



2009 Annual Report on Uranium Management Activities

A Joint Report by the Canadian
Nuclear Safety Commission
and Environment Canada



Government
of Canada

Gouvernement
du Canada

Canada

2009 Annual Report on Uranium Management Activities

© Minister of Public Works and Government Services Canada 2010

Catalogue number CC171-9/2009E-PDF

ISBN 978-1-100-17805-9

Published by the Canadian Nuclear Safety Commission (CNSC)

Catalogue number: INFO-0812

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

Également publié en français sous le titre de :

Rapport annuel 2009 sur les activités de gestion de l'uranium

Document availability

This document can be viewed on the CNSC Web site at nuclearsafety.gc.ca.

Canadian Nuclear Safety Commission

280 Slater Street

P.O. Box 1046, Station B

Ottawa, Ontario K1P 5S9

CANADA

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

Facsimile: 613-995-5086

E-mail: info@cnsccsn.gc.ca

Web site: nuclearsafety.gc.ca

Cover Images

Top: McArthur River Scoop tram

Bottom: Rabbit Lake

TABLE OF CONTENTS

EXECUTIVE SUMMARY	5
1. INTRODUCTION	8
2. URANIUM RELEASES TO THE ENVIRONMENT	10
2.1 Uranium Mines and Mills	13
2.1.1 Rabbit Lake Mine and Mill	15
2.1.2 Key Lake Mill	17
2.1.3 McClean Lake Mine and Mill	18
2.1.4 McArthur River	20
2.1.5 Cigar Lake Mine	21
2.1.6 Mining Releases Summary	21
2.2 Uranium Processing and Conversion Facilities	24
2.2.1 Blind River Refinery	24
2.2.2 Port Hope Conversion Facility	26
2.2.3 Uranium Processing and Conversion Facilities Summary	26
2.3 Waste Management Facilities	28
2.3.1 Elliot Lake Waste Management Facilities	28
2.3.2 Welcome and Port Granby Waste Management Facilities	30
2.3.3 Waste Management Facilities Summary	32
3. CONTAINMENT PRACTICES FOR FACILITIES MANAGING HIGH-CONCENTRATION URANIUM SOLUTIONS	34
3.1 Port Hope Conversion Facilities	36
3.2 Rabbit Lake Mill	37
4. MANAGEMENT OF URANIUM RELEASES: SPECIAL ACTIVITIES	38
4.1 CNSC Effluent Project Charter: Process for Establishing Release Limits for Nuclear Facilities	39
4.2 Environment Canada Guidelines: Water Quality Guideline for Uranium	39
5. CNSC/ENVIRONMENT CANADA 2009 ANNUAL MEETING	40
6. CONCLUSION	42
7. REFERENCES	44
APPENDIX A: Memorandum of Understanding (MOU) Between the Canadian Nuclear Safety Commission and Environment Canada	45
APPENDIX B: GLOSSARY	52

FIGURES AND TABLES

List of Figures

Figure 1	Locations of Uranium Mine and/or Milling Operations in the Athabasca Basin of Northern Saskatchewan	13
Figure 2	2009 Average Monthly Uranium Discharge Concentrations (Rabbit Lake)	16
Figure 3	2009 Average Monthly Uranium Discharge Concentrations – Mill Effluent (Key Lake)	17
Figure 4	2009 Average Monthly Uranium Discharge Concentrations – Dewatering (Key Lake)	18
Figure 5	2009 Average Uranium Discharge Concentrations – SUE Water Treatment Plant (McClean Lake)	19
Figure 6	2009 Average Uranium Discharge Concentrations – JEB Water Treatment Plant (McClean Lake)	19
Figure 7	2009 Average Uranium Discharge Concentrations (McArthur River)	20
Figure 8	2009 Average Monthly Uranium Discharge Concentrations (Cigar Lake)	21
Figure 9A	2009 Uranium Mines – Annual Average Concentrations	22
Figure 9B	2009 Uranium Mines – Mass Loadings	22
Figure 9C	Annual Mass Loadings from Uranium Mining and Milling Facilities	23
Figure 10	Location of Cameco Blind River Refinery, Blind River, Ontario	25
Figure 11	Location of Cameco Port Hope Conversion Facility, Port Hope, Ontario	26
Figure 12	Annual Mass Loadings from Uranium Processing and Conversion Facilities (2008 to Present)	27
Figure 13	Locations of Waste Management Facilities in Elliot Lake, Ontario	29
Figure 14	Locations of Welcome and Port Granby Waste Management Facilities	30
Figure 15	Annual Mass Loadings from Waste Management Facilities (2008 to Present)	33

List of Tables

Table 1	Discharge Concentrations and Loadings of Uranium from Canadian Mines and Mills, 2009 (NR = No Release)	15
Table 2	2009 Uranium Releases to Water (Blind River Refinery)	25
Table 3	2009 Uranium Releases to the Environment (Elliot Lake Waste Management Facilities)	29
Table 4	2009 Monthly Average Uranium Concentrations Released to the Environment (Welcome and Port Granby Waste Management Facilities)	31

EXECUTIVE SUMMARY

Environment Canada (EC) and the Canadian Nuclear Safety Commission (CNSC) have developed and signed a Memorandum of Understanding (MOU) wherein the parties agree to consult and cooperate on the overall regulation of nuclear facilities in Canada. CNSC staff assessments indicate that current licensed facilities are not releasing uranium in effluent that would result in significant risk to the environment. However, in accordance with the *Nuclear Safety and Control Act* and its regulations, licensees are further expected to “take all reasonable precautions to control releases” and to keep all releases (including hazardous substances) as low as reasonably achievable (ALARA).

Uranium Mines and Mills

The 2009 review of uranium releases at Canada’s operating uranium mines and mills indicates that no facilities exceeded their Saskatchewan licence limit (2.5 mg/L) for uranium effluent discharge concentration. All facilities also achieved the optimization screening objective (OSO) of 0.1 mg/L.

Results from 2009 show that of all facilities, the Rabbit Lake operation continues to discharge the highest load of uranium to the environment. Substantial reductions in effluent uranium concentrations and loadings were achieved by facility modifications and upgrades during 2007 and 2008. Throughout 2009, the average monthly concentration of uranium in effluent was consistently below the OSO of 0.1 mg/L. The facility’s uranium loading to the environment (340 kg) was also approximately 45% lower than in 2008 (610 kg). Releases are expected to further decrease in 2010 with additional fine tuning and modification of the overall treatment process. The CNSC now considers that treatment at Rabbit Lake has been optimized and that Rabbit Lake has achieved the regulatory requirement put in place after the PSL2 assessment which found that uranium was CEPA toxic.

Careful monitoring of uranium in effluent will continue, with specific targets for further uranium reduction by several mines and mills under the continuous improvement initiatives within the environmental management system required by the CNSC.

Uranium Processing and Conversion Facilities

Monthly mean uranium release concentrations from the Blind River facility were consistently below the OSO during 2009. The Port Hope conversion facility no longer discharges treated process water to the harbour, so there are no routine treated effluent uranium releases to report. The total annual uranium load to the aquatic environment from uranium processing and conversion facilities remained low.

Low-Level Waste Management Facilities

The Welcome and Port Granby waste management facilities (WMFs), originally intended for interim storage, are out-dated by today's standards and as a result have difficulties meeting the uranium OSO. In 2008, regulatory action was taken at both these facilities in response to their uranium-in-effluent performance, requiring reviews of treatment facility and receiving environment performance, and the demonstration that these releases did not pose an immediate risk to humans or the environment.

