and safety standards in the province's uranium mines.

Employment at uranium mines carries an additional risk beyond the conventional health and safety concerns of other mines - the possibility of exposure of workers to radiation. The Atomic Energy Control Board performs compliance and audit inspections to ensure implementation of acceptable measures for protection from radiation exposures.

The AECB practises a multiphase strategy to ensure compliance: a review of the proponent's plans, modelling assessment, hazard analysis, site inspections, and audits for all proposed and operating uranium mines are included in its activities. The AECB sets public and occupational radiation dose limits, based upon recommendations of the International Commission for Radiological Protection (ICRP).

The province is also involved in the regulation of radiation health risks through the Mines and Radiation Safety Branch of Saskatchewan Labour. The legislation regarding radiation is *The Radiation Health and Safety Act, 7985* and its regulations. Although the *Act* and regulations do not have provisions which apply specifically to uranium mine workers, the province imposes dose limits by specifying them in the surface lease agreements.[55]

By virtue of federal and provincial legislation, both levels of government have a responsibility to monitor radiation risks at uranium mine sites. This suggests an ideal opportunity for cooperation between the regulators, to share information and avoid duplication. However, presentations to the panel at public hearings indicated that the federal and provincial regulators were not capitalizing on these opportunities.[56] This lack of cooperation is worrisome, not only for the inefficiencies it represents, but also for its potential to compromise the health and safety of workers. A formal arrangement should be established between the AECB and the provincial regulators to share information and work-site observations on radiation monitoring, with the objectives of strengthening worker protection, and reducing duplication in testing and reporting activities.

9.2 Radiation Health Risks and Protection

There are certain radiological protection challenges that must be addressed in the mining and milling of the high grade McArthur River ore. The mining methods (Section 6.1) have been designed specifically to prevent direct exposure of the miners to the ore. Worker safety would be dependent on the successful containment of the ore during mining, during crushing and grinding, during pumping of the ore slurry to surface, during transport of the ore to the mill, during the blending of McArthur River ore with Key Lake special waste, during milling, and during deposition of the tailings. The EIS predicts that maximum mine worker exposure (for an

[54] Government of Saskatchewan, ***Opening Presentation to the McArthur River Public Hearings,*** Regina, Saskatchewan, September 5, 1996, pp. 19-21.

[55] Ibid, p. 19.

[56] R. McCabe, ***Transcript of Public Hearings, Saskatoon, Saskatchewan, September 9, 1996,*** p. 31.

underground boring operator) would approximate 29% of the proposed new annual exposure limits.

Despite the protection offered by mine design and processes, the AECB has identified several areas of mine operation where special care must be taken to avoid radiation problems. These include ventilation control, the ground water containment system, and ore-handling upset conditions. These are concerns that cannot be dealt with during an environmental review; for entirely practical reasons, they should be monitored and controlled by the regulators through the licensing procedures.

> *We. ..believe that the technical challenges of mining the high grade ore at McArthur River can be overcome.*
>
> J. Parr, Government of Saskatchewan, *Transcript of the McArthur River Public Hearings,* Regina, Saskatchewan, September 5, 1996, p. 92.

The AECB reported that it is satisfied that the proponents have adequately assessed worker risks from exposure to radiation during mining and have planned appropriate monitoring and mitigation measures to control source releases.[57] Saskatchewan Labour reached similar conclusions.

In addition to complying with regulatory limits, the proponent is required to comply with the "as low as reasonably achievable" (ALARA) principle. It is not permissible to use a particular approach if a comparable, but safer, approach exists. Unnecessary exposure is unacceptable, even if regulatory limits are not exceeded. ALARA is an important concept and it is essential that it be complied with as scrupulously as any of the regulations.

> *So how the geologists and their drillers, their helpers, samplers and those guys who are still handling with their bare hands extremely high grade ore which you will never find in the world, what is the enhanced protection today within such an environment? I still wonder.*
>
> Dr. G. Strnad, *Transcript of McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 11, 1996, p. 92.

> *... to say that the workers cannot be protected, I would say, is a misleading statement. We have, as mentioned, drilled 10,000 metres, handled radioactive cores which, at times, were 40 percent in grade, and we monitor all the people, when they drill, when they carry the cores, when they examine the cores; and all these monitoring has shown that the safety standards which we are to meet are completely met. So that is my answer. We have experience that shows that it works.*
>
> Bernard Michel, President, Cameco Corporation, *Transcript of McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 11, 1996, p. 93.

McArthur River ore would be milled at the Key Lake mill, with tailings deposition taking place in the Deilmann Tailings Management Facility (DTMF). The EIS predicts that maximum worker exposures, stated as percentages of the newly proposed, more stringent radiological exposure limits, would be within acceptable regulatory limits: 36%, for mill maintenance workers; 37%, for the DTMF workers during subaerial tailings deposition operations; and 10%, for similar DTMF workers during subaqueous tailings deposition operations. Since these predictions represent significant fractions of the allowable limit, careful monitoring using state-of-the-art technology will be required to ensure that workers do not receive unacceptable exposures.

The Key Lake mill has a history of acceptably low worker radiological exposures. This indicates that appropriate health and safety controls are in force. In addition, the worker radiation training program, workplace monitoring and emergency spill response protocols are well developed at this site, creating confidence that workers will be appropriately protected.

[57] Atomic Energy Control Board, *Radiological Assessment of the Mining Methods at the McArthur River Project, Submission to the McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 11, 1996, p. 4.

However, the blended McArthur River ore will be more radioactive than ore previously milled at Key Lake and there will be no room for complacency based on past accomplishments when the new process begins.

In order to better assess radiological health and safety impacts to workers, the AECB, uranium mining companies and the Government of Saskatchewan have undertaken jointly to complete a cohort mortality study of Saskatchewan uranium miners.[58] The panel strongly endorses this epidemiological study which will last for approximately thirty-five years. It should be given priority status, and appropriate funding should be made available to permit its long-term research goals to be achieved. See Sections 11.5 and 11.6.

The public voiced concern about continuing uncertainty in the assessment of radiological risks and the selection of appropriate, conservative standards for dose limits. The AECB sets public and occupational radiation dose limits, based upon recommendations of the ICRP. Existing federal standards, based on the 1977 ICRP-26 recommendations, are under revision, with the proposed AECB *Radiation Protection Regulations* calling for a considerable reduction in dose limits. The current AECB limit for workers is 50 mSv per year and, for the public, 5 mSv per year. The new occupational dose proposed by the AECB (based on ICRP-60) is 20 mSv per year averaged over a defined period of 5 years, with an additional proviso that the effective dose should not exceed 50 mSv in any single year. The dose limit proposed for the public is 1 mSv per year.

Current Saskatchewan radiation dose standards are also based upon ICRP-26, although the province plans to incorporate ICRP-60 radiation protection standards into future surface lease agreements with uranium mines.[59]

Much of the public concern seems to be related to the time it has taken for the recommendations of ICRP-60 and later revisions to be accepted and implemented. Both governments should move expeditiously to adopt the intent of ICRP-60 and ICRP-65, and should be prepared to review and amend dose limits quickly, in line with any future recommendations by the commission.

[58] Atomic Energy Control Board, ***Submission to the McArthur River Project Public Hearing?,*** Regina, Saskatchewan, September 6, 1996, p.5.

[59] Government of Saskatchewan, ***Opening Presentation to the Cigar Lake Public Hearings,*** Regina, Saskatchewan, September 4, 1996, p. 33.

> ***...it was about three years ago that your Panel recommended that the province move towards adopting the ICRP-60 exposure limits. It appears that not much progress has been made....***
>
> Ann Coxworth, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 9, 1996, p. 25.

9.3 Conventional Health and Safety

Saskatchewan updated *The Occupational Health and Safety Act* in 1993, and began a three-year review of *The Occupational Health and Safety Regulations* in the same year. The revised regulations were expected to come into effect before the completion of this review.[60] Mining regulations, however, were last revised in 1978, with no plans for their review until after the enactment of the health and safety regulations. The continued reliance on outdated mining regulations is of concern.

Since 1978, the mining environment has changed dramatically. New developments in automated mining technology, communications systems, computerized process control and worker safety monitoring require corresponding changes in the legislation and regulations. For example, a new mining code should include regulated worker-to-worker and worker-to-surface communications systems to enhance emergency response capabilities. Underground lighting standards should be upgraded, using recent developments in high-efficiency portable lighting sources, and all regulations should be reviewed to ensure that they make the best use of available technologies. Saskatchewan Labour should upgrade its *Mines Regulations* to reflect current mining procedures and the use of modern technologies.

9.4 Conclusions and Recommendations

Mine workers, particularly those in underground developments, depend on mine regulators to ensure safe workplaces. It is therefore essential that legislation and regulations provide adequate protection for contract and non-contract workers; that mine sites be inspected frequently; and that due care be exercised to ensure that safe work practices are being followed.

[60] J. Parr, ***Transcript of Public Hearings, Regina, Saskatchewan, September 5, 1996,*** p. *05.*

The panel is satisfied that the proponents have adequately assessed worker radiological risks and have planned appropriate monitoring and mitigation measures to control source releases. However, the proponent is reminded of the importance of the ALARA concept, and Cameco is urged to observe ALARA in all activities and phases of the project as scrupulously as its legislated and regulated standards. In addition, it is recommended that both federal and provincial governments move expeditiously to adopt the intent of ICRP-60 and ICRP-65.

Jurisdictional overlap and ambiguities between the federal and provincial governments have the potential to decrease the level of worker protection as well as introducing certain inefficiencies into the system. Because the province plays the pre-eminent role in performing workplace inspections and monitoring, it is recommended that Saskatchewan be given the legislated authority and responsibility for conventional health and safety at uranium mines. For radiological health protection, it is recommended that a formal arrangement be established between the AECB and the provincial regulators to share information and site-inspection observations, with the objectives of strengthening worker protection and reducing duplication.

It is also recommended that Saskatchewan Labour expeditiously complete reviews and revisions of *The Health and Safety Regulations* and the *Mines Regulations,* to ensure that they reflect current mining procedures and the use of modern technologies.

10.0 BIOPHYSICAL IMPACT ASSESSMENT

10.1 General Principles and Comments

A major concern of northerners is that mining activity might interfere with their traditional use of the land. They want to know that it is safe to drink the water, to fish, to trap, to hunt and to harvest plants, both now and in the future when the mines have ceased operating. To ensure that the environment is safe for these activities, an objective assessment of mining impacts is essential. This requires collecting baseline data to determine the state of the environment before mining begins, observing changes that occur during mining, and monitoring the recovery or restoration of the environment after decommissioning. Conceptually, these procedures are easy to design, but in practice they are often difficult to implement.

> *People are very concerned about their land and their lakes and they want to protect them because that is where they make their living from and they want to live there the rest of their lives.*
>
> Emile Hansen, Chief of the Hatchet Lake Band, ***Transcript of Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 31.

10.1.1 Location of Sampling Sites

Collection sites should be arranged along the predicted concentration gradients of emissions from a point where contaminant concentrations are highest to a point where they approach background levels. Three sites per gradient, representing possible high, medium and low impacts, would be sufficient. In addition, another set of collection sites should be placed where predictions indicate that no impacts would occur. These control or reference sites are necessary because ecological systems may change through time. Impacts are assessed by comparing the control and potentially impacted sites with one another and to their respective baseline (i.e. pre-impact) states. Replicate samples should be collected at all sites.

Although the spatial arrangement of the collection sites might seem simple to establish, practical difficulties frequently interfere with the ideal statistical design. Matching of sample sites is important, but undoubtedly there will be variation in site factors such as size and depth of lake, the substrate type, and the communities of organisms that live in an area. For example, a lake receiving mill effluent might be shallower and smaller than lakes further down the watershed, making precise matching of sites or the biota to be monitored impossible. Inevitably, the design of a study will be compromised to some extent, and judgment will be required to determine the best location of sample sites.

10.1.2 Components to be Monitored

The movement of contaminants through the environment is monitored by measuring their concentrations in different components of the ecosystem. The assessment of impacts on the biota is done by looking at changes in population size, biomass, species composition, or other measures of population or ecosystem health.

Mine operators have emphasized the monitoring of chemical contaminants in air, water, soil and sediments but have done relatively little monitoring of biological effects. The current and proposed monitoring programs sample fewer valued ecosystem components (VECs) than do the government agencies which monitor cumulative effects at points distant from the mines (see Section 10.4). This should not be so. To create an integrated monitoring program, the mine operators and government agencies must monitor the same components. An exception would be made in the case of caribou; because they are seldom present at mine sites, it would be appropriate to substitute another terrestrial mammal such as the vole or squirrel. Thus, the existing or proposed monitoring programs at the mine sites should be expanded to include a terrestrial mammal, spruce grouse, spruce needles, and aquatic macrophytes. Phytoplankton and zooplankton should also be monitored because they are among the best indicators of trends in relation to effluent concentration gradients at Key Lake.[61] The inclusion of some of these components would require the collection of additional baseline information.

The range of contaminants to be monitored should be reviewed periodically. At the public hearings, a presenter suggested that biota should not be analyzed for thorium-230, because it is not very mobile in the environment, because it is present in only very small amounts in organisms, because it contributes a very small radiation dose to the biota, and because it is so

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"Terrestrial & Aquatic Environmental Managers Ltd., ***Operational impact assessment to support nickel water quality objective setting for the McDonald Drainage system,*** prepared for Cameco Corporation, December, 1993.

expensive to analyze.[62] The money saved in eliminating unnecessary chemical analyses would allow improvement elsewhere in the monitoring program.