In 2008, the CNSC issued a Request for Information pursuant to Subsection 12(2) of the *General Nuclear Safety and Control Regulations: Effluent Discharge Releases at the Welcome and Port Granby Waste Management Facilities*. During 2009, all required actions of the 12(2) letters for the Welcome and Port Granby WMFs were completed. From the information provided, the CNSC required Cameco to take actions to mitigate effects on the environment and to control the releases of nuclear and hazardous substances into the environment. The CNSC's request required two actions:

- Cameco was to submit an action plan by the end of May 2010, to increase capacity of the collection ponds and to avoid emergency discharges to Clark's ditch during heavy precipitation, which had occurred from January to April.
- Cameco was to submit the results of acute toxicity testing performed during 2009 to the CNSC.

In 2009, Cameco was also requested to address the feasibility of extending the Port Granby WMF's discharge pipeline into Lake Ontario. These issues and additional site modifications and improvements to be taken by Cameco will be presented in the 2010 annual uranium report.

Uranium discharge concentrations from waste management facilities were below the OSO, with the exception of the Welcome and Port Granby WMFs. In 2009, releases from Welcome WMF were slightly lower than in 2008. However, there was a considerable decrease in the annual mean monthly discharge concentration from the Port Granby WMF from 1.63 mg/L to 0.92 mg/L. This resulted in a 33% decrease in loadings to the environment (from 115.1 kg to 77.2 kg).

Considering the upcoming full remediation of the Welcome and Port Granby WMFs and the recent improvements made to these facilities, the CNSC believes these facilities can continue to operate in accordance with their licence requirements until remediation occurs under the Port Hope Area Initiative.

Elliot Lake Waste Management Facilities

All releases for 2009 were below the OSO (0.1 mg/L). These releases are similar to those documented in 2008. Despite consistently low uranium concentrations, releases from Denison tailings management areas were approximately 83 kg. This is lower than the 2008 mass loading (103kg) for this area; however, releases associated with these areas will be reviewed to determine if further continuous improvement activities are required or can be implemented.

2009 Versus 2008 Releases

In 2009, total releases from uranium mines and mills and other CNSC-regulated facilities were lower than those in 2008. In 2009, the total annual loading released from uranium mines and mills was just over half of that of 2008 (from 711 kg to 378 kg). Similarly, the total annual loading released from waste management facilities decreased by approximately 16%, from 368 kg in 2008 to 310 kg in 2009. Loadings from uranium processing and conversion facilities continued to be very low, but increased slightly from 2.1 kg in 2008 to 4.8 kg in 2009.

In 2009, the total uranium mass loading to the environment was 693 kg compared to 1,081 kg in 2008, representing a 36% overall decrease. The most significant decrease in uranium releases came from Rabbit Lake and Port Granby, which achieved reductions of 270 kg and 38 kg, respectively.

In 2009, uranium discharge concentrations from all operating uranium mines and mills were below the OSO. This included Rabbit Lake, whose average annual discharge concentration decreased by over half (from 0.158 mg/L in 2008 to 0.076 mg/L in 2009), with no average monthly discharge concentrations exceeding the OSO. This overall decrease demonstrates the effectiveness of the optimization screening objective of 0.1 mg/L for uranium in effluent, and is evidence that the CNSC continues to be proactive in requiring pollution prevention and continuous improvement measures for its licensees, and in regulating adequate control. The CNSC and EC continue to meet their regulatory commitments and responsibilities associated with the safe regulation and risk management of uranium releases from nuclear facilities.

Future Steps

The prevention of accidental or uncontrolled releases involves facility designs that incorporate engineered controls and barriers, as well as administrative procedures such as preventative maintenance programs, documentation, and training on operating procedures. Site-specific reviews of facility designs and management practices focusing on uranium solutions and mixtures will continue, in order to ensure that CNSC licensees are effectively minimizing releases of uranium to the environment. Other risk management initiatives will focus on controlled releases of uranium from CNSC-licensed waste management facilities.

In terms of controlling releases, the CNSC initiated the *Process for Establishing Release Limits for Nuclear Facilities Project* to address the need for formal, transparent licence limits and other means of controlling effluent loadings of uranium and other hazardous substances into the environment. Documentation of national and international practices from Australia, the United States, the European Union, France, the United Kingdom, and South Africa were completed by the end of 2009. In 2010, the CNSC will review the practices documented in 2009 and make appropriate recommendations.

Introduction

1

CIGAR JETBORE



Background

The Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC) have independent, but related mandates within the nuclear industry for protecting the environment. The two organizations have developed and signed an MOU, agreeing to work together on the environmental regulation of nuclear facilities in Canada. This agreement (see Appendix A) was created to minimize regulatory duplication and comply with the Government of Canada's policy requiring departments to coordinate their activities.

The assessment of releases of radionuclides from nuclear facilities was added to the second Priority Substances List (PSL2) of the *Canadian Environmental Protection Act* (CEPA) to determine if such releases pose significant risk to the environment in Canada. The evaluation was produced under the direction of CNSC technical specialists, and the final report, *Releases of Radionuclides from Nuclear Facilities (Impact on Non-human Biota)*, concluded that releases of uranium and uranium compounds contained in effluent from uranium mines and mills are toxic as defined in Section 64 of CEPA.

As part of the risk management activities required for CEPA toxic substances, an Annex was added to the existing MOU between EC and the CNSC in December 2004. This Annex identified specific risk management activities for each facility associated with the conclusion of CEPA toxicity and required the production of an annual report outlining the progress of these risk management activities.

The first risk management annual report, published jointly by EC and the CNSC in 2007, demonstrated that the specific risk management activities identified within the Annex were achieved within the required timeframe. The report also indicated that in order to promote transparent reporting, that future risk management activities would document uranium releases within the broader nuclear fuel cycle, in addition to facilities identified in the Annex.

This *2009 Annual Report on Uranium Management Activities* continues to report uranium releases to the environment as specified in the Annex, and reviews management practices related to uranium in effluent within other sectors of the nuclear industry.

Uranium Releases to the Environment

2



SOIL SAMPLING

Uranium Releases to the Environment

In May 2000, the CNSC replaced the Atomic Energy Control Board (AECB), following the coming into force of the *Nuclear Safety and Control Act* (NSCA) and its regulations.

The CNSC is mandated under the NSCA to regulate all nuclear facilities and nuclear-related activities in Canada. Under the NSCA, there are currently 11 regulations that set out specific requirements and are further supported by regulatory policies, standards and guidelines.

The CNSC has adopted environmental risk assessment methodologies linked to the site-specific receiving environment, to identify contaminants of potential concern (COPC) and aspects of environmental risk at each facility. Extensive environmental effects monitoring programs have also been implemented at facilities to identify impacts in receiving environments and to ensure that licensees have taken all reasonable precautions to control releases. Effluent and environmental monitoring programs are developed on a risk basis and depend upon the complexity of the released effluents, the sensitivity of the receiving environment and the anticipated effects on the environment.

The AECB previously regulated uranium primarily from a radiological perspective. Uranium is now viewed as a toxic substance, in light of the expansion of the mandate under the NSCA to include hazardous substances and environmental protection, and with the conclusions of the PSL2 Assessment, conducted under the *Canadian Environmental Protection Act* (CEPA).

In 2006, the CNSC commissioned a review of treatment technologies to assist staff in overseeing uranium risk management activities for the Rabbit Lake operation. This review identified a concentration of uranium in effluent of 0.1 mg/L as a potential treatment design objective that could be achieved with current standard chemical precipitation technology. The CNSC is using this value (0.1 mg/L) as an interim design objective for new facilities. It is also being used as an optimization screening objective (OSO) for existing facilities, in order to identify operations which — while not exceeding regulatory limits — should review their treatment processes to determine if systems can be optimized or upgraded to meet the CNSC's expectations for ALARA.