10.1.3 Monitoring Methodology

The method of monitoring sediments should be changed at some sample sites. Typically, sediment cores are collected every three years and divided into two strata: O-5 cm and 5-l 5 cm. However, in areas where sediments accumulate, contaminants enter at the sediment surface by adsorption and by the deposition of new sediment. Because the deposition rates of new sediments are low in northern Saskatchewan, the impacts from most mines would only be observed in the top few centimetres of sediment. Although there is some debate on this issue, evidence received from the Department of Fisheries and Oceans indicates that sediment cores provide a history of events for many contaminants of interest at uranium mine sites.[63] By dating the different strata in the core, it is possible to calculate the rate at which contaminants are accumulated in the sediments. This would provide an independent check of the predictions of some impact models. For this technique to be useful, it would be necessary to subdivide cores into 1 -cm strata and to lower the detection limits of contaminants to ensure that there would be no "less than" detected values.

This improved methodology for sediment sampling would be more expensive; however, the increase in cost could be offset by taking samples less frequently, a justifiable approach because the accumulation of contaminants in sediments is a slow process. In addition, sampling at this level of detail would be required at only a few sediment sampling sites.

> ***So it is one thing to go out and take a dredge of mud and come back and measure the various things in it. /t .is another to go out and take a core and do the same thing, and it is a third level, / think, of sophistication to date that core so you can use it to calculate fluxes.***
>
> Dr. L. Lockhart, ***Transcript of McArthur River Public Hearings,*** Sas katoon, Saskatchewan, September 18, 1996, p. 72.

Pathways analysis is used to analyze the movement of contaminants through ecosystems (see Section 10.4). The analysis involves compartment models which use transfer coefficients to estimate the proportions of contaminants moving from one compartment to another.[64] Frequently, transfer coefficients are derived from the literature and their applicability has been questioned.[65] For example, is the forage-to-meat transfer coefficient of radium-226 in an Ontario cow a reliable estimate for the forage-to-meat transfer of that element in moose in northern Saskatchewan? The calculation of site-specific transfer coefficients would alleviate questionable assumptions of this type. This could be done at no extra cost, providing samples of the various components were collected at the same time and place.

The biological availability of contaminants and their effects on fish, or on other biota, need careful assessment. The uptake of metals by fish should be assessed by measuring concentrations in kidney, liver, gills, and possibly scales. On the other hand, the effects of increasing metal concentrations on fish are less easily assessed. Various indicators have been suggested, including lipid peroxide, metallothionein, and histopathology, but the significance of these indicators is still debatable? This aspect of ecosystem health should be studied further to facilitate the development of a definitive monitoring system.

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[62] P. Thomas, ***Submission to McArthur River and Cigar Lake Public Hearings, Saskatoon, Saskatchewan,*** **September** ***16, 1996,*** **p.** ***7.***

[63] J.F. Klaverkamp, C.L. Baron, H.M. Cooley and R.V. Hunt, The Use ***of Fish in Environmental Effects Monitoring for Uranium Mines, Submission to the McArthur River and Cigar Lake Public Hearings, Saskatoon, Saskatchewan,*** September 16, 1996, p. 2. W.L. Lockhart and P. Wilkinson, ***Lake Sediment Cores as Archives to Detect and Measure Environmental Changes, Submission to the McArthur River and Cigar Lake Public Hearings, Saska toon, Saskatchewan,*** September 18, 1996.

[64] The environment is viewed as being made up of a number of compartments such as the air, water, soil or sediment, or organisms at a particular location. An organism compartment may be specified to the species level (e.g. caribou), or may include several species (e.g. plants that the caribou eats), or may include only a part of an organism (e.g. muscle or liver).

[65] P. Thomas, ***Submission to McArthur River and Cigar Lake Public Hearings,*** Saskatoon, Saskatchewan, September 16, 1996, p. 2.

[66] ***McArthur River Environmental Impact Statement, Addendum,*** Cameco Corporation, June 1996.

> ***Although contaminant analyses of fish muscle is appropriate to assess the suitability for consumption by humans, the use of muscle to determine the biological availability of metals is not appropriate with the exception of mercury.***
>
> J.F. Klaverkamp, C.L. Baron, H.M. Cooley and R.V. Hunt, ***The Use of Fish in Environmental Effects Monitoring for Uranium Mines, Submission to the McArthur River and Cigar Lake Public Hearings,*** Saskatoon, Saskatchewan, September 16, 1966, p. 2.

At public hearings, the panel was alerted to a concern that the amounts of calcium sulphate in mill effluent could adversely impact the downstream watershed. This compound, often thought to be largely inert, could, in fact, change the chemistry of the lakes, producing effects that might only become apparent well after decommissioning.[67] Exploratory research is desirable to identify a simple indicator that could assess the probability of potential negative impacts from calcium sulphate.

10.1.4 Assessment of Impacts

There are several approaches to impact assessment. The following discussion is not exhaustive but does consider examples of all the main methods of assessing impacts.

In one approach, models are used, prior to operations, to predict contaminant concentrations at different locations. The predictions are then compared to accepted benchmarks that characterize the risk, enabling a qualitative risk assessment to be made. This approach is used in pathways analysis (see Section 10.4) where predicted doses to humans are compared to ICRP standards. Another example is Cameco's use of an Integrated Risk Management Approach (IRMA) to compare predicted contaminant concentrations to toxicity values in the literature (LC_{20} or LC_{50} values[68]) for various species, or to regulatory standards such as the Saskatchewan Surface Water Quality Objectives (SSWQO) or the proposed Canadian Sediment Quality Guidelines.

This type of risk assessment can be useful, but it does not eliminate the need for doing biological effects monitoring to check the validity of the predictions. This is because IRMA, which uses toxicity values from the literature, screens only a limited number of species, but bases its results on the assumption that these species are representative of all the species in the ecosystem. For example, IRMA might screen only a single species of phytoplankton, although there could be more than 100 species living in the system. If the species selected were tolerant to metal pollution, all phytoplankton would then be assumed to be tolerant, although we know this is not true. Similarly, since regulatory standards like the SSWQO have no limits for contaminants such as uranium or total dissolved solids, conforming to the standard does not automatically confer protection for all species.

A second impact assessment approach uses standard toxicity testing of effluent and possibly of sediment. This may be done either by acute toxicity testing, or by chronic or subchronic testing. Acute toxicity tests measure the percentage of the population killed by different concentrations of a chemical in a relatively short period of time. Chronic or subchronic tests screen sublethal effects, such as the causing of non-terminal cancers, malformations, mutations, etc. These toxicity tests are useful to assess risk but can only screen a limited number of species and life stages. In this way the approach suffers from some of the same drawbacks as IRMA; however, it may be very helpful for detecting upset conditions and should be used to screen mill effluent when there is a change in the mill process.

A third approach uses a variety of statistical models to analyze changes in the number, density, or biomass of a species, or to examine changes in the species composition of communities. This approach might also be used to analyze changes in contaminant concentrations, either in the biota or in the physical environment. The ability to detect an impact will increase as the magnitude of the change increases, as the sample variation decreases, and as the number of samples increases. On the other hand, the chance of detecting impacts may be reduced by inappropriate choice of sample collection sites, unsuitable sampling techniques, or by poorly matched samples. For example, if sediments were sampled using an Ekman dredge, the top IO-20 cm would be mixed, and dilution would reduce the ability to detect an increase of a contaminant in the top 1-2 cm.

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[67] R.H. Hesslein, ***A generic proposal for research on the effects of greatly elevated levels of calcium sulfate in lakes down stream of ore processing operations, Submission to McArthur River and Cigar Lake Public Hearings,*** Saskatoon, Saskatchewan, September 10, 1996.

[68] LC_{20} or LC_{50} values refer to the concentrations of a substance that will kill 20% or 50% of a population.

If the data are analyzed and no change detected, this might indicate that no impacts are present; however, it might also indicate that the impacts (changes) present could not be detected by the tests because of low statistical power.[69] Thus, a test done might not be able to detect a change in a population or contaminant concentration because of small sample size and a large variation between samples. Baseline and monitoring data should be subjected to power analysis at each sample site. As a general rule, it should be possible to detect a 50% reduction (or increase) in a population at each site with a high degree of power or probability (>95%). If there is little chance of detecting such a magnitude of change, the sampling program should be modified. This may require taking a larger number of samples at each sample site, or matching sites more carefully to reduce sample error. To compensate for increased costs, it might be possible to increase the time interval between samples, or to decrease the number of sample sites, as long as the overall range of potential impacts is not decreased. It is better to sample a few things well and obtain definitive results, than to sample many things poorly.

10.1.5 Northern Participation

Even if the monitoring program were carefully designed and executed, its results might fail to convince the people of the region of its validity. Residents of the north must be involved, especially in the implementation of the program, before they will trust the results. This involvement can be accomplished, in part, through the Environmental Quality Committees (see Section 11.2). They could fulfil a valuable liaison role by connecting their communities to the monitoring program. In addition, it is important that some mechanism be found to involve northerners directly in the activities of monitoring.

> *. . . the more involved they become in monitoring, the more they are going to trust the industry.*
>
> Dr. Pat Thomas, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 16, 1996, p. 189.

[69] Statistical power refers to the ability of a particular statistical test to detect a given change in a population.

10.1.6 Design of Monitoring Programs

The monitoring programs are specified by the regulatory agencies in the various operating licences for each mine. The specification of programs is not a one-way process, but rather the result of discussions between the operators and their consultants, and the regulatory agencies and their advisory government departments. This consultation process, necessary because of the expertise required to develop a well-designed monitoring program, might lead to concerns about the independence of the regulatory agencies from the industry. The panel suggests broadening the technical group that advises on monitoring protocols to include appropriate expertise from universities and from government institutes. In addition, representatives of the Environmental Quality Committees should be included. The technical group could hold a workshop every five years to evaluate the monitoring programs at all mines, enabling adjustments to be made in protocols in a timely manner.

> *. . . But companies are stuck with regulations, and regulations are built from the information available at the time they were made. And so part of the problem may be that the regulations have not necessarily kept pace with the science.*
>
> Dr. L. Lockhart, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 18, 1996, p. 86.

10.2 Monitoring at the McArthur River Site

The EIS predicts that the mine would leave a remarkably small footprint on the surrounding environment considering the size of the ore body. This is because of the way in which the mine has been designed, the fact that the ore will be milled at Key Lake and the proposal to dispose of problematic wastes either in the Deilmann Tailings Management Facility (DTMF) or underground in the McArthur River mine.

Cameco predicts very low radon emissions for the McArthur River mine, compared to most other uranium mines, because minewater inflow would be controlled by ground freezing or grouting, and the ore stream would be contained from extraction to transportation. Consequently, the impacts of aerial emissions are likely to be small.

The environmental impacts likely to be greatest at McArthur River would result from the release of treated effluent into the muskeg that drains into the east end of Boomerang Lake, and onward into Read Creek, which supports a grayling fishery. The lakes downstream are also productive, making them an important resource to protect. Minewater inflow would increase as the mine is extended along the ore body and two more shafts are constructed. There would be a corresponding increase in the volume of treated effluent, to approximately 4670 m^3/day in the year 2012. This would be only about 10% of the average flow rate immediately downstream of Boomerang Lake, but almost 30% of the mean low flow rate. However, the effluent would be considerably lower in dissolved salts than would that released from milling operations, and it is predicted that contaminant concentrations in Lucy Lake would be less than levels deemed acceptable by the Canadian Water Quality Guidelines and Saskatchewan Surface Water Quality Objectives.

The effluent would seep through the muskeg and enter Boomerang Lake or Read Creek in a very diffuse manner. It is also likely that many contaminants would be adsorbed by the muskeg. This fact has not been taken into account in predicting water concentrations in Lucy Lake, located about three-quarters of a kilometre downstream of Boomerang Lake; therefore, the predictions for Lucy Lake are likely to be conservative. The panel concludes that the risk to fish and other aquatic organisms is acceptable.

In general, the proposed monitoring program is acceptable, with the provision that biological effects monitoring should be extended to include a terrestrial vertebrate, aquatic macrophytes, and plankton (see Section 10.1.2). The method of sampling sediments should be improved (see Section 10.1.3) to include a detailed profile of the sediments in Little Yalowega Lake.

The panel heard concern that four rare or uncommon plants (*Carex pauciflora, C. trisperma, Pinguicula villosa* and *Scheuchzeria palustris*), found in the muskeg that would receive the treated effluent, might be adversely affected. Given that this habitat is commonly found throughout the region, it is not likely that these species are at risk; however, Cameco should monitor to determine if these plants suffer adverse impacts.

10.3 Monitoring at the Key Lake Site

Milling of the McArthur River ore at Key Lake would impact two watersheds: the David Creek and the McDonald Lake drainage systems. Mill effluent would be combined with treated water from the DTMF and released into Wolf Lake which drains via Yak Creek into David Creek. The impacts to this watershed would likely increase marginally above current levels. Contaminant loadings would increase because of milling a higher grade ore and an increase in the volume of treated water from the DTMF.

The relatively clean water intercepted by perimeter wells around the DTMF would be released into the McDonald Lake drainage system. The impacts from the release of this water would likely decrease below current levels. Concentrations of nickel and other contaminants would be reduced by the recently commissioned reverse osmosis plant, and the need to pump the perimeter wells would decrease as the water level in the DTMF is restored.

Unfortunately, the ability to detect aquatic impacts, particularly those resulting from the release of mill effluent, has been compromised by the inadequacy of baseline information and a poorly designed monitoring program during the operation of the Key Lake mine. Cameco commissioned a set of studies by Terrestrial and Aquatic Environmental Managers Ltd. to correct this deficiency,[70] and collected additional operational baseline information to facilitate the assessment of incremental impacts. However, because the ability to assess impacts depends on the magnitude of the change, the incremental effects would have to be large before their detection would be possible.