It is recognized that the OSO value is substantially lower than regulatory limits established by the US Environmental Protection Agency (USEPA) (*Regulation 40 CFR-N Part 440*) and the 1996 Saskatchewan *Mineral Industry Environmental Protection Regulations* (MIEPR). However, this value has been proven to be achievable and demonstrates the CNSC's commitment to incorporating the principles of pollution prevention within its regulatory mandate. It should be emphasized that exceeding this value is neither an indication of unreasonable risk to the environment nor a licence violation.

In addition to effluent concentration, it is important to review a facility's total annual load in kg/year to the receiving environment. Over the operating lifetime of a facility, the annual load provides a measure of the amount of uranium that may accumulate in the downstream environment particularly in sediment. For example, a facility with relatively high uranium concentrations but a low volume of effluent can discharge the same total mass of uranium as a high-volume effluent with very low uranium concentrations¹.

¹ The total load of a contaminant released to the environment is a function of the concentrations of the contaminant and the volume of effluent in which it is being released: concentration x volume = load.

In 2009, the CNSC continued to develop formal technical procedures for establishing release limits for hazardous and nuclear substances discharged from nuclear facilities. This project's objective is to review the CNSCs existing practices and present national and international practices both for radionuclides and hazardous substances. This project is outlined further in Section 4.1.

2.1



RABBIT LAKE MINE SHAFT

2.1 Uranium Mines and Mills

The 2003 CEPA toxic determination was related to the releases from specific uranium mines and mills: the Rabbit Lake mine/mill effluent, the Key Lake dewatering water releases and the Cluff Lake mine/mill effluent. This section summarizes uranium releases from these facilities (with the exception of the now decommissioned Cluff Lake operation) and other uranium mines and mills whose releases were not considered to be CEPA toxic. Figure 1 indicates the locations for these operations.

Figure 1 | Location of Uranium Mine and/or Milling Operations in the Athabasca Basin of Northern Saskatchewan

From Rabbit Lake Solution Processing Project Environment Impact Statement Executive Summary, January 2008



Sources of water potentially requiring control and treatment that are generated at operating uranium mines and mills may include the following: pit dewatering water, mine process water, runoff from waste rock piles and facility aprons, mill process water (i.e. raffinate, scrubbing solutions, barren strip solutions and tailings process water), raise waters or seepage waters from ore, waste rock, tailings management facilities and domestic water. The sources, quantity and quality of water to be handled and treated are site specific and affected by local hydrology as well as the selected mining and milling methods and the characteristics of the ore, waste rock and tailings produced at each site.

Effluent treatment systems at operating uranium mines/mills rely primarily on chemical precipitation and separation to remove contaminants of concern. Earlier systems mainly used large sedimentation ponds to settle precipitated contaminants with continuous release of effluent following the retention ponds. This method has been replaced by batch release discharge in many systems.

The *Metal Mining Effluent Regulations* (MMER) apply to effluent releases from all metal mines, including uranium mines and mills. These limits identify the minimal level of effluent treatment and are incorporated directly into CNSC licences for all uranium mining facilities. Although the MMER have no limit for uranium releases, they do specify a maximum limit for radium 226 and other parameters of concern from a mining perspective. They also require that all effluent from mining operations be non acutely lethal to fish. A copy of the MMER annual report can be obtained at www.ec.gc.ca/publications. As in 2008, the uranium mining sector of the metal mining industry was the best-performing mining sector relative to the MMER effluent limits, with no exceedances in 2009.

The use of site-specific ecological risk assessments (ERAs), combined with information obtained from the receiving environment monitoring programs, has caused the CNSC to require additional effluent treatment at various uranium mines/mills for contaminants beyond those encompassed by the MMER. These include uranium, molybdenum and selenium. No other limits have been formally placed into CNSC uranium mining licences, but operational control for these additional effluent COPCs have been incorporated into the facilities' Environmental Codes of Practice (ECOPs).

An ECOP includes tiered response levels to show when a facility is deviating from normal operational releases. These levels provide an early indication of potential loss of control, thereby providing adequate time to implement corrective measures. Two types of response levels are developed for each facility: action levels and administration levels.

2009 Results

Table 1 provides the monthly mean and annual average concentrations of uranium in water discharged to the environment during 2009 for active uranium mines and mills in northern Saskatchewan. Mass loadings of uranium are also presented. Uranium is only one of many effluent constituents monitored and reported to the CNSC in each facility's annual report. All discharges to the environment are measured regularly according to site-specific monitoring programs included in licence conditions approved by the CNSC and in the Province of Saskatchewan operating permit.

Table 1 | Discharge Concentrations and Loadings of Uranium From Canadian Mines and Mills, 2009 (NR = No Release)

2009 Monthly Arithmetic Mean	Mine/Mill						
	Key Lake (Mill)	Key Lake (Dewatering)	Rabbit Lake	McArthur River	McClean JEB	McClean SUE	Cigar Lake
January	0.003	0.0013	0.0455	0.0037	0.0040	0.001	NR
February	0.003	0.0013	0.0505	0.0047	0.0050	0.002	0.0001
March	0.004	0.001	0.0954	0.0048	0.0090	NR	0.0002
April	0.004	0.0013	0.0920	0.0043	0.0060	NR	0.0010
May	0.004	0.0013	0.046	0.005	0.0050	NR	0.0008
June	0.006	0.001	0.0694	0.0065	0.0030	NR	0.0004
July	0.006	0.0007	0.0988	0.0088	0.0030	NR	0.0013
August	0.003	0.0006	0.0936	0.0084	0.0010	NR	0.0004
September	0.005	0.0008	0.0633	0.0042	0.0020	0.001	0.0008
October	0.005	0.001	0.0808	0.0118	0.0010	0.001	0.0003
November	0.005	0.001	0.0864	0.0138	0.0010	NR	0.0001
December	0.004	0.0007	0.0868	0.0185	0.0020	NR	0.0001
Annual Avg. (mg/L)	0.004	0.001	0.0765	0.0072	0.003	0.001	0.0005
Std. Dev. (mg/L)	0.0011	0.0003	0.0278	0.0073	0.002	0	0.0006
Loading (kg)	6.3	5.6	340	20	6.01	0.29	0.15

As shown in Table 1, all operations had discharges below the OSO of 0.1 mg/L. The following sections discuss each of these reported facilities.

2.1.1 Rabbit Lake Mine and Mill

The Rabbit Lake operation is a uranium mining and milling facility in northern Saskatchewan on the west side of Wollaston Lake, approximately 450 km north of La Ronge. It is the oldest active uranium mining and milling operation in Canada.

Currently, the mill is operated on a week-on, week-off basis. The water treatment plant operates on a continuous basis, which includes continuous release of treated water from weir #3 to the receiving environment. Unlike batch-release systems, this continuous operation precludes the testing and recycling of pond waters not meeting water quality expectations. Instead, effluent quality relies on monitoring throughout the process to control reagent addition and precipitate removal effectiveness. It also depends on the use of relatively large final settling and buffering ponds.

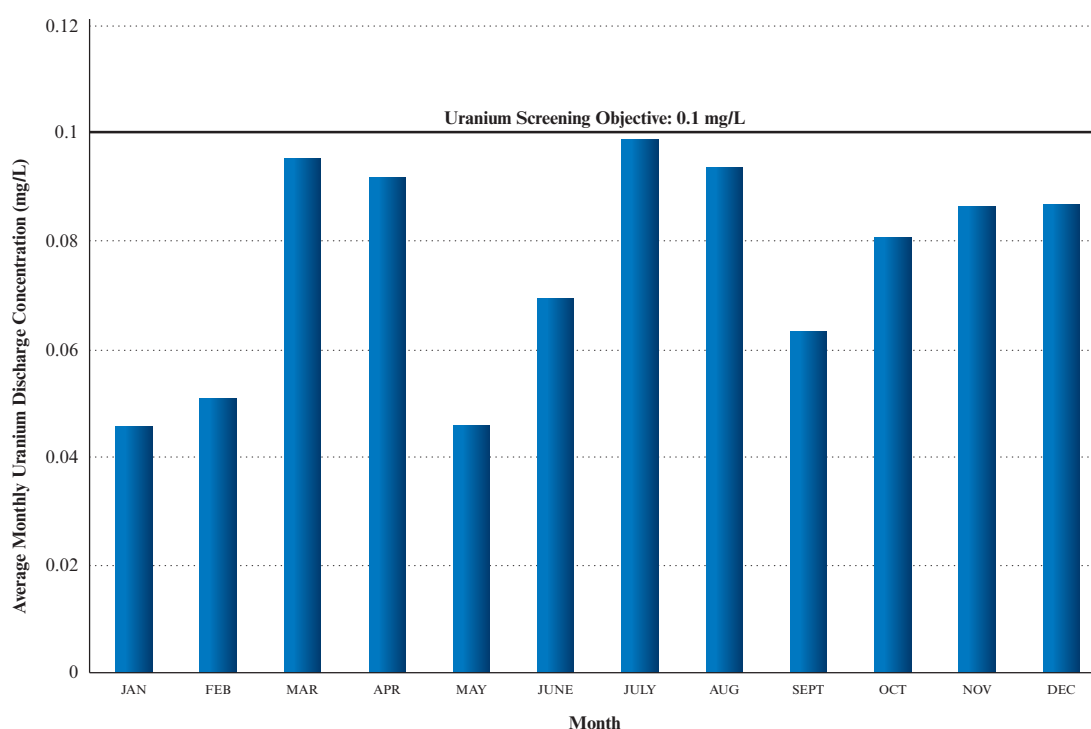
The CEPA toxic conclusion (for uranium releases from uranium mining and milling) resulted primarily from the Rabbit Lake operation. The *2007 Uranium Risk Management Annual Report*² provides detailed documentation of activities completed to the end of 2007 that resulted in a substantial reduction in uranium releases to the environment.

² nuclearsafety.gc.ca/eng/readingroom/reports/uranium/index.cfm

As indicated in Figure 2, the average monthly uranium discharge concentration remained below the OSO during 2009. During 2009, the Rabbit Lake facility also significantly reduced its total loading of uranium to the environment by approximately 45%, compared to that released in 2008.

The Rabbit Lake operation, however, continues to release the largest total amount (load) of uranium to the environment relative to other operating mines. This total load is a function of greater effluent concentrations, as well as the high treated effluent volumes that arise from the large number of sources requiring treatment. Uranium reduction therefore remains a key element of this facility's continuous improvement plans. Releases should further decrease in 2010 with fine-tuning and modification of the overall treatment process. Additional uranium reductions are projected as an added benefit of the inclusion of the Mo/Se treatment circuit into the system.

Figure 2 | 2009 Average Monthly Uranium Discharge Concentrations (Rabbit Lake)

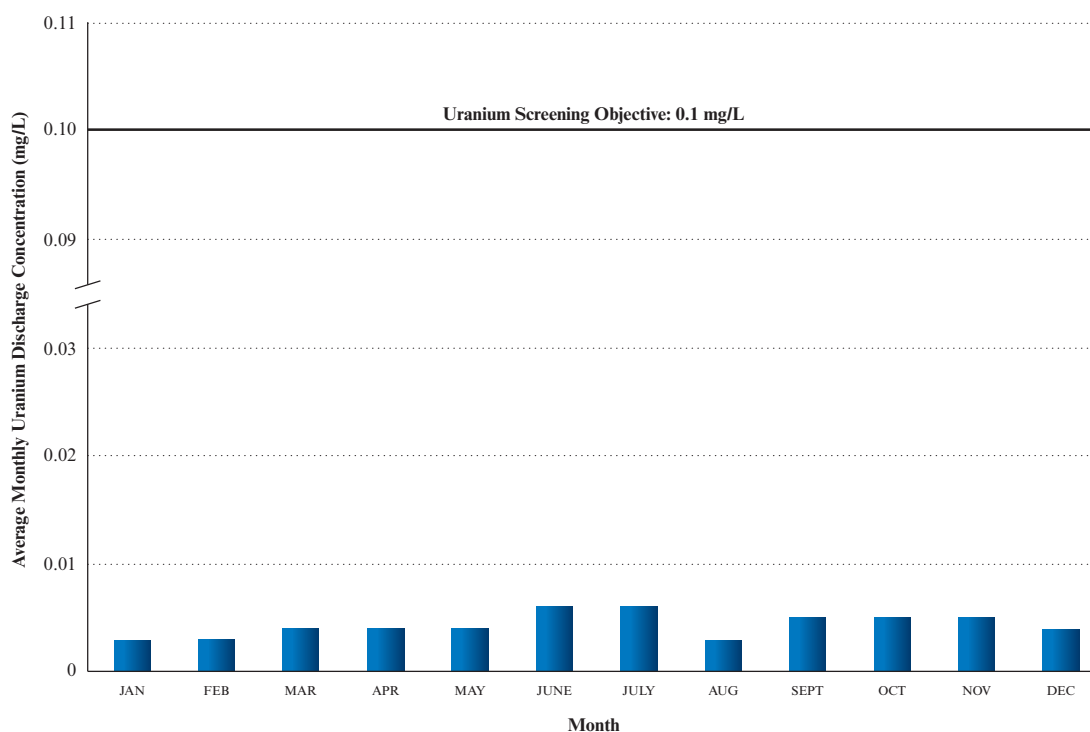


2.1.2 Key Lake Mill

The Key Lake operation is located in north-central Saskatchewan, approximately 70 km east-southeast of Cree Lake (see Figure 1). Mining at Key Lake ceased in 1997, with the milling of Key Lake ore continuing into 1998–99. In 2000, Key Lake commenced milling ore from the nearby McArthur River underground mine.

The Key Lake operation has two primary release points to the aquatic environment: the treated mill effluent released to the David Creek drainage, and the treated dewatering water (intercepted groundwater) released to the McDonald Creek drainage. Table 1 and Figure 3 demonstrate that the monthly and annual averages for 2009 have consistently remained well below the OSO of 0.1 mg/L. The 2009 total annual load from the mill (6.3 kg) is approximately 40% of the quantity/load released from the site in 2008 (15.6 kg).

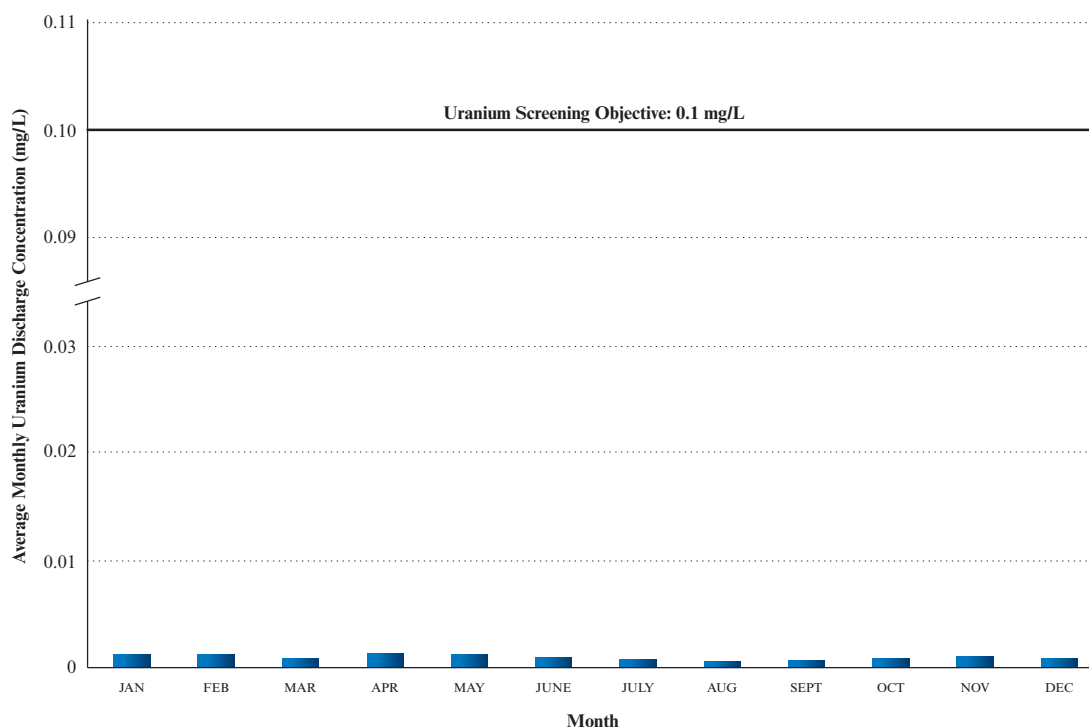
Figure 3 | 2009 Average Monthly Uranium Discharge Concentrations – Mill Effluent (Key Lake)