Aerial emissions from the mill will also impact surrounding ecosystems. However, the results of the aerial monitoring program indicate that sulphur dioxide emissions are not sufficiently large to acidify the surrounding lakes, and that contamination by radioactive dust and radon progeny is largely confined to the Key Lake site.

The proposed monitoring program could be improved in many ways by applying the principles discussed in Section 10.1. First, biological effects monitoring should be implemented for the water body into which effluent is released; namely, Wolf Lake, for mill effluent, and Horsefly Lake, for intercepted groundwater around the Deilmann and Gaertner pits. It is disturbing to note that Delta Lake, approximately 10 km downstream from the point of release of mill effluent, was selected as a near-field sample station; this would actually be a low-impact

[70] *McArthur River Environmental Impact Statement, Appendix 8,* Cameco Corporation, December, 1995, Sections 4.6.3.3 and 4.6.3.4. *McArthur River Environmental Impact Statement, Appendix 12A,* Cameco Corporation, December, 1995.

station. At this distance, sodium and sulphate ions would be diluted to approximately 20% and uranium, to approximately 2 %, of effluent concentrations. Second, the biotic components to be monitored should be expanded to include aquatic macrophytes, a terrestrial mammal, spruce grouse, and plankton. Third, the sampling of sediments should be improved, as outlined in Section 10.1.3.

The operating licence for the DTMF would prescribe the monitoring method for the tailings, groundwater, the water in the pond overlying the tailings, and the water collected in the drainage sump beneath the tailings. Subsequently, the licence for the decommissioning phase would require monitoring of the final consolidation of the tailings and the restoration of the groundwater. Such monitoring is one of the responsibilities of the regulatory agencies; the panel is confident of their ability and determination to enforce an acceptable monitoring program for the facility.

The main outstanding issue to be addressed is the length of the monitoring period after the pumps are shut off and the water table is restored. Local people deserve to be assured that contaminants are being contained within the facility and that, in the long term, any leakage of contaminants will be sufficiently small as to not harm organisms. The panel believes that the only way in which the people of the region can be assured of environmental protection is to monitor the facility indefinitely; many impacts may become apparent only in the long term and it is, therefore, not possible to guarantee a walk-away, zero-risk tailings storage facility. The industry and its regulators must recognize that tailings management facilities will require monitoring, and possible mitigation, in perpetuity.[71] The details of the monitoring program, possible maintenance of the facility, and ability to respond to any contingencies would require careful thought and appropriate funding (see Section 12.5).

10.4 Pathways Modelling and Cumulative Effects

Pathways modelling has been used to predict the movement of contaminants in the environment and the dose to human receptors at different locations (see Sections 10.1.3 and 10.1.4). The dose estimates obtained from pathways models are subject to criticism, which is not surprising in view of the complexity of the models and the many source terms and factors on which they are based. Although it is important to make models as realistic and accurate as possible, it is impractical to expect precise predictions, because of the many uncertainties in the source terms and factors. It should be recognized that the main purpose of modelling exercises is to assess potential risks, not produce exact predictions. Monitoring is necessary because it is the **only acceptable way to assess actual risks. Furthermore, the model must be updated whenever a significant amount of new information becomes available, as a result of monitoring.**

> ***. . . that such a program incorporate more food chain pathways bioaccumulation studies and further that northern stakeholders be involved in all aspects of monitoring.***
>
> Bill Layman, South Central EQC, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 48.

The proponent used environmental pathways analysis to assess the radiological dose from mine and mill emissions to hypothetical humans. The analysis was done for humans living at the McArthur River and Key Lake mine sites and nearby areas, and for residents of Wollaston Lake, Hatchet Lake and Black Lake. The analysis of the latter group involved an assessment of the cumulative effects of all the mines in the eastern part of the Athabasca basin. Cameco estimated the doses to members of the public to be well below regulatory limits and a small fraction (approximately 1 % or less) of the natural background dose. A person at the Key Lake camp would **receive the highest incremental dose, amounting to approximately** 10% of the **natural background dose. The Atomic Energy Control Board did an independent assessment[72] and obtained comparable estimates. Thus, it may be concluded that the potential radiological impact of the McArthur River development would be acceptably low.**

Even when it is anticipated that levels of impact would be acceptable, it is necessary to confirm all predictions by using a well-defined monitoring program. Saskatchewan Environment and Resource Management (SERM) and the AECB agreed to establish such a program in response to an earlier recommendation of the

[71] D. Kirkwood, T. Peters and D. McCreath, ***Decommissioning of Uranium Mine Tailings Management Areas in the Elliot Lake Area, June, 7996,*** Supply and Services Canada.

[72] L. Chamney, Atomic Energy Control Board, ***Regulatory Review of the Radiological Impact of Cigar Lake and McArthur River Uranium Projects, Submission to the McArthur River and Cigar Lake Public Hearings, Saskatoon, Saskatchewan,*** September 16, 1996.

panel (see Section 13.1). They formed a Cumulative Effects Monitoring Working Group (CEMWG) in 1994 with technical advice from representatives of Saskatchewan Health, Environment Canada, the Department of Fisheries and Oceans Canada, the Saskatchewan Research Council, the University of Saskatchewan Toxicology Centre, the Saskatchewan Northern Mines Monitoring Secretariat, and Terrestrial and Aquatic Environmental Managers Ltd. This working group continues to improve the IMPACT/AECB model, which evaluates cumulative environmental effects.

The CEMWG has also established a cumulative effects monitoring program to test the reliability of the model's predictions using field observations. A total of 63 sample stations has been established. Valued ecosystem components (VECs) are monitored on a 3-year cycle, and include air, soil, lichen, blueberry, spruce needles, caribou, spruce grouse, water, depositional sediments, macrophytes, benthos, and fish. Each VEC is measured for concentrations of radionuclides and metals, together with other physical and chemical parameters.

The way in which sediments are monitored also needs careful consideration (see Section 10.1.3). A detailed profile of sediments at a few localities would provide an excellent assessment of the spread and flux of contaminants for the past few decades.

> *. . . on a regional basis for cumulative effects monitoring, a lot of northern residents are hunting, fishing, trapping all the time, and it would be much more cost-effective and less of an impact on the environment, if they were the ones supplying those types of samples, rather than consultants or scientists flying up there, spending all this money to collect the samples, when there are people there that need the work, and could do it anyway. All they need is training.*
>
> Dr. Pat Thomas, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 16, 1996, p. 189.

The panel endorses the CEMWG initiatives and notes that the existence of this diverse and highly competent team of scientists should reassure Athabasca residents and other northerners about the safety of country foods. Attempts should, however, be made to give northern residents a sense of ownership of this project and its results. This could possibly be achieved if the residents were involved in the collection of information and had representation on the monitoring committees (see Sections 11 .1 and 11.2).

10.5 Conclusions and Recommendations

The available information indicates that the environmental impacts of this project will likely be within acceptable limits; however, careful monitoring will be required to ensure protection of the environment and human health.

The proposed monitoring program should be revised as follows:

- it should include the monitoring of the water bodies which will receive effluent;
- biological effects monitoring should be expanded to include all VECs that are monitored for cumulative effects at more distant sites;
- sampling of sediments should be modified to measure detailed profiles of contaminants at some sample sites; and,
- statistical power analysis should be conducted on baseline and monitoring data. If the results indicate little probability of detecting even a large change or impact, the monitoring program should be revised accordingly.

Monitoring will be required over a much longer time span for the Deilmann Tailings Management Facility than that proposed. Arrangements should be made that will permit perpetual monitoring.

Local residents should be involved in all monitoring activity.

Regular workshops should be held to review and advise on the biological effects monitoring for uranium mines. Participants could include technically qualified people from the uranium companies, the regulatory agencies and advisory government departments, other government institutes, and relevant departments of universities. Representatives of the Environmental Quality Committees should also be included.

11.0 COMMUNITY HEALTH AND SOCIAL IMPACTS

11.1 Contamination of Air, Water and the Food Web

A fundamental concern of many northerners is the possibility that uranium mining and milling operations might poison the air that they breathe, the water they drink, and the country foods they eat. Some of the attempts to quantify and monitor these risks have been described in the previous section.

> *That is what our elders want . . . They want that assurance that the fish, the water, the potable drinking water that is available in the north right now, is there 100 years from now -- 200 years from now.*
>
> Vice-Chief Allan Adam, *Transcript of McArthur River Public Hearings,* Saskatoon, Saskatchewan, September *19, 1996,* p. 118.

A food chain study, involving the Cumulative Effects Monitoring Working Group, was done on caribou harvested by local hunters in the Wollaston Lake area.[73] The objective of this study was to measure radionuclide body-burdens and to assess transfers of radionuclides from lichen to caribou, and potentially to humans. The data obtained suggested that the radiation dose from eating Wollaston-area caribou meat is similar to the dose received from eating caribou meat harvested in an area of the Northwest Territories where there is no uranium mining. The panel encourages government agencies to continue the involvement of local area residents in such monitoring programs.

The available information suggests that there has been no detectable regional contamination of the food web in northern Saskatchewan. It appears that there is no danger, at the present time, associated with the consumption of locally grown plants, meat, or fish. This is fortunate because locally harvested foods continue to make an important contribution to the diet of many people in northern Saskatchewan. It is important that precautions be taken to eliminate the possibility of future contamination of the food web. Protection of the food web by continuous monitoring and local mitigation would be far more acceptable (and less expensive) than would be the efforts required to restore a clean environment, should contamination become widespread.

11.2 Environmental Quality Committees

In response to a recommendation from this panel, the Government of Saskatchewan established three regional Environmental Quality Committees (EQCs) in 1995.[74] The South Central Environmental Quality Committee represents the region in which the sites under consideration in this review are located. Its initial activities included a visit to both the Key Lake and the McArthur River sites and a review of the environmental impact statement submitted for the McArthur River Project. Representatives of the South Central and the Athabasca EQCs submitted several recommendations to the panel, all of which have received careful consideration in the preparation of this report.

The panel's impression is that Cameco, the various provincial government departments and the communities are taking these committees seriously and attempting to actively involve them in various monitoring activities. This approach is welcome, because the effectiveness of the EQCs depends on the opportunities provided for them to work in concert with the mine operators, the government regulatory agencies and the communities which they represent.

> *Efforts continue to ward full and active participation by all communities in the north. As well, we continue to identify and facilitate opportunities to increase the "hands-on" activities 0 f the Environmental Quality Committees in monitoring the biophysical and socio-economic environments around northern mines, and in the north in general.*
>
> Ray McKay, *Transcript of McArthur River Public Hearings,* Regina, Saskatchewan, September 4, *1996,* p. 123.

The panel fully endorses these committees and commends Cameco and government departments for their willingness to work with, and support, the EQCs. We do, however, have two specific recommendations

[73] P. Thomas, *Radionuclide Analyses of Saskatchewan Caribou -1 995, Final Report of Saskatchewan Environment and Resource Management and Saskatchewan Health.*

[74] D.G. Lee, J.F. Archibald, J. Dantouze, R. Neal, and A. Yassi, *Dominique-Janine Extension, McClean Lake Project, and Midwest Joint Venture,* Supply and Services Canada, October *1993,* p. *11.*

with regards to the sustainability of the Environmental Quality Committees. The first is that adequate, continuing financial support must be provided to allow the committees to effectively address the various issues related to uranium mining in northern Saskatchewan. Future activities in which EQC involvement is desirable require that committee members have an increased understanding of the issues. If the EQCs are to fulfil their mandate effectively, it will be necessary to dedicate additional resources for relevant training and information sessions for their members. It is also important, for obvious reasons, that the EQCs do not become dependent upon grants from the mining companies to support their activities.

The second recommendation is related to the need for the Atomic Energy Control Board to further develop its EQC support and participation. The AECB plays a unique role in the regulation of the uranium mining industry. It has much to offer to, and much to gain from, strong involvement in EQC activities. Its participation is essential to their continued success.

11.3 The Athabasca Working Group

Prompted by a desire for better communication with the people of the Athabasca region, the presidents of Cameco and Cigar Lake met with 23 community leaders and representatives from Camsell Portage, Uranium City, Fond du Lac, Stony Rapids, Black Lake and Wollaston Lake in March 1993. A discussion of their concerns identified three major issues:

- a desire for more opportunities for jobs, training and business, but not at the expense of the environment;
- a need for a written guarantee stating that companies would protect the environment and compensate for any damage that might result from mining activity; and,
- a desire to receive benefits and revenues beyond those of jobs, training and business opportunities.

The participants agreed that discussions should continue until a formal written agreement is reached on these three issues.

This led to the formation of the Athabasca Working Group (AWG). Cogema Resources joined the process in January, 1994, making this the primary means of communication between all of the uranium mine operators and the Athabasca residents. The AWG consists of two members from each of the six Athabasca communities, and at least one representative each from Cameco, Cigar Lake, and Cogema. The group wishes to remain free of political involvement; government officials, and officers from the Métis Society, Prince Albert Grand Council, and the Federation of Saskatchewan Indian Nations are not included, except by invitation.

The AWG has no established rules or procedures; it is simply a forum for discussing and negotiating issues between the uranium mines and the Athabasca communities. The selection of issues to be discussed is determined by the consensus of the community representatives, and any agreements reached would be formulated as legally binding documents.

> *So we are speaking on behalf of the people in our communities, representing our communities, not the mining sector.*
>
> Janet Holmgren, Athabasca Working Group, *Transcript of McArthur River Public Hearings,* La Ronge, Saskatchewan, October 1, 1996, p. 138.

The AWG has devoted about half of its discussion time to dealing with mine site issues. Community members who work at the mines address their concerns to their AWG members who in turn bring them to the table at the next AWG meeting. One problem identified was the inability of many northerners to communicate fully with human resource people at the mine sites. In response to this concern, an employee relations counsellor was hired to help all northern employees with their concerns and grievances.