Releases from the Key Lake operation's dewatering system were specifically mentioned within the PSL2 report (Environment Canada & Health Canada, 2003) CEPA toxic determination. These figures were based on historical releases before the installation of the reverse osmosis treatment system. The 2007 *Uranium Risk Management Annual Report* provides details of the history, performance and receiving environment quality associated with these releases.

Data presented in Table 1 and Figure 4 demonstrate the reverse osmosis treatment plant's high level of performance. The 2009 annual average of 0.001 mg/L is more than two orders of magnitude lower than the OSO of 0.1 mg/L. The total 2009 annual load from this treatment system is also relatively low (5.6 kg) and is lower than the 2008 loading (8.8 kg).

Figure 4 | 2009 Average Monthly Uranium Discharge Concentrations – Dewatering (Key Lake)



2.1.3 McClean Lake Mine and Mill

The McClean Lake operation, consisting of a uranium mine and milling facility, is located in the northeast corner of Saskatchewan (see Figure 1). Mining commenced in 1995 and the mill began production in June 1999.

The JEB water treatment plant receives contaminated water feeds mainly from the mill and JEB tailings management facility areas. The plant removes radionuclides, dissolved metals and suspended solids, and then discharges treated effluent to the Sink/Vulture treated effluent management system.

The SUE water treatment plant receives contaminated water feeds from the SUE mine site. It removes radionuclides, dissolved metals and suspended solids, and also discharges treated effluent to the Sink/Vulture treated effluent management system.

Onsite precipitation runoff or spill water from the mine and mill main areas that could be contaminated is intercepted. It is then recycled or treated before being released to the environment.

Table 1 and Figures 5 and 6 demonstrate that the 2009 monthly means for both treatment plants have consistently achieved concentrations of an order of magnitude or more lower than the OSO. Together, the two releases result in an annual total load of approximately 6.3 kg of uranium discharged to Sink reservoir. These results were similar to 2008 results (7.5 kg). However, the SUE water treatment plant did not operate most of the year (from March to August, and again from November to December) as there were no mining activities. From late August to mid-October a plant trial operation was conducted, and discharges are shown in Figure 5.

Figure 5 | 2009 Average Uranium Discharge Concentrations – SUE Water Treatment Plant (McClellan Lake)

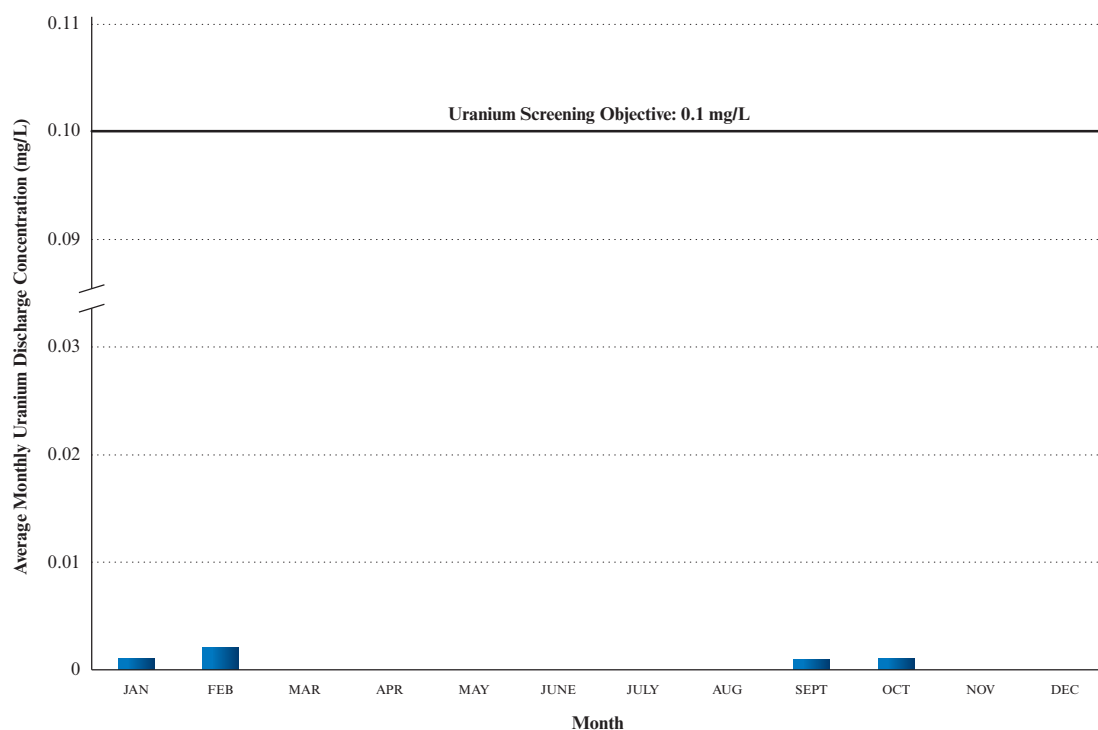
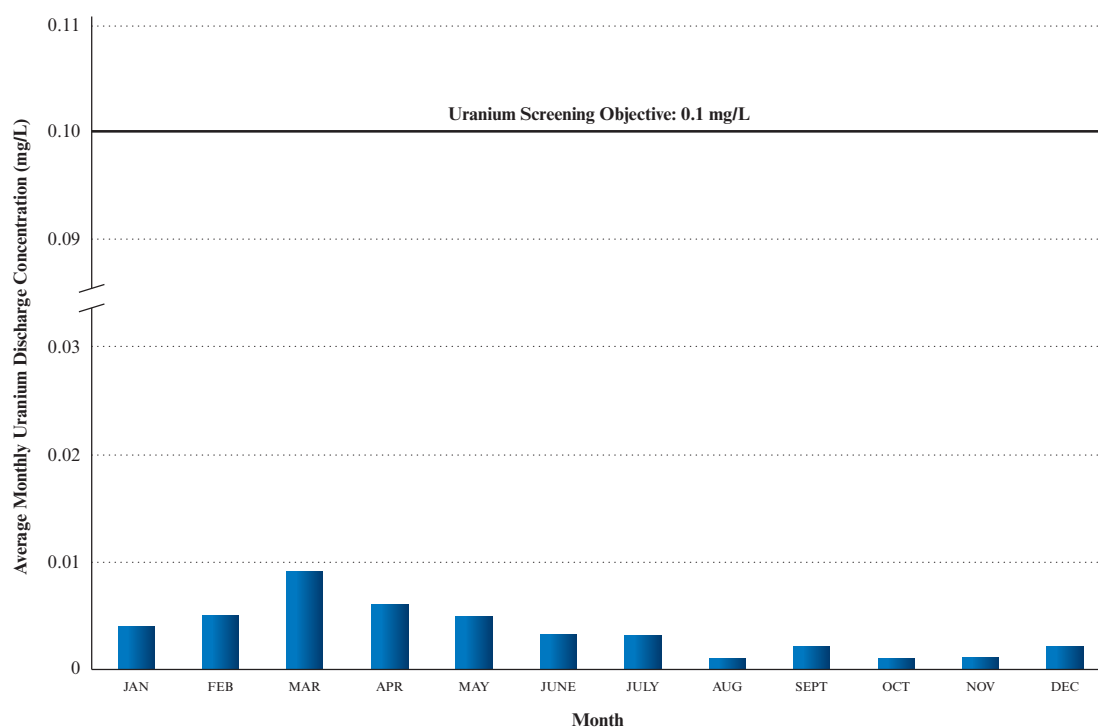