The remainder of the AWG discussions has focused on the three main issues identified in the first meeting. The AWG has reached agreement on the first issue, and has defined procedures to maximize jobs, training and business opportunities for the people of the Athabasca region. Discussions are nearly complete on the issue of protection for the environment and compensation for environmental damage. The AWG has identified the people and communities which might be impacted, the types of losses that could occur, and the compensation options that would be available. The procedures to be followed should damage occur are now being finalized. The third issue, benefit sharing, has not been discussed fully.

The panel supports the AWG initiative and its attempts to establish consensus between the people of the region and the mining companies on the way in which mining is

carried out in the north. The lack of formal procedures is a strength when discussions are going well, but may prove to be a weakness when consensus is difficult to reach. There is also a possibility that mining companies might feel less motivated to reach agreement on outstanding issues after mine approvals have been granted. The panel encourages the continuation of the AWG initiative, and suggests that it establish terms of reference and procedures to confirm and protect the dialogue between the communities and the mining companies.

11.4 Community Vitality

> *Now we are telling you guys, as a matter of fact, we do know that we are a community, we do know how to build this community, and we do know how to build a future.*
>
> ***Greg Ross,*** Mayor of Pinehouse, ***Transcript of Public Hearings,*** Pinehouse, Saskatchewan, October 7, 1996, p. 5.

Community vitality, defined as the social well-being and quality of life experienced by community residents,[75] is subject to both positive and negative impacts from uranium mining.

On the positive side, enhanced employment and business opportunities in northern communities may provide a better standard of living and be a source of optimism and hope for community members. Mine employees may also be good role models, encouraging students to stay in school and others to upgrade their education. The seven-day-in, seven-day-out rotation allows wage earners to remain active in traditional pursuits and to have quality time to spend with their families. The presence of mines may bring reduced transportation costs of goods throughout the region, and often results in an improved infrastructure (roads, electrical power lines, water and sewer, etc.) that contributes to the viability and vitality of a community.

> *You could say that I was doing my own study of the changes in the environment as an aboriginal living off the land. I came to realize that all seemed well and that there was a positive side to mining. Such things as jobs and education were being addressed, and the all-weather road supported our traditional fishing, trapping and wild rice activity in the area.*
>
> Rene Rediron, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 11, 1996, p.184.

On the negative side, there is a communal sense of injustice and anger caused by the extraction of resources worth billions of dollars from the traditional lands of communities where many are struggling to meet basic needs. High expectations of northerners for jobs might not be realized, in particular with the McArthur River Project where few new jobs would be created. Tensions might develop between community members with jobs and those without, and between those who oppose mine development and those who favour it. Uranium mining might cause a deterioration in the traditional way of life that is valued by many northerners. Fear of environmental pollution could create anxiety in communities that share the same watershed as the mines. Some employees might decide to move to southern cities, thus depriving northern communities of potential leadership. In addition, improved infrastructure might result in concerns about traffic accidents and possible spills of toxic materials.

Although this description of possible impacts is far from exhaustive, it does indicate that uranium mining has the potential to cause both positive and negative impacts on the vitality of northern communities. Therefore, if uranium mining is to remain a feature of the northern economy, it is as important to monitor its impacts on community vitality as it is to monitor its impacts on the environment. At least as much attention should be directed toward maintaining the well-being of the people of the region as is devoted to preserving the biota.

In order to do this, it will be necessary to identify a set of indicators that can be used to assess the impact of uranium mining on the quality of life experienced by residents of northern communities, This will be a challenging undertaking, one that will almost certainly require professional assistance. The panel, therefore, welcomes and strongly commends the leadership of Cameco for offering to provide $250,000 annually

[75] D.G. Lee, J.F. Archibald, J. Dantouze, R. Neal and A. Yassi, ***Guidelines for the Preparation of Environmental Impact Statements and Government Information Requests for the cigar Lake and McArthur River Projects,*** September 1992, p. 53.

towards the funding of a social scientist in the north, and the establishment of a northern community socio-economic and health impacts database. This initiative will be facilitated by the Department of Northern Affairs, through the Northern Mines Monitoring Secretariat, and in discussion with the emerging Northern Health Boards. Groups like the EQCs and the AWG might also play a role in the process.

The panel heard various suggestions about ways in which community vitality could be enhanced or studied. The Athabasca Environmental Quality Committee recommended that a comparative study be done of the cost of living in Athabascan communities, other northern Saskatchewan communities, and southern Saskatchewan communities. They suggested that a study of this nature might result in a formula whereby all workers would have parity in purchasing power, regardless of their place of residence and thereby encourage workers to maintain their northern residency. Another suggestion was that communities and mining companies explore the possibility of joint bulk purchasing and transportation of dry goods, fuel, and construction supplies. The savings created by economies of scale could be shared. Such suggestions show ways in which the mining companies, government, and communities could work together to improve the quality of life of northerners, and should be carefully considered.

11.5 Community Health

Saskatchewan Health considers health to be "*a dynamic process involving the harmony of physical, mental, emotional, social and spiritual well-being. Health enables individuals, families and communities to function to the best of their ability within their environment.*"[76] In addition, the province's wellness approach recognizes that the state of our health is affected by factors like employment, income, education, housing, the environment, and individual lifestyle choices. Thus, the health of northerners is intimately connected to community vitality.

> *The health of a community involves the physical, spiritual and cultural well-being; it means people having access to basic health services; it means people having meaningful employment and a sense of worth and contribution to their community, it means families having a basic standard of living, and it means a community that is satisfied and confident with itself and of its residents.*
>
> *Athabasca Environmental Quality Committee, Submission to McArthur River and Cigar Lake Public Hearings,* La Ronge, Saskatchewan, October, 1996, p. 8.

The community health impacts of uranium mining development in the north are being assessed in keeping with this broad definition of health. Cumulative health effects involve environmental pathways analysis and the monitoring of contaminants in a variety of VECs on a regional basis through the CEMWG (see Sections 10.4 and 11.1). Saskatchewan Health has completed a literature review on potential physical health effects of uranium mining on adjacent human populations and is studying recommendations arising from this review.[77]

A steering committee, comprised of federal and provincial government departments, northern communities, and industry, initiated a study of the feasibility of a comprehensive baseline health status survey. Based on its recommendations, Saskatchewan Health will facilitate a more detailed analysis of existing databases, the viability and validity of linking databases and of using them as indicators in a baseline health study.[78]

The first phase of a health monitoring study to identify health trends, past and future, in northern Saskatchewan was scheduled to begin in the fall of 1996.[79] Cameco's proposed support for social and health impact monitoring (see Section 11.4) could enhance this health monitoring study by looking at appropriate socio-economic and community health indicators.

Finally, an epidemiological study of the incidence of lung cancer and mortality of uranium mine workers in Saskatchewan has been announced. The proposed

[76] Government of Saskatchewan, ***Submission to the McArthur River and Cigar Lake Public Hearings,*** Regina, Saskatchewan, September 4, 1996, p. 40.

[77] Ibid, p. 45.

[78] Ibid, p.46

[79] Ibid, p.46.

study is a cooperative venture involving the AECB, Saskatchewan Labour, Saskatchewan Health, and the mining companies. See Section 9.2.

These initiatives, many of which respond to previous recommendations of the panel (see Section 13.1), are most welcome. They should augment the general health planning process for northern Saskatchewan.

11.6 Conclusions and Recommendations

Information indicates that there has been no regional contamination of the food web in northern Saskatchewan. Continuous monitoring and mitigation are necessary to protect it from deterioration as the region experiences development activities.

The Environmental Quality Committees provide a good avenue for incorporating local participation in decisions related to uranium mining activities in northern Saskatchewan. Adequate financial support should be provided to educate and train committee members in the various issues related to uranium mining and milling. The AECB should be more active in its EOC support and participation.

The activities of the Athabasca Working Group are to be encouraged; it is important that the mining companies and community leaders from the region meet directly to discuss issues of common concern.

Just as the monitoring of biophysical impacts requires the participation of professional biologists and chemists, the monitoring of impacts to community vitality requires assistance from social scientists. Cameco is to be commended for helping to fund this expertise and for linking it with community health.

The panel is encouraged by the recent initiatives to monitor different aspects of community health, including cumulative effects and the possible contamination of country foods, a baseline community health status survey, and the health study of uranium mine workers. Funds should be made available to ensure the continuation of these initiatives.

12.0 DECOMMISSIONING

12.1 The McArthur River Site

The decommissioning and reclamation of uranium mines and their associated facilities is intended to return disturbed areas to as near to predevelopment condition as possible. For the McArthur River Project, decommissioning as proposed in the EIS includes the dismantling of surface buildings and their associated infrastructure; the sealing of development shafts and ventilation raises; the appropriate disposal of wastes; the salvage and decontamination of reusable materials; the disposal of non-salvageable material underground; the filling of the water treatment ponds; the contouring of waste rock piles; and the revegetation of disturbed areas.

The mining regulations administered by both federal and provincial governments require submission of a site-specific conceptual decommissioning plan which includes proposed reclamation activities and associated costs. The plan must be reviewed and approved before operating licences are issued. Mining companies are encouraged to conduct decommissioning and reclamation activities as soon as possible after an area is removed from production. This allows for the updating of the conceptual decommissioning plan and the adjustment of the amount of financial surety required.

At the end of mining, the operator is required to submit, for review and approval, a detailed final decommissioning plan based on existing conditions and the best available technology. Once decommissioning and reclamation work have been completed, the mining company is required to monitor the site for a number of years. The length of the monitoring period is determined by the stability of the site and the levels, if any, of contaminants being discharged into the receiving environment. Only after on-site monitoring has demonstrated that decommissioning has been successful is a release granted from further requirements.

It should be possible for Cameco to leave a minimal footprint when the McArthur River site is decommissioned. The ore would be milled at Key Lake, the tailings would be deposited in the DTMF, and the mineralized waste would be placed in mined-out drifts underground at McArthur River, or in the DTMF. Only a stockpile of clean waste would be left on the site. With careful management of waste rock during operations, no significant environmental concern should remain at the site after decommissioning and reclamation. All activities during operation should be planned and implemented to reduce or eliminate the size and duration of the mine's footprint at the McArthur River site.

During public hearings, the desire of local communities to be consulted on conceptual and final decommissioning plans was clearly heard. Because of the proximity of the mine site to the northern communities, the panel believes that northern involvement should extend beyond information consultation, to participation in the decommissioning, reclamation and postdecommissioning monitoring activities. The continuing involvement of the Environmental Quality Committees is an ideal vehicle through which northern community residents could be consulted on decommissioning issues, activities and monitoring.

> ***The communities do want to be involved in the monitoring. And we see that as an important step and are working towards the communities being involved. And they have already started being involved in hands-on sampling in some of the government programs.***
>
> Pam Schwann, ***Transcript of McArthur River Public Hearings,*** Regina, Saskatchewan, September 4, 1996, p. 128.

12.2 The Deilmann Tailings Management Facility

The decommissioning of the Deilmann Tailings Management Facility (DTMF) would be the most significant long-term challenge faced by the proponent and the regulatory agencies. The proponent plans to decommission the DTMF by capping the tailings mass with inert, screened, outwash sand or till. The capping would be applied subaqueously, with the objectives of enhancing consolidation of the tailings mass and providing a diffusion barrier against long-term contaminant release. Once the capping is completed and contaminant levels in the pond above the tailings have been demonstrated to be acceptably low, water levels would be allowed to rebound, re-establishing the lake that was dewatered for the original Key Lake mine.

Research is being done by Mine Environment Neutralization Drainage (MEND) into the subaqueous placement of organic layers on mine wastes in order to reduce the flux of contaminants into the overlying water column. The applicability of this and other research to the Deilmann Tailings Management Facility decommissioning should be fully evaluated, and the

conceptual decommissioning plan adjusted to take advantage of any useful results.

The EIS states that the underdrain/side drain system at the DTMF, together with the dewatering system (vertical wells, horizontal drains, drainage trenches), would have sufficient filter drainage and pumping capacity to remove all groundwater and surface water from the pit walls and the tailings mass. During operations, pumping would capture any contaminated water from the tailings area and send it for treatment. It is recommended that decommissioning allow for recommissioning of this dewatering system at a later date, should the levels of contaminants exiting the pit area exceed those predicted by modelling. This would re-establish the ability to intercept and treat contaminated water before it can adversely impact the receiving environment. Re-establishment of the pump-and-treat system would allow time to develop mitigation measures for any unacceptable contaminant levels exiting the decommissioned Deilmann Tailings Management Facility. As stated in Section 10.3, a plan should be implemented for monitoring this and other tailings management facilities indefinitely.

> ***After the mines are closed and shut down in the future, we the Dene people of Fond du Lac will still be here. In fact, all the communities will still be here.***
>
> Caroline Isadore, Chief of the Fond du Lac Band, ***Transcript of McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 32.

12.3 Roads

The proponents should be prepared to decommission roads built to support a project once they are no longer needed. However, the public has indicated a wish to be consulted before decisions are reached on decommissioning of the Fox Lake winter road. Decommissioning should be the subject of full discussions with all stakeholders, including the people from Pinehouse, Patuanak and the English River First Nations. The wishes of the traditional users of the land in the area should be respected. In particular, the bridges currently in place should be maintained until the northern communities have had an opportunity to assess potential benefits and liabilities associated with their removal.

12.4 Financial Guarantees

Both the federal and provincial governments have introduced legislation and/or regulations requiring mining companies to provide, prior to mine start-up, financial guarantees of sufficient magnitude to cover the costs of all decommissioning activities. This financial guarantee is intended to ensure that uranium mine and mill sites can be decommissioned at no cost to Canadian or Saskatchewan taxpayers even if a mining company were unable to meet its commitments. The amount of the financial guarantee required by government is based on the needs outlined in the conceptual decommissioning plan, which is subject to regular reviews to ensure that it reflects existing conditions.

12.5 Uranium Mining Contingency Fund

The financial guarantees for decommissioning costs cover a period of, at most, a few decades after mining ceases. When contaminant concentrations have been reduced to acceptable levels, and the leakage of contaminants from tailings management areas and waste rock piles, etc., has stabilized, the operator can apply to abandon the sites.

> ***The companies seem to believe that they will be able to walk away from these projects. I think that we will need to continue to monitor these sites long after the companies have taken their profits and run.***
>
> Karen Weingeist, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 15, 1996, p. 160.

However, tailings areas have the potential to pose a threat to the receiving environment for periods which may far exceed the life of an individual mining company. Consequently, the tailings management facilities will require monitoring for the foreseeable future. The panel agrees with the discussion and conclusions contained in the report submitted by the environmental assessment review panel that studied uranium mine tailings management areas near Elliot Lake, Ontario." As with the Elliot Lake areas, the decommissioned Deilmann Tailings Management Facility would be required to

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[80] D. Kirkwood, D. McCreath, and T. Peters, ***Decommissioning of Uranium Mine Tailings Management Areas in the Elliot lake Area,*** June, 1996, Supply and Services Canada, Section ***3.4, The In-Perpetuity Problem,*** pp 16-l 7.

contain contaminants for millennia, during which time many aspects of both the biophysical and institutional environments would be altered. There must be some means of ensuring regular monitoring of the integrity of contaminant containment systems and the performance of mitigative measures after institutional responsibility for the area has been transferred back to the government. For this reason, the panel recommends the establishment of a contingency fund to provide for the ongoing costs of long-term monitoring (and mitigation, should it be required) after the responsibility for the sites is returned to government.

The value of the contingency fund should be sufficiently large to cover the costs of long-term monitoring and maintenance of the Deilmann Tailings Management Facility and the potential implementation of contingencies. Instead of establishing such a fund for each mine independently, there might be merit in considering an industry-wide Uranium Mining Contingency Fund. Such a fund could provide better overall fiscal protection to future generations and cost the mining companies less in total. There could also be a single authority to manage the fund and oversee the maintenance, monitoring and mitigation activities at all decommissioned uranium mine and mill sites.

In 1980, the Government of Saskatchewan established a similar fund, referred to as the Environmental Protection Division of the Saskatchewan Heritage Fund.[81] It was created, in part, to provide a contingency fund for monitoring abandoned uranium mine and mill sites and for dealing with unforeseen environmental problems from these sites. Although the Saskatchewan Heritage Fund has been repealed, the Environmental Protection Division continues as a reserve, reported at $11.9-million,[82] within the consolidated fund. The panel recommends that the total remaining in this Environmental Protection Division be used as seed money for the Uranium Mining Contingency Fund. Currently, revenue from investment income does not accrue to the fund; however, this should be changed, with interest being reinvested in the fund to maintain its value and to enhance its viability.

12.6 Conclusions and Recommendations

Decommissioning, since it will take place in the future, is only described conceptually at this stage; the scrutiny and acceptance of specific details must be entrusted to the regulatory agencies. These agencies should ensure that they receive advice from local residents at each stage, and for all elements, of the decommissioning process. Because of the proximity of the mine site to northern communities, this involvement should extend beyond consultation, to participation in the decommissioning, reclamation and postdecommissioning monitoring activities. The Environmental Quality Committees are appropriate vehicles through which northern community residents could be consulted on decommissioning issues, activities and monitoring.

This project, and in particular the Deilmann Tailings Management Facility, would require long-term monitoring and possible mitigative activities in the future. Arrangements should be made to guarantee that monitoring and any required mitigation could occur without placing a financial burden on future generations. For this reason, the panel recommends the establishment of a contingency fund to provide for the ongoing costs of long-term monitoring and mitigation, after the responsibility for the sites is returned to government.

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[81] Saskatchewan Environment and Resource Management, *Final Report. Information from the Government of Saskatchewan requested by the Federal Provincial Panel on Uranium Mining in Northern Saskatchewan for the Cigar Lake and McArthur River Projects*, May, 1996, Section 1, p. 46.

[82] Ibid.

13.0 MISCELLANEOUS

13.1 Government Response to Previous Reports

In October, 1993, the panel completed reviews of proposals for three Saskatchewan uranium mines - the Midwest Joint Venture, the McClean Lake Project and the Dominique-Janine Extension. In its report, the panel recommended the approval of the Dominique-Janine Extension, subject to certain conditions; the approval of the McClean Lake project, also subject to certain conditions, including a delay of 5 years to permit time for education, training and research prior to the start of mining; and the rejection of the Midwest Joint Venture proposal. These recommendations and attendant conditions were submitted to the provincial and federal governments to assist in their decision-making. The governments responded in December, 1 993.[83] The provincial government recently presented a status report on the commitments it had made in 1 993.[84] The AECB, the agency responsible for the implementation of most of the recommendations and conditions directed to the federal government, dealt with many of the panel's concerns in licensing reports for the Dominique-Janine Extension and the McClean Lake project.[85]

The provincial and federal governments accepted the panel's advice on approving the Dominique-Janine Extension, and the majority of the attached conditions. The governments accepted the panel's recommendation that the Midwest Joint Venture not be approved. The governments also accepted the panel's advice for the approval of the McClean Lake Project, and implemented most of the attached conditions. While the recommended 5-year delay in start-up was not accepted, the government indicated that the *"licensing process is a staged process, providing sufficient time to address all of the issues raised by the Joint Panel before the McClean lake Project would come in to operation in several years ".*[86]

Although the governments did not accept the panel's recommended 5-year delay of approval, the reality of the phased licensing process is that the panel's intent of a structured multi-year development at McClean Lake has been substantially achieved. At the close of hearings on the McArthur River Project, three years after recommending the 5-year delay, licences to mine and mill ore from the McClean Lake site had yet to be issued.

The panel also recommended delayed licensing of the JEB tailings management facility at McClean Lake to permit cautious evaluation of the Rabbit Lake pervious surround tailings disposal technique upon which it was modelled. The governments did not agree with the need for this delay, in view of strong support for the method by the Rabbit Lake Panel,[87] by provincial regulators and by independent consultants hired by the province to assess the technology. The consensus of these reviewers was that the pervious surround technology was the most appropriate tailings disposal option available.

The most significant divergence by the federal and provincial governments from the panel's advice concerned a recommendation for the introduction of a form of revenue sharing. The federal government's response stated only that, *"The Government of Canada encourages the Province of Saskatchewan to carefully consider this proposal. "*[88] In making this statement, the federal government seemed to imply that revenue sharing was entirely a provincial matter. However, the Government of Canada also derives significant benefits from these mines, and has fiduciary responsibility for most of the people living in the impacted communities. In responding to the panel, the federal government should have addressed these realities in the context of the panel's recommendation. An effective program of revenue sharing in northern Saskatchewan would require a commitment from, and the participation of, both levels of government.

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[83] *The Government's Position on Proposed Uranium Mining Developments in Northern Saskatchewan,* Government of Saskatchewan, December, 1993.

McLellan Announces Federal Response to Panel Report on Uranium Mining Proposals in Northern Saskatchewan, News Release, Government of Canada, December 23, 1993.

[84] Government of Saskatchewan, *Opening Presentation, Submission to Midwest Project Public Hearings, Appendix 1,* Regina, Saskatchewan, June 11, 1996.

[85] *Cogema Resources Inc., Amendment of Mining Facility Operating License AECB-MFOL-743-5,* Atomic Energy Control Board, May, 1994.

Minatco Limited_, McClean Lake Facility Construction License AECB-MFCL -169-0, Atomic Energy Control Board, May, 1994.

[86] *McLellan Announces Federal Response to Panel Report on Uranium Mining Proposals in Northern Saskatchewan, News* Release, Government of Canada, December 23, 1993.

[87] K.W. Hindmarsh, D. Lehmkuhl and R. Martin, *Rabbit lake Uranium Mining A-Zone, D-Zone, Eagle Point,* Supply and Services Canada, 1993.

[88] *McLellan Announces Federal Response to Panel Report on Uranium Mining Proposals in Northern Saskatchewan, News* Release, Government of Canada, December 23, 1993.

Although the Government of Saskatchewan rejected revenue sharing per se, it has, however, undertaken, "*... to address the desires of Northerners for greater northern benefits from mining and for greater economic self-sufficient y...*".[89] The province's initiatives include the Multi-Party Training Plan, establishment of the Northern Municipal Round Table, amendment of the Northern Revenue Sharing Trust Account, establishment of the Northern Development Fund and redeployment of infrastructure funds to northern municipalities and First Nations communities. Many of the policies and programs which have been developed derive from ongoing consultations with northerners.

The panel agrees with the province that certain expenditures of mining revenues are being invested in support of the future of northerners. Revenues which can be spent in the present, while resources exist, to enhance employment, education, training and economic development are seen as an investment for the future, when non-renewable resources may be depleted. This approach encourages long-term, structured growth in the north.

However, the panel stated in 1993 that northerners should share more generously in any benefits derived from mines because they bear the greatest risk of environmental damage or social disruption by these developments. The panel's opinion has not altered.

> *Our traditional lands have been used by the mines. The Government of Saskatchewan derives mega financial benefits. We are the people of this land. Where are our benefits?*
>
> Caroline Isadore, Chief of the Fond du Lac Band, *Transcript of McArthur River Public Hearings,* La Ronge, Saskatchewan, October 1, 1996, p. 32.

The fact that the report was not placed on a back shelf to gather dust is an indication of the commitment both levels of government have to the environmental review process. Of particular satisfaction to the panel are the positive actions taken on the following issues:

- provision of a financial guarantee to cover decommissioning and postdecommissioning costs. In Saskatchewan, the requirement to provide such a guarantee became law on March 5, 1996, as part of changes to the *Mineral Industry Environmental Pro tec tion Regulations.* Federally, the Atomic Energy Control Board (AECB) has accomplished the same thing by an amendment to the *Uranium and Thorium Mining Regulations;*

- establishment of cumulative effects monitoring programs to monitor regional environmental effects resulting from multiple mining operations. The lead provincial and federal regulatory agencies, Saskatchewan Environment and Resource Management (SERM) and the AECB, have established a joint cumulative effects monitoring program, and act as joint chairs of a scientific steering group, the Cumulative Effects Monitoring Working Group;

- establishment of a research fund to support the search for innovative ways to reduce the volume of effluent, and the quantity of chemicals required to treat contaminated water, and to examine innovative techniques for tailings management. SERM reports that formal discussions have taken place between the Industrial Branch and the presidents of Cameco, Cogema and Uranium Saskatchewan. An agreement in principle has been reached for the companies to provide funding for research;

- establishment of a monitoring committee. Environmental Quality Committees, described in Section 11.2, have been instituted and the Northern Mines Monitoring Secretariat has been established to provide them with funding and administrative, professional, technical and communication support;

- establishment of mechanisms for conducting an epidemiological study on current and former miners. The AECB, the mining companies and the Saskatchewan government are collaborating to carry out such a cohort study; and

- initiation of a comprehensive health study of northern people as a baseline against which any future impact of uranium mining can be assessed. A feasibility study for such a program has been completed.[90]

[89] *The Government's Position on Proposed Uranium Mining Developments in Northern Saskatchewan, Government of Saskatchewan,* December, 1993, p. 33.

[90] J.D. O'Neil, T.K. Young, C.A. Mustard, J. Irvine and B.D. Elias, *Monitoring the Health Impact of Uranium Mining Developments in Northern Saskatchewan: Conceptual Issues and Design Options, Northern Health Research Unit, The University of Manitoba, 1995.*

13.2 Environmental Assessment Review Process

The process of public environmental assessment reviews in Canada is well established. The various stages - scoping, preparation of guidelines, EIS submission and examination, provision of required additional information, public hearings, report-writing and decision-making - have proven effective for the assessment and mitigation of potential environmental, socio-economic and health impacts. The transparency of the process, whereby public participation and scrutiny are sought at every stage, adds extra weight to the panel recommendations. The panel wishes to emphasize the positive value added to its deliberations by contributions from the public, both written and oral.

> *I am very grateful for this process and I have supported it.*
>
> Maisie Shiell, *Transcript of McArthur River Public Hearings,* La Ronge, Saskatchewan, October 1, 1996, p. 81.

For the current review, the panel modified the general process to include a panel-proponent information meeting after the EIS had been received and examined. The meeting assisted the panel in its determination of the adequacy of the EIS. The information meeting took the form of a structured, but informal, round table discussion of the project by the panel and the proponents. The meeting, its agenda and procedures were announced in advance. Members of the public, representatives from governments, media people and other interested persons attended as observers. During the course of the one-and-a-half day meeting, the proponent described its project under a set of preselected topics and answered questions from the panel members. The result was a lively discussion in which the panel members obtained a clearer understanding of the proposal and the proponent had an opportunity to explain its EIS while learning of the panel's concerns.

As a consequence of the information meeting, it was easier to accommodate greater public participation in the subsequent public hearings. Because the panel members had been able to receive responses to many of their concerns during the information meeting, most of the time during hearings was dedicated to concerns raised by the public and representatives of the governments. Although this approach introduced an additional step into the review process, the consensus from the panel and the proponent[91] was that it improved the overall efficiency of the hearings.