Figure 6 | 2009 Average Uranium Discharge Concentrations – JEB Water Treatment Plant (McClellan Lake)



2.1.4 McArthur River

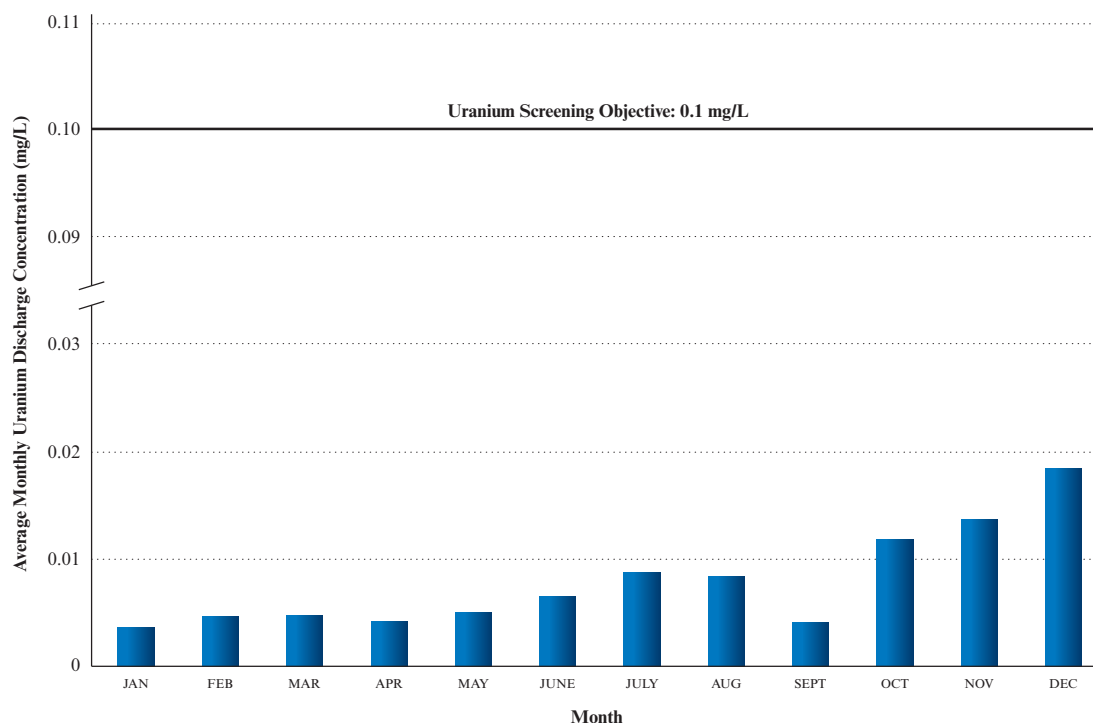
Located in north-central Saskatchewan approximately 300 km north of La Ronge (see Figure 1), Cameco Corporation's McArthur River operation mines the world's largest high-grade uranium deposit. It began operations in 1999, extracting ore using the raisebore mining method. The high-grade ore is processed underground and pumped in slurry form to the surface, where it is loaded into specially designed containers and transported by truck to Cameco's Key Lake mill 80 km to the south. At Key Lake, the uranium is extracted, processed and packaged in the form of "yellowcake" and is shipped off site for further refining and conversion.

Most ore processing equipment at McArthur River is underground, with the exception of the slurry loadout building, where the high-grade ore slurry is loaded for shipment. The minewater treatment plant, storage ponds and the final effluent discharge point are located on the surface. Treated effluent is discharged from the secondary water treatment plant pumphouse through a 1,250-m pipeline to a muskeg receiving area adjacent to shaft #3. As there is no mill at this site, there is no specific uranium removal process at the facility.

Site-specific risk assessments required by the CNSC have identified uranium as a COPC, and it is specifically targeted for reduction within the McArthur River facility's continuous improvement program. Modifications to water management and optimization of the overall treatment process have resulted in improvements over the last few years.

During 2009, monthly uranium in effluent concentrations were consistently below the OSO (see Figure 7), with a total annual load of 20 kg released from this site (see Figure 9A). The continuing uranium reduction activities at McArthur River are preventative, as releases from this facility were not determined to be CEPA toxic. The annual uranium load (quantity) released in 2009 (20 kg) was approximately 30% of the load released from the site in 2008 (68.7 kg).

Figure 7 | 2009 Average Uranium Discharge Concentrations (McArthur River)

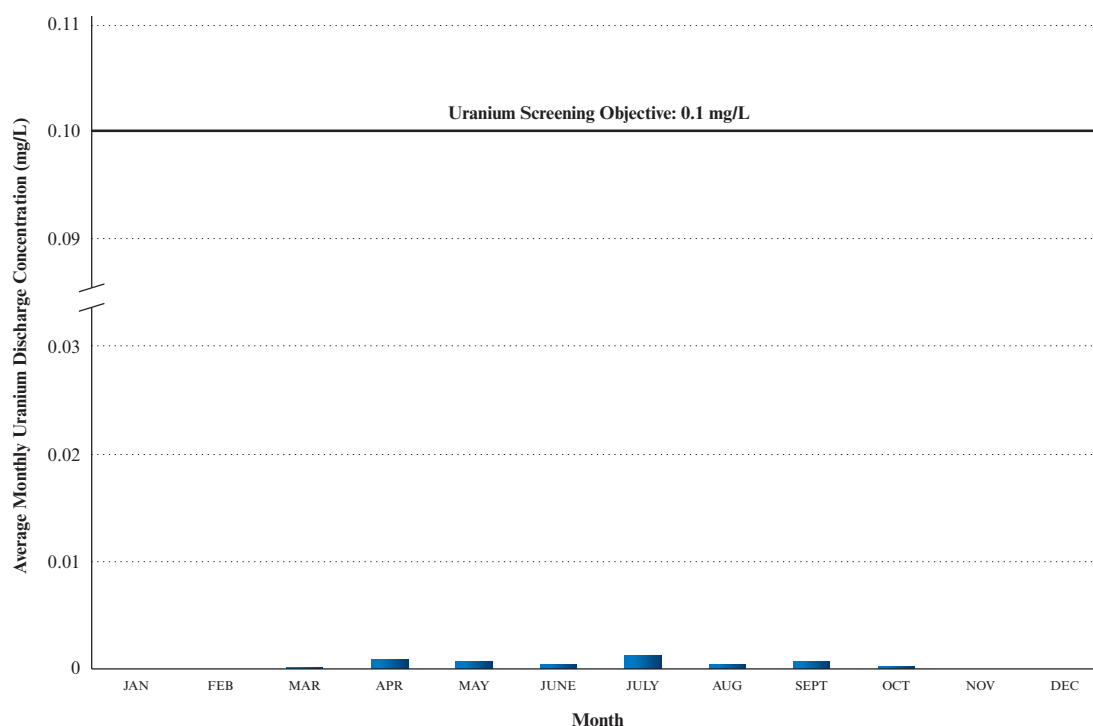


2.1.5 Cigar Lake Mine

In 2009, activities at the Cigar Lake Project focused on remediating the mine and preparing to resume operations in the underground workings. Remediation of the 2008 inflow area was completed during the year, and dewatering of the underground workings commenced. During remediation and dewatering activities, mine water pumped from the underground mine was treated to remove contaminants. Effluent is monitored before it is discharged to the receiving environment (composite samples are collected during the filling of monitoring ponds) and at the 'final point of control' (i.e. during batch discharge). Results for 2009 uranium discharge concentrations are provided in Figure 8.