> *. . . when you elected to organize the technical sessions last spring to identify early in the review process issues which required clarification in order to facilitate these subsequent meetings. This was an innovative and effective approach, and frankly we believe it has paved the way for better communications during the hearings, and in turn, we believe that it helped make the public process participatory.*
>
> Bernard Michel, President, Cameco Corporation, *Transcript of Public Hearings,* Pinehouse, Saskatchewan, October 7, 1996, p. 142.

13.3 Revenue Sharing

It is evident from their words and actions that northern leaders wish to have the issue of revenue sharing resolved in a political forum rather than as part of the environmental review process. We agree with that approach and urge both levels of government to become involved in a multipartite discussion of revenue sharing with northern leaders.

The issue of revenue sharing is broader than most others dealt with in this review and it should not be resolved at the expense of any single industry and its employees and contractors. It is clear, however, that uranium mining would likely receive wider acceptance by the residents of northern Saskatchewan if a comprehensive program of revenue sharing were in place. We, therefore, recommend that both levels of government give serious consideration to the initiation of a program of revenue sharing at the earliest possible date.

We are aware that the concept of revenue sharing will be difficult to implement because of the many levels of government involved and the numerous overlapping issues indicated in figure 5. Despite these complexities, it should be possible for people of good will to find a compromise that is equitable to all. We urge that the process begin.

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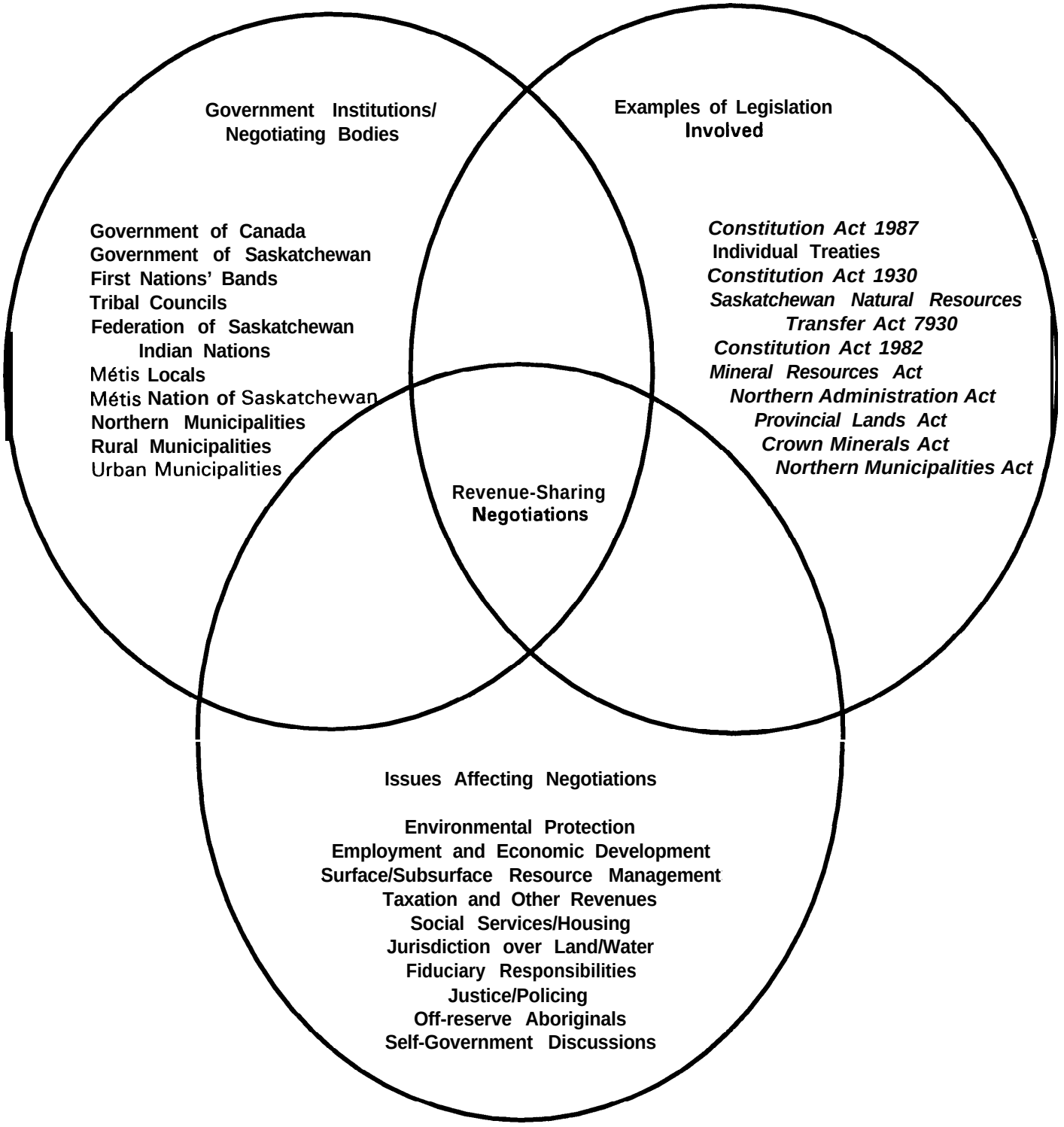
[91] B. Michel, *Transcript of Public Hearings for McArthur River and Cigar Lake, Pinehouse, Saskatchewan,* October 7, 1996, p. 142.

FIGURE 5
Some Factors Affecting Revenue-Sharing Negotiations



13.4 Regulation

13.4.1 Public Participation

Many of the environmental impacts of this project cannot be predicted with certainty in advance. It is conceivable that unexpected developments, large and small, could occur with the potential to cause environmental damage. It is for this reason that the public must have a great deal of trust in the mine regulators. It is they who have the responsibility to ensure that the project is completed in accordance with the commitments made by the proponents and the decisions taken by the ministers responsible for approving this project. And it is they who will have to approve or reject any proposed modifications If there is public mistrust of the regulators, the uranium mining industry will never be accepted by northern people who fear that their air, water and/or food might be contaminated.

One way to foster greater trust is to provide the public with an opportunity to participate in the regulatory process. Such participation should be at an early enough stage to influence decisions. It is not sufficient to explain why a decision was taken, after the fact. It is clear that northerners wish to be involved at a much earlier stage in the decision-making process.

The Environmental Quality Committees provide a forum through which public participation can be solicited on a routine basis. Meaningful communication between the regulators and the Environmental Quality Committees is essential, as is the need for periodic community meetings.

> *... we seem to be making it easier or that it is easier for the ones who are mining uranium to get permits to dump toxic waste -- radioactive waste in to lakes, to dig up lakes, to dam lakes. /t is easier to get permission to do that it seems than it was for me to get permission to build my outhouse 500 metres from the edge of the lake. / find this very curious.*
>
> Joys Dancer, ***Transcript of McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 19, 1996, p. 10.

13.4.2 Cooperation/Harmonization

Both the provincial and federal governments have responsibilities for licensing and regulating uranium mining, a fact which the public and the industry find confusing and inefficient. Although each government department has a specific mandate, it often appears that there is overlap between departments, and between governments. The South Central Environmental Quality Committee stated its perception:

> *... there is presently a somewhat non-coordinated approach to uranium mining regulation in northern Saskatchewan, and ... The multiplicity of federal and provincial regulatory and advisory agencies often work at cross purposes to each other and with much duplication of effort ...*[92]

It would be simplistic to suggest that only one department and one government be responsible; in fact, the panel heard the fear that restricting regulation and licensing to the province alone would be risky.

> *... provincial authorities could be unduly influenced by industry, being smaller and more in a position to be influenced, ... whereas the federal government being larger and a national force would not be put...in that compromising position.*
>
> Neil Sinclair, ***Transcript of the McArthur River Public Hearings,*** Saskatoon, Saskatchewan, September 9, 1996, p. 7.

The public demands assurance that there is adequate protection in place to safeguard health and protect the environment; the industry and its employees require clear direction:

> *Companies, working people and unions need clear, strong, up-to-date and enforceable legislation and regulations ... (and) ... Governments need to enforce legislation and*

[92] South-Central Environmental Quality Committee, ***Submission to the McArthur River Public Hearings,*** La Ronge, Saskatchewan, October 1, 1996, p. 3.

> *regulations in a fair and unequivocal manner.*[93]

In Sections 9.1 and 9.2, the panel commented about the need for clarifying responsibility in the area of conventional health and safety, and for harmonizing efforts for radiation monitoring. During the review, several comments were made concerning the need for cooperation on other matters between the federal and provincial regulators. At a time of scarce public resources, cooperation is a practice that governments cannot afford to neglect. It would not only reduce red tape for the operators of the mine but also make it easier for interested members of the public to research mine impacts.

Harmonization of federal and provincial regulations would reduce confusion and increase efficiency; it is an appropriate long-term goal. Initiatives presently being undertaken by federal and provincial officials to eliminate overlap and regulatory duplication, under the Efficiency of the Federation Initiative, are encouraging.

13.5 Nuclear Non-Proliferation

Although the Government of Canada prohibits the use of Canadian uranium in nuclear explosive devices, it permits the sale of uranium to foreign buyers in accordance with its policy of fungibility. This policy requires that, for all Canadian uranium sold, an equivalent quantity must be accounted for in non-military applications. However, no process exists to separate Canadian uranium from uranium acquired from other sources. The policy of fungibility, therefore, fails to provide assurance to the public that Canadian uranium will not be used in weaponry.

> *While both levels of government proclaim concern for non-proliferation in their rhetoric and their press releases, they do not practise what they preach if there are economic benefits to be gained from making uranium and reactor sales.*
>
> Peter Prebble, Saskatchewan Environmental Society, *Transcript of McArthur River Public Hearings,* Saskatoon, Saskatchewan, September 16, 1996, p.157.

Also at issue is the continued sale of Canadian uranium to countries which have recently tested nuclear weapons or otherwise violated the intent of internationally ratified agreements, such as the Nuclear Non-Proliferation Treaty, to which Canada is a signatory. Further, some members of the public expressed their concern over ongoing uranium mining activities in Canada by companies owned by the governments of these same countries.

A participant suggested that Canada might address these concerns by revoking the licence of companies owned by foreign governments that test nuclear weapons and/or by prohibiting, for a period of five years, sales of uranium to countries that have violated the Nuclear Non-Proliferation Treaty.[94] Such a measure could prove to be a powerful incentive for governments to comply with international agreements to which they and Canada are signatories.

13.6 The Key Lake Tailings Management Facility

The existing above-ground tailings management facility contains tailings produced from the milling of Key Lake ore over the past two decades. Cameco indicated in the EIS that it might wish to process these tailings for their nickel content, using the reserve capacity of the DTMF to dispose of tailings produced from the process. This appears to be an attractive possibility because it would result in the transfer of above-ground tailings into the pit and reduce the amount of nickel that might eventually be released as a serious contaminant. One site of long-term environmental liability would thereby be eliminated. Although not part of the current review, the panel supports this option, conditional on careful study of the possible impacts and a separate environmental review.

13.7 Conclusions and Recommendations

The panel wishes to acknowledge the positive responses that the federal and provincial governments have made to recommendations in its previous reports. Their obvious attention to the contents of the reports and their efforts to implement the recommendations are an indication of their commitment to the environmental assessment process.

It is recommended that the federal and provincial governments enter into a multipartite discussion with northern leaders to design and implement a comprehensive program of revenue sharing for northern Saskatchewan.

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[93] United Steelworkers of America, *Submission to the McArthur River and Cigar Lake Public Hearings,* Saskatoon, Saskatchewan, September 9, 1996, p. *4.*

[94] P. Prebble, *Transcript of McArthur River Public Hearings, Saskatoon, Saskatchewan,* September 16, 1996, p. *156.*

The panel recognizes that issues related to nuclear weapons proliferation are outside of its mandate, but wishes to bring concerns expressed by some members of the public over the possible use of Saskatchewan uranium for military purposes to the attention of the federal government. Serious consideration should be given by the government to the measures proposed by the public.

Cooperation between provincial and federal agencies that regulate uranium mining could reduce the costs for these services, simplify compliance for the operators and make it easier for interested members of the public to research mine impacts.

JOINT FEDERAL-PROVINCIAL PANEL
ON
URANIUM MINING DEVELOPMENTS IN NORTHERN SASKATCHEWAN

— MCARTHUR RIVER PROJECT —

Dr. Donald Lee
Chairperson

Dr. James Archibald

Dr. Richard Neal

APPENDIX A - PANEL MEMBER BIOGRAPHIES

DONALD LEE (Chairperson)

Dr. Lee is Professor of Chemistry at the University of Regina and past President of Luther College. A native of Saskatchewan, he has a Master of Arts degree from the University of Saskatchewan, a Ph.D. in Chemistry from the University of British Columbia and has completed postdoctoral studies at Harvard University. Dr. Lee has been a member of the faculty at the University of Regina since 1967 and has served as a visiting professor at the University of North Carolina, Stanford University and the University of Oslo. He has published over ninety scientific papers and numerous non-scientific articles.

Active in community affairs for many years, Dr. Lee has been Chairman of the Saskatchewan section of the Chemical Institute of Canada, Executive Member of the Saskatchewan Association of Independent Schools, a national official of the Canadian Amateur Swimming Association, and President of the Regina Optimist Dolphin Swim Club.

JAMES F. ARCHIBALD

Dr. Archibald received his Ph.D. in Mining Engineering at Queen's University and is a Professor in the Department of Mining Engineering at Queen's His work experience is primarily in the academic field and includes associated private consultation with national and international mining organizations. Dr. Archibald is a member of the Canadian Institute of Mining and Metallurgy (CIM), the CIM Backfill Sub-Committee (Rock Mechanics Group) and the American Institute of Mining Engineers,

Dr. Archibald's research interests include measurement and control of radiation hazards in underground mines, mine ventilation systems, in-situ stress analysis, rock burst prediction and structural mine design evaluation, Dr. Archibald is a member of the Nuclear Fuel Waste Management and Disposal Scientific Review Group examining the concept of deep geologic disposal of nuclear fuel waste.