During 2009, effluent released from the Cigar Lake mine water treatment system consistently achieved the OSO (0.1 mg/L), with an annual load of 0.15 kg released to the environment. The 2009 loading is greater than the 2008 loading (0.03 kg), although still very low. This increase was expected, and increases are likely to continue as the facility becomes operational. It should be noted, however, that effluent concentrations below the OSO are considered achievable.

Figure 8 | 2009 Average Monthly Uranium Discharge Concentrations (Cigar Lake)



2.1.6 Mining Releases Summary

The review of uranium releases at the operating uranium mines and mills indicates that all facilities are readily achieving the OSO of 0.1 mg/L (see Figure 9A).

Figure 9B provides a summary of the uranium mass loadings for 2009. The highest annual loading of uranium in effluent continues to be the Rabbit Lake operation (340 kg). However, uranium releases from the Rabbit Lake operation have been significantly reduced by approximately 45% compared to 2008 (610 kg). Figure 9C compares the 2008 annual mass loadings from uranium mines and mills to those of 2009. The total annual loadings in 2009 were just over half of those from 2008 (378 kg, down from 711 kg). Releases are expected to further decrease in 2010 with continued fine-tuning and modification of the overall treatment processes.

Figure 9A | 2009 Uranium Mines – Annual Average Concentrations

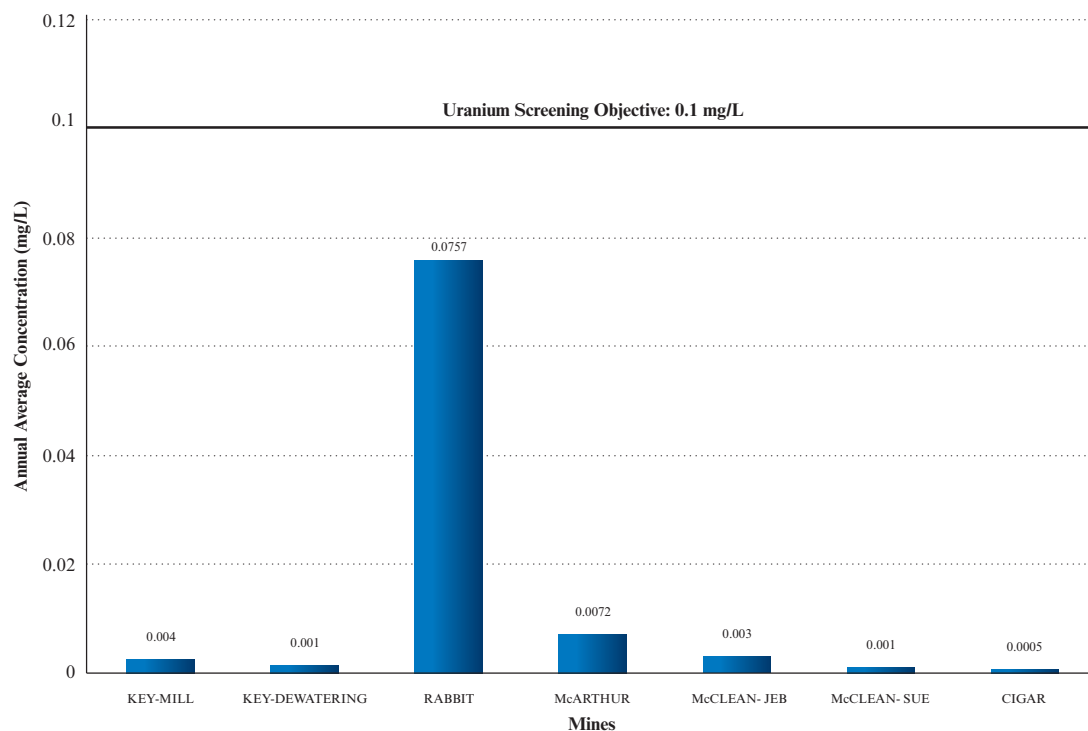


Figure 9B | 2009 Uranium Mines – Mass Loadings

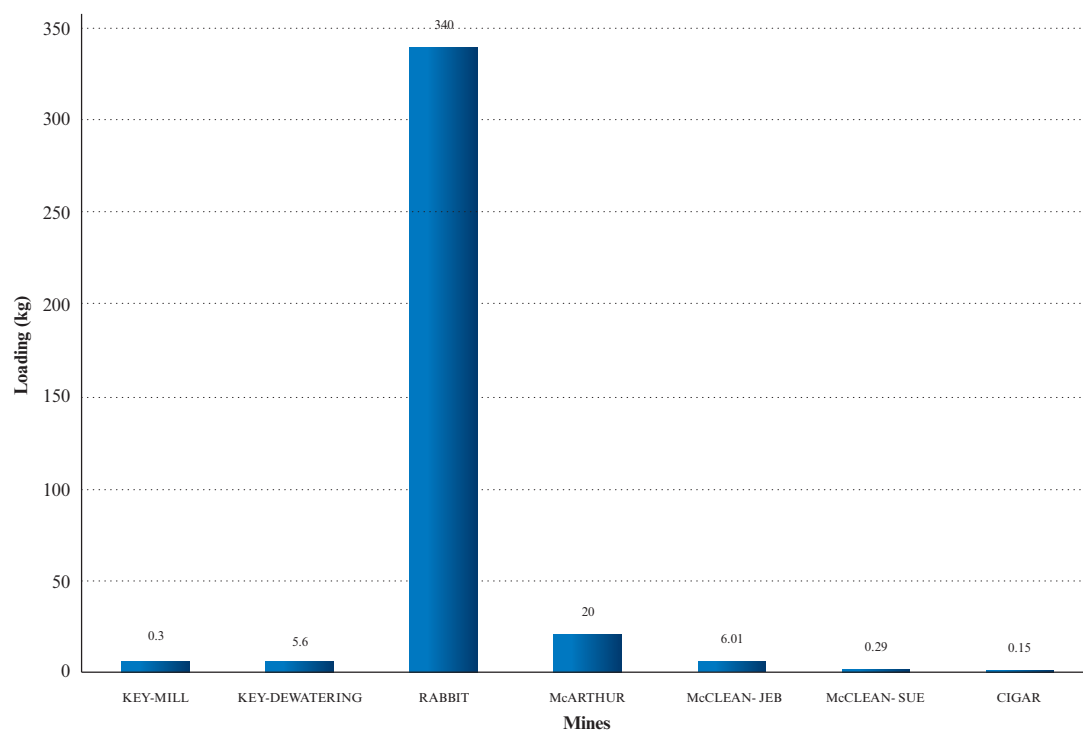
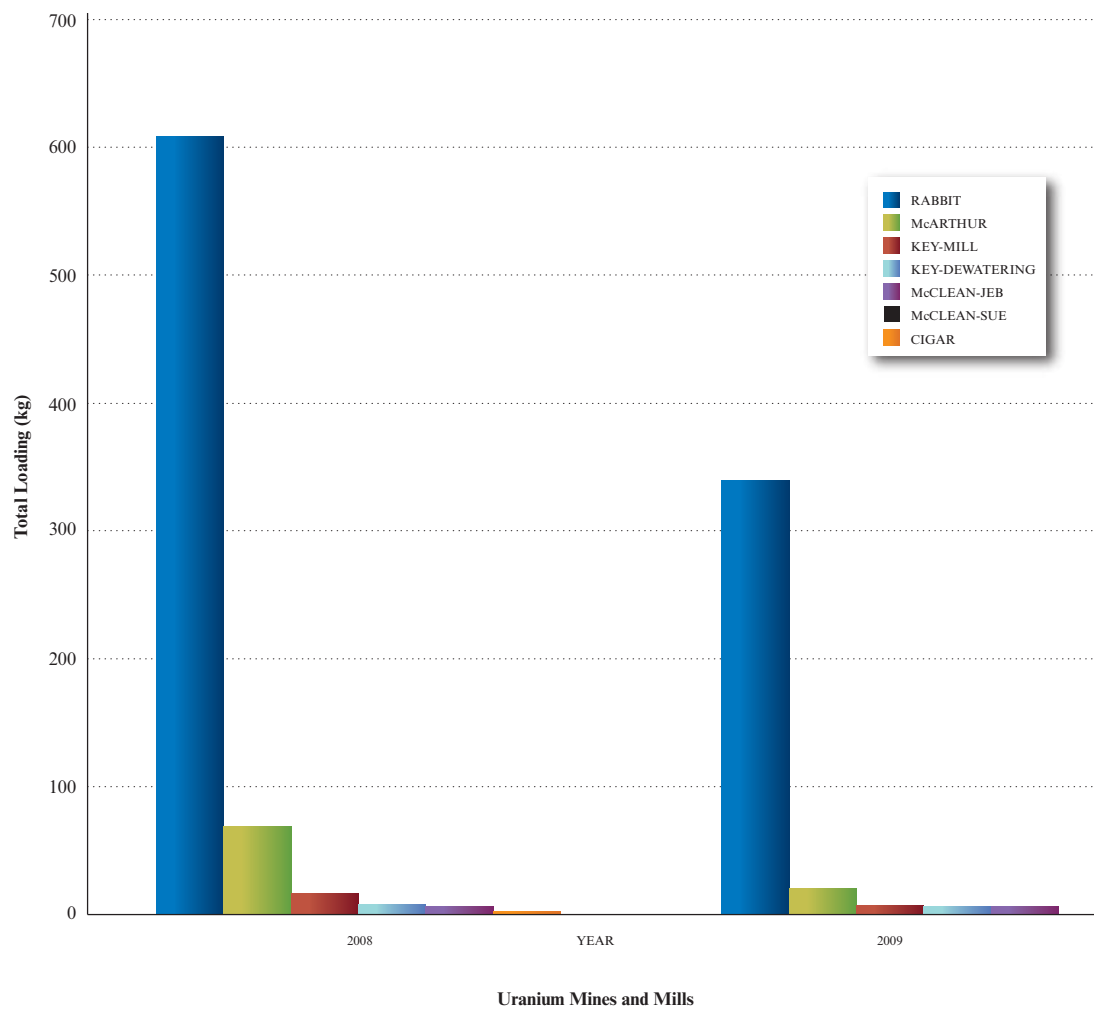


Figure 9C | Annual Mass Loadings from Uranium Mining and Milling Facilities





KILN AT PORT HOPE'S URANIUM DIOXIDE PLANT

2.2

2.2 Uranium Processing and Conversion Facilities

Canada has two uranium processing facilities — the Blind River refinery and the Port Hope conversion facility — as well as three uranium fuel fabrication facilities.