RICHARD NEAL

Dr. Neal is Professor of Biology and Associate Dean (Academic) of the College of Arts and Science, University of Saskatchewan. He received both his Bachelor of Science and Ph.D. in Zoology from the University of Southampton, U.K. Dr. Neal has been a member of the Department of Biology at the University of Saskatchewan since 1968, and has taught extensively in the field of biology.

Dr. Neal's research interests include population ecology and a broad range of environmental issues, including impacts of uranium, potash and molybdenum mines and effects of pesticides on prairie ponds and duck populations. Dr. Neal is actively involved in a number of professional organizations and has been the Chairman of the Environmental Advisory Committee of the City of Saskatoon.

APPENDIX B - TERMS OF REFERENCE

TERMS OF REFERENCE FOR THE ENVIRONMENTAL ASSESSMENT REVIEW OF URANIUM MINING DEVELOPMENT

MANDATE

1. The panel shall review the environmental, health, safety and socio-economic impacts (hereinafter referred to as "impacts") of the proposed uranium mine developments (listed in Schedule A) in northern Saskatchewan and assess their acceptability.

   In assessing the acceptability of the proposed developments, the panel will include in its review and consider:

   a) the historical experience with past and existing uranium mining operations in Saskatchewan;
   b) the cumulative impacts of existing operations and the proposed developments;
   c) the short and long term impacts of the proposed projects, spanning their construction phase, operating period, decommissioning phase and post-decommissioning phase;
   d) the impact of employment and socio-economic opportunities afforded northern residents by the proponents and the measures necessary for implementation of those opportunities;
   e) the adequacy of measures proposed by the project proponents to protect environmental quality and to safeguard worker health and safety, and whether the measures can be expected to meet the requirements of Canadian and Saskatchewan law, regulations and policies applicable to uranium mine developments;
   f) the adequacy of monitoring, enforcement and compliance systems to ensure that measures necessary for mitigating adverse impacts can be implemented; and
   g) the benefits afforded by the proposals.

2. The panel shall determine from its review whether a project is acceptable or unacceptable.

   In concluding that a project is acceptable, the panel may recommend that specified minimum terms and conditions, including any mitigative measures or any other measures relating to the impacts under the panel's review, be implemented where it considers these necessary for the protection of health, safety and the environment or for dealing responsibly with socio-economic concerns. The panel may also suggest measures that it considers would enhance the acceptability of the proposals.

   If the panel concludes a project is unacceptable, it shall provide its reasons for this conclusion.

3. In fulfilling its mandate, the panel shall provide full opportunities for public consultation and review.

REVIEW PROCEDURES

Detailed written procedures for conducting the review shall be established by the panel and made available to the public.

TECHNICAL EXPERTS

The panel may secure the services of independent technical experts to assist and advise on complex technical and/or socio-economic issues related to its mandate. Such experts will also be available to respond to inquiries from review participants.

STAGES OF THE REVIEW

Schedule A lists the five proposals to be reviewed by the panel. The five proposals have been referred due to potentially significant or unknown adverse environmental effects and public concern.

While all of the proposals are in the planning stage, some are further advanced than others. Environmental Impact Statements (EIS) have been prepared for the first three proposals listed in Schedule A, one of which (Dominique-Janine extension) is associated with the existing operating uranium mining facility and two of which are for new uranium mining facilities. EIS documents have yet to be prepared for the last two proposals listed in Schedule A. The panel will take the differing stages of these projects into consideration in scheduling its review.

The panel will seek public comment on the three available EIS's and determine their adequacy before proceeding to public hearings. When the panel is satisfied with the

information provided, including that with respect to the cumulative impacts, it may report on one or more of these projects to the Ministers as described in the following stages of the review. The panel shall submit its final report(s) on these proposals within 18 months of its appointment.

In reviewing the remaining two proposals, the panel will conduct scoping sessions in appropriate communities to solicit public comment and, based on these comments and its own consideration, prepare and issue Guidelines to the respective proponents for the preparation of EIS's. The cumulative impacts of these two proposals will be considered when the EIS documents have been submitted. The stages of the review following submission of these documents to the panel are outlined below. The panel shall submit its final report(s) on these two proposals within 18 months of receipt of the proponents' EIS's.

1. Review of Information

   a) Review of the available information on the environmental, health, safety and socio-economic impacts of the uranium mining industry in Saskatchewan to date. The information and any related reports prepared will be made available to the public.
   b) Review of the past performance of the uranium mining industry in providing employment and socio-economic opportunities to northern residents. The information and any related reports prepared will be made available to the public.
   c) Review by the panel of Environmental Impact Statements (EISs) submitted by the proponents. The EISs will also be made available to the public for review and written comment.
   d) The panel may draw on proponents, technical agencies from within federal or provincial governments, independent experts and the public for available information.

2. Should the panel, after reviewing the above information and considering public comments, deem an EIS deficient it may request additional information from the project proponent.

3. Once the panel is satisfied with the information provided, it will announce public hearings for the project in question. If appropriate, the hearings may be structured to address more than one project.

   For the purposes of promoting public awareness and facilitating public comment, the panel will hold meetings and/or hearings in the appropriate northern communities, Regina, Saskatoon and in such other Saskatchewan communities as the panel may think necessary.

4. When the panel is in a position, following the completion of public hearings, to provide a report on its findings, conclusions and recommendations relevant to a specific project, it will submit the report to the federal Ministers of Environment and of Energy, Mines and Resources and to the Saskatchewan Minister of Environment and Public Safety.

   The panel should, to the extent possible, ensure that the timely review of a specific project is not jeopardized by delays in the review of another project included in its mandate.

LINKAGE TO OTHER POLICY PROCESSES

The panel is not expected to interpret its mandate so as to duplicate the work of other public inquiries and policy processes or to focus on national or international issues which are not directly related to the impacts of the proposals.

However, concerns may be raised by the public which extend beyond the impacts of direct concern to the panel, and in such cases the panel will ensure that the public is provided a reasonable opportunity to express these concerns.

SCHEDULE A

EIS Submitted

1. Dominique-Janine Extension
   Amok Ltd.
2. South McMahon Lake Project
   Midwest Joint Venture (Denison Mines Ltd.)
3. McClean Lake Project
   Minatco Ltd.

EIS to be Prepared

4. McArthur River Project
   McArthur River Joint Venture (Cameco Corporation)
5. Cigar Lake Project
   Cigar Lake Mining Corporation

APPENDIX C - PANEL ACTIVITIES

- Joint public review announced and terms of reference issued by Robert de Cotret, Minister of the Environment, and Grant Hodgins, Minister of Saskatchewan Environment and Public Safety, April *18,* 1991

- Joint review panel members appointed by Beattie Martin, Minister of Saskatchewan Environment and Public Safety, and Jean Charest, Minister of the Environment, August 22, 1991

- Panel toured all proposed mine development sites, October 1-6, 1991

- Panel's operational procedures released, December 19, 1991

- EISs received and released for 90-day public review as follows:

  Midwest Joint Venture, December 19, 1991
  (deadline date for submissions March 20, 1992)
  McClean Lake Project, January 13, 1992
  (deadline date for submissions April 13, 1992)
  Dominique-Janine Extension at Cluff Lake, March 31, 1992
  (deadline date for submissions June 30, 1992)

- Deadline date for public submissions for MJV and McClean Lake extended to May 29, 1992

- Scoping meetings for Cigar Lake and McArthur River announced January 7, 1992, to begin February 7, 1992

- Dates and locations of scoping meetings announced January 22, 1992, with meetings held as follows:

  February 7, 1992
  Ben McIntyre School, Uranium City
  February 8, 1992
  Fond du Lac Band Hall, Fond du Lac
  February 10, 1992
  Community Hall, Stony Rapids
  February 10, 1992
  Community Hall, Black Lake
  February 11, 1992
  Hatchet Lake Band Hall, Wollaston Lake
  February 12, 1992
  Arena Hall, La Loche
  February 13, 1992
  Complex Hall, Buffalo Narrows
  February 14, 1992
  Community Hall, Ile-a-la-Crosse
  March 2, 1992
  Ramada Renaissance, Regina
  March 3, 1992
  Holiday Inn, Saskatoon
  March 4, 1992
  Marlboro Inn, Prince Albert
  March 5, 1992
  Kikinahk Centre, La Ronge

- Modifications to the Midwest Joint Venture and McClean Lake proposals issued May 6, 1992

- Technical reviews of Midwest Joint Venture and McClean Lake projects, as prepared by Ecologistics Limited, released by the panel May 29, 1992

- Draft guidelines for EIS preparation and government information requests for Cigar Lake and McArthur River issued June 1, 1992, for public review until July 3, 1992

- Summary report on scoping meetings for Cigar Lake and McArthur River, prepared by Quadra Planning Consultants Ltd., released by the panel, August *19, 1992*

- *Guidelines for the Preparation of Environmental Impact Statements and Government Information Requests for the Cigar lake and McArthur Projects,* issued by the panel, September *11, 1992*

- *Request for Additional Information* issued to Amok Ltd. on October 7, 1992

- Amendments for Midwest Joint Venture and McClean Lake EIS issued October 30, 1992, for a public review period ending November 30, 1992

- EIS on McArthur River Project Underground Exploration Program, July 1992, and Addendum, October, 1992, referred to the panel for public review on October 29, 1992, with review period ending December 2, 1992

- **Dates and locations for public hearings on McArthur River Underground Exploration Project announced November 1, 1992; hearings held as follows:**

  December 3, 1992
  Hotel Saskatchewan, Regina
  December 4-5, 1992
  Holiday Inn, Saskatoon
  December 6, 1992
  Community Hall, Fond du Lac
  December 7, 1992
  Community Hall, Black Lake
  December 8, 1992
  Hatchet Lake Band Hall, Wollaston Lake
  December 9, 1992
  Community Hall, Pinehouse
  December IO, 1992
  Kikinahk Centre, La Ronge

- **Total Minatco's response to panel's *Request for Additional Information* on the McClean Lake project released on December 15, 1992, for a public review period ending January 15, 1992**

- **Panel released commissioned reports December 15, 1992, as follows:**

  ⇒ ***Health in the Con text of Uranium Mining in Northern Saskatchewan,*** **Ed Weick, ESAS**
  ⇒ ***An Overview of the Biophysical Environmental Impact of Existing Uranium Mining Operations in Northern Saskatchewan,*** **Dr. Herman Dirschl, ESAS**
  ⇒ ***A Brief Historical Review of the Beaverlodge Mining Area of Northern Saskatchewan,*** **R. Barsi and Dr. A.W. Ashbrook**
  ⇒ ***A Socio-Economic Overview of Uranium Mining in Northern Saskatchewan,*** **Ed Weick, ESAS**
  ⇒ ***Review of the Cluff Lake and Key Lake Reports,*** **L. Vigrass**

- **Panel released Midwest Joint Venture's response to its *Request for Additional Information* on December 23, 1992, for a public review period ending, January 22, 1993**

- **Panel released specialists' report, *Assessing Cumulative Effects of Saskatchewan Uranium Mines Development,* on January 8, 1993**

- **Panel submitted *McArthur River Underground Exploration Program* report to federal and provincial governments on January 15, 1993**

- **Cogema's (formerly AMOK) response to the panel's *Request for Additional Information* released February 8, 1993, for a public review period ending March 5, 1993**

- **Public hearings dates and locations for Dominique-Janine, McClean Lake and Midwest Joint Venture proposals announced on February 19, 1993, with changes announced on March 26 and April 26, 1993. Hearings were held as follows:**

  March 22-24, 1993
  Hotel Saskatchewan, Regina
  April 13, 1993
  Community Hall, Black Lake
  April 14, 1993
  Hatchet Lake Band Hall, Wollaston Lake
  April 15-l 6, 1993
  Kikinahk Centre, La Ronge
  April 16, 1993
  Friendship Centre, Ile-a-la-Crosse
  April 19, 1993
  Complex Hall, Buffalo Narrows
  April 20, 1993
  Arena Hall, La Loche
  April 21, 1993
  John M. Cuelenaere Library, Prince Albert
  May 3-5, 1993
  Holiday Inn, Saskatoon
  May 7-8, 1993
  Holiday Inn, Saskatoon
  May 17-20, 1993
  Holiday Inn, Saskatoon

- **Panel submitted *Dominique-Janine Extension, McClean Lake Project and Midwest Joint Venture,* its report on those proposals, to federal and provincial governments on October 15, 1993**

- **New proposal for development of the Midwest ore body, proposed by Cogema Resources Inc., referred by Sheila Copps, Minister of the Environment, and Berny Wiens, Minister of Saskatchewan Environment and Resource Management, November 9, 1994, to the joint panel**

- **EIS on Midwest Project released for a 60-day public review August 31, 1995**

- **EIS for the Cigar Lake proposal released October 4, 1995, for a 90-day public review**

- **Public panel-proponent information meeting for the Midwest Project convened November 15-l 6, 1995, at the Legion Hall, La Ronge**

- *Request for Additional Information* on the Midwest Project issued to Cogema Resources Inc. by the panel on December 8, 1995

- EIS for Cameco Corporation's McArthur River proposal released December 11, 1995, for a 90-day public review

- Public panel-proponent information meeting for the Cigar Lake proposal held January 23-24, 1996, Legion Hall, La Ronge

- *Request for Additional Information* issued to Cigar Lake Mining Corporation by the panel, February 20, 1996

- Response to the panel's *Request for Additional Information* on the Midwest Project released on March 4, 1996, for a public review period ending March 18, 1996

- Public panel-proponent information meeting for the McArthur River project held March 21-22, 1996, Legion Hall, La Ronge

- Response to panel's *Request for Additional Information* from Cigar Lake Mining Corporation released on April 1, 1996, for a public review period ending May 1, 1996

- Panel issued a second request for information on the Midwest Project to Cogema Resources Inc. on April 12, 1996 and received the supplementary information on May 13, 1996

- *Request for Additional Information* issued to Cameco Corporation on the McArthur River proposal on April 17, 1996

- Dates and locations for public hearings on the Midwest Project announced on April 25, 1996; hearings were held as follows:

  May 27-31, 1996
  Ramada Hotel, Saskatoon
  June 4-5, 1996
  Kikinahk Centre, La Ronge
  June 6, 1996
  Fond du Lac Band Hall, Fond du Lac
  June 7, 1996
  Black Lake Band Hall, Black Lake
  June 8, 1996
  Father Megret School, Wollaston Lake
  June 1 O-l 2, 1996
  Regina Inn, Regina
  June 13-l 5, 1996
  Ramada Hotel, Saskatoon

- Response to panel's *Request for Additional Information* from Cameco Corporation on the McArthur River proposal released on June 18, 1996, for a public review period ending July 18, 1996

- Panel issued a second request for information on the Cigar Lake Mining Corporation on May 11, 1996 and received the supplementary information on July 18, 1996, for a 30-day public review period ending August 18, 1996

- Dates and locations for public hearings on the Cigar Lake and McArthur River projects announced on July 18, 1996, as follows:

  September 4-6, 1996
  Regina Inn, Regina
  September 9-l 8, 1996
  Ramada Hotel, Saskatoon
  October 1-2, 1996
  Kikinahk Centre, La Ronge
  October 3, 1996
  Father Megret School, Wollaston Lake
  October 4, 1996
  Community Hall, Stony Rapids
  October 5, 1996
  Fond du Lac Band Hall, Fond du Lac
  October 7, 1996
  Kateri Hall, Sandy Bay
  October 8, 1996
  Band Hall Gymnasium, Montreal Lake
  October 9, 1996
  Community Hall, La Loche
  October 10, 1996
  Mezzanine, Beauval Arena, Beauval
  October 11, 1996
  Community Hall, Patuanak

- Additional public hearing session, September 19, 1996 in Saskatoon, announced on August 16, 1996

- Panel announces reopening of Midwest review, and postponing of Cigar Lake technical sessions on tailings disposal, to permit public review of changed proposal for tailings disposal, August 26, 1996

- **Public hearings for the McArthur River and Cigar Lake proposals held as follows:**

  September 4-6, 1996
  Regina Inn, Regina
  September 9-l 9, 1996
  Ramada Hotel, Saskatoon
  October 1-5, 1996
  Kikinahk Centre, La Ronge
  October 7, 1996
  Community Hall, Pinehouse

APPENDIX D - SUBMISSIONS TO PANEL

Oral Presentations Made at Public Hearings

Abrahamson, Mervyn
AGRA Earth & Environmental Limited (Andy Small)*
Annie Johnstone Pre-School (Caroline Ratt)
Association of Consulting Engineers of Saskatchewan (Phil Bruch)*
Association of Professional Engineers of Saskatchewan (Henry Feldkamp, Dennis Paddock) *
Athabasca Catering Ltd. Partnership (William Smith) *
Athabasca Working Group (Chairperson Janet Holmgren, Georgina MacDonald, Councillor Margaret Powder, Mayor Victor Robillard) *
Atomic Energy Control Board (Fred Ashley, Larry Chamney, Peter Courtney, Stan Isanen, Rick McCabe, Rick McCabe, Tom Viglasky)"

BCP Engineering (Michelle Cabalt) *
Beauval, Northern Village of (Deputy Mayor Elaine Malbeuf) *
Betanger, Buckley
Black Lake First Nation (Vice Chief Alan Adam, Elder Pierre Robillard, Chief Ron Robillard)
Boyd, Laura
Angus Butler Engineering (Jerry Helfrich) *

Caisse, William
Cameco Corporation (Doug Beattie, Chuck Edwards, Stan Frost, Nick Holl, Tom Jackson, Brian Jamieson, Jim Lauritzen, Jamie McIntyre, Bernard Michel, Rita Mirwald, Cam Osler, Bob Phillips, Bob Steane, John Takala, Mark Wittrup)"
Can Am Construction (Jean Poirier)"
Canadian Nuclear Association (Murray Stewart) *
Carle, Gordon
Chambers, Dr. Doug
Charles, Tom
Chary, Dr. Srini
Cogema Resources Inc. (Alain Marvy, Liz Quarshie) *
Container Port of Saskatchewan (Jerry Hnatiuk)"

Daigneault, Larry
Dancer, Joys
Dantouze, Vice Chief John*

Environment Canada (Bill Howard, Dr. Dennis Lawson) *

Federation of Saskatchewan Indian Nations (Vice Chief Alan Adam) *
Fisheries and Oceans Canada (Bruce Fallis, Dr. Ray Hesslein, Dr. Jack Klaverkamp, Dr. Lyle Lockhart, Paul Wilkinson) *
Flath, Tom
Francis, Mai
Fond du Lac First Nation (Chief Caroline Isadore)
Fortugno, Maria

Golder Associates (Laurent Gareau) *
Government of Saskatchewan (Jane Forster, Ray McKay, Tony Penikett) *
Gurney, Penny*

Hatchet Lake First Nation (Chief Emil Hansen)
Haukley, Daryl
Haynes, Stephen
Hinds, Bob

Indian and Northern Affairs Canada (Michel Blondin, Maurice LaFond) *
Inter-Church Uranium Committee (Michael Poellet) *
International Uranium Congress (Michelle Kowalski, Dan Parrott) *

Jackson's Lodge (Tom Jackson)
JNE Welding (Jim Nowakowski) *

Kilborn Western Inc. (Bruce Leech)"
Kitsaki Development Corporation (Dave McIlmoyl)
Kossick, Don
Kramer Ltd. (Tim Kramer)"
Kustiak, Cory

La Loche, Northern Village of (Deputy Mayor John Janvier)
La Ronge/Air Ronge Economic Development Committee (Angus Pratt, Morris Gabrush) *
Lush, Don

McLeod, Bob
McCallum, Glen
McNulty, Tom

Metis Addictions Council of Saskatchewan (Hannah Natomagen)
Mid-North Safety (Martin Arndt) *
Millennium III Properties Corporation (Everett Kearley) *

Natomagen, Clarence
Natomagen, Roxanne
Natural Resources Canada (Grant Feasby, Carmel Letourneau, Rennie Tupper, Bob Whillans) *
Nature Saskatchewan (Curt Schroeder) *
Northern Health Services (Charlotte Ratt, Neil McLeod)
Northern Dene Airways Ltd. (Dave Webster)"
Northern Resources Trucking (Dwayne Hounsell, Roger Olyowsky) *
Northlands College (Peter Mayotte, Bill McCallum) *
Northwest Municipalities Association (Mayor Joe Daigneault, Mayor Max Morin)"

O'Sky Yak Horizons (Tom Sanderson)

PCL Construction Management Inc. (Anibal Valente) *
Penna, Angela
Penna, Dr. James"
Penna, Marion *
Penna, Phillip *
Peterson, Todd
Plunz, Mike
Points North Freight Forwarding Inc. (George Eikel)"
Pinehouse, Northern Village of (Rene Rediron, Mayor Greg Ross) *
Prince Albert Development Corporation (Trevor Ives) *
Probert, Rodney

Ratt, Charlotte
Recovery Lake (Leonard McCallum)

Sandy Bay, Northern Village of (Mayor Ina Fietz Ray)"
Saskatchewan Association of Rehabilitation Centres (Carl Kwiatkowski) *
Saskatchewan Chamber of Commerce (Jim Glass)"
Saskatchewan Construction Association (Manley McLachlan) *
Saskatchewan Energy and Mines (Jane Forster) *
Saskatchewan Environment and Resource Management (William Caisse, Tom Gates, Rob Kidd, Malcolm Ross, John Schisler, Randy Sentis, Ron Zukowsky) *
Saskatchewan Environmental Society (Ann Coxworth, Peter Prebble) *
Saskatchewan Health (Dr. James Irvine) *
Saskatchewan Highways (Stu Armstrong) *
Saskatchewan Labour (Brian Allan, Dr. Ernest Becker, Jeff Parr)"
Saskatchewan Mining Association (Bob Cunningham)*
Saskatchewan Northern Affairs (Ray McKay, Richard Turkheim)
Saskatchewan Northern Mines Monitoring Secretariat (Pam Schwann)
Saskatchewan Risk Assessment Society (Dr. Ralph Cheesman) *
Saskatchewan Uranium Coalition (Dr. Marvin Resnikoff) *
Saskatoon City Hospitals Foundation (Randy Kershaw) *
Saskatoon and District Chamber of Commerce (Kenneth Ziegler) *
Saskatoon Regional Economic Development Authority (John Hyshka) *
Septre Controls (Larry Bohn) *
Shearer, Craig
Shiell, Maisie"
Shumard, Shirley
Simpson, Graham
Sinclair, Neil *
Smith, Fred
Smith, Martin
Snake Lake Construction (Rene Rediron)
South Central Environmental Quality Committee (Bill Layman, Greg Ross)"
Steinhausler, Dr. Fritz
Stilborn, Dan
Stomp, Mayor Gordon
Strnad, Dr. George
Synergy Today (Rob Phillips) *

Taylor, A.S. *
Thomas, Dr. Pat"
Tinker's Enterprises (Philip Tinker)
Tippo Forrest Products (Glen McCallum)
TriKon North General Contractors Ltd. (Ron Hemeon) *

United Steel Workers of America (Ken Neumann, Gordon Telfer, Bernie Welke) *
Uranerz (Al Shpyth)
Van Waters & Rogers (Lionel DeBray) *

Weingeist, Karen *
West Wind Aviation (Chris Tabler) *
Wood, Lee
Workplace Education Consortium of Saskatchewan (Phyllis Ramsden) *

Young, Tom

"A written submission was supplied to accompany the oral presentation, and is available for public review.

Written Submissions

Buff alo Narrows, Northern Village of (Mayor Bobby Woods)

Canadian Nuclear Workers Council of Canada (Dave Shier)

English River First Nation (Chief Archie Campbell)
Environmental Quality Committees (Athabasca, West Side)

Health Canada (Donna Clarke)

Lawrence, Steve

Northwest M&is Development Corporation
(Norm Johnson)

Points North Construction Ltd. (Bob Westgard)

Strnad, Dr. J.G.

Thyssen Mining Construction of Canada Ltd.
(Volker Ebert)

Uranerz Exploration and Mining Company
(Dr. Hikmet Akin)

APPENDIX E - BIBLIOGRAPHY OF REVIEW DOCUMENTS

Guidelines for the Preparation of Environmental Impact Statement and Government Information Requests for the Cigar Lake and McArthur River Projects, Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan, September 1992.

McArthur River Project Environmental Impact Statement, Cameco Corporation, December 1995.

- Request for Additional Information on the McArthur River Project, requested by the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan, April 1996.

- McArthur River Project Additional Information, Cameco Corporation, June 1996.

APPENDIX F - PARTICIPANT FUNDING PROGRAM

SUMMARY OF ALLOCATIONS
McARTHUR RIVER PUBLIC REVIEW

INDIVIDUAL/ ORGANIZATION	DESCRIPTION OF WORK FUNDED	AMOUNT RECEIVED
Dr. Patricia Thomas	To review the Environmental Impact Statement to determine if the baseline environmental data are complete for future monitoring efforts at the site. To prepare brief to be presented to the Panel at the public hearings.	$ 4,000.00
Saskatchewan Uranium Coalition	To review the Environmental Impact Statement focusing on the health and environmental effects of wastes from the proposed mine. To prepare a brief to be presented to the Panel at public hearings.	$1 o,ooo.oo
La Ronge/Air Ronge Community Development Corporation	To review the Environmental Impact Statement to identify opportunities that northern businesses can develop as a result of the expansion in mining activities. To prepare a brief to be presented to the panel at public hearings.	$ 2,500.00
Prince Albert Grand Council Management Co. Ltd.	To review the Environmental Impact Statement in terms of the project's potential social, economic and environmental impacts on First Nation members residing in the Athabasca region. To prepare a brief to be presented to the panel at the public hearings.	$15,000.00
Meadow Lake Tribal Council and the Federation of Saskatchewan Indian Nations	To review the Environmental Impact Statement in terms of the cumulative social and economic impacts of the uranium mines in northern Saskatchewan. To prepare a brief to be presented to the panel at public hearings.	$15,000.00
Northern Village of Buffalo Narrows	To review the Environmental Impact Statement to ensure that environmental, health and safety concerns are addressed. To prepare a brief to be presented to the panel at hearings.	$ 2,500.00
Kikinahk Friendship Centre	To review the Environmental Impact Statement regarding the race relations impacts of the uranium mining industry. To prepare a brief to be presented to the panel at hearings.	$ 5,000.00
English River First Nation	To review the Environmental Impact Statement for impacts on traditional hunting, trapping and fishing areas. To review the cumulative impacts and probable effects on employment. To prepare a report to be presented to the panel at public hearings.	$ 8,000.00
Maisie Shiell	To review the Environmental Impact Statement and participate in the public hearings.	$ 1,000.00
Hatchet Lake Band	To review the Environmental Impact Statement and consult members regarding the proposal's impacts on the community and how they can be mitigated. To prepare a brief to be presented to the panel at the public hearings.	$12,000.00
	TOTAL	$75,000.00