The fuel fabrication facilities are the Cameco fuel manufacturing facility in Port Hope, and the GE Hitachi Toronto and Peterborough facilities, all in Ontario. This report does not consider uranium releases from these facilities, as they are considerably low and outside this document's scope (i.e. contaminated water is discharged to municipal sewers in accordance with municipal by-laws).

2.2.1 Blind River Refinery

Cameco Corporation of Saskatoon, Saskatchewan, owns and operates a Class IB nuclear fuel refining facility near Blind River, Ontario (see Figure 10). This facility refines yellowcake received from various sources to produce uranium trioxide (UO_3), an intermediate product of the fuel cycle. Cameco's Port Hope conversion facility is the primary recipient of this product.

The facility is licensed to produce up to 18,000 tonnes of uranium as UO_3 during any calendar year. The facility converts various milled uranium concentrates (i.e. yellowcake) to UO_3 powder through chemical processes. In addition, the facility operates a hazardous waste incinerator that handles contaminated combustible waste from the Blind River Refining Facility and the Port Hope Conversion Facility.

Cameco Blind River refinery has a single liquid effluent discharge point that releases through a diffuser to Lake Huron. Table 2 provides monthly mean uranium concentrations for releases to water and the total uranium loading for 2009. Monthly means were consistently below the OSO (0.1 mg/L) and the total amount of uranium released in 2009 was low (4.8 kg).

Figure 10 | Location of Cameco Blind River Refinery, Blind River, Ontario

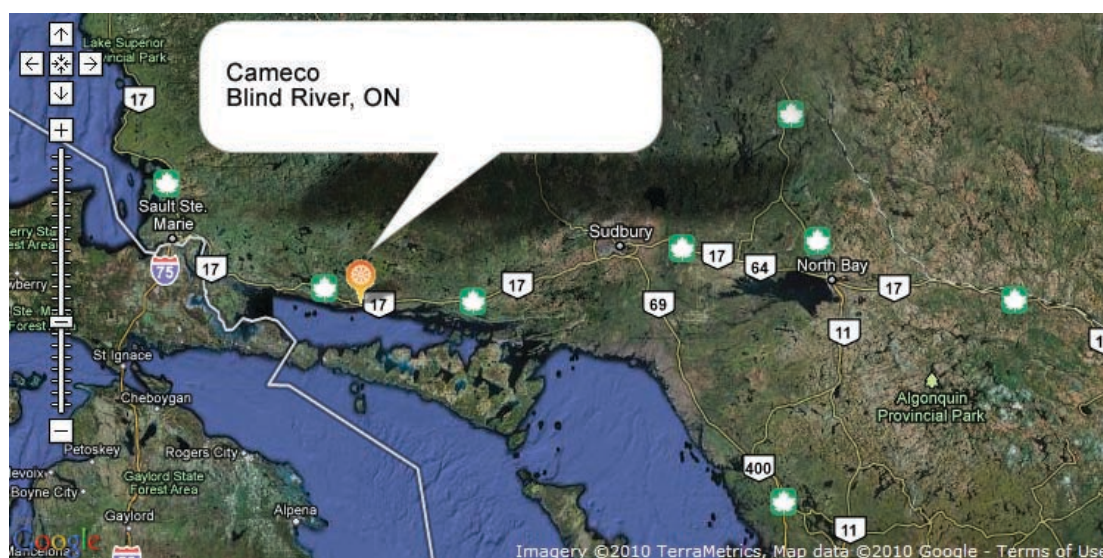


Table 2 | 2009 Uranium Releases to Water (Blind River Refinery)

Month	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)
January	0.014	0.01	0.017
February	0.016	0.014	0.019
March	0.016	0.01	0.028
April	0.037	0.013	0.064
May	0.028	0.022	0.036
June	0.048	0.018	0.121
July*	*N/A	*N/A	*N/A
August	0.038	0.018	0.062
September	0.014	0.008	0.02
October	0.015	0.011	0.02
November	0.017	0.01	0.031
December	0.014	0.009	0.021
Average	0.0233		
Standard Deviation	0.0123		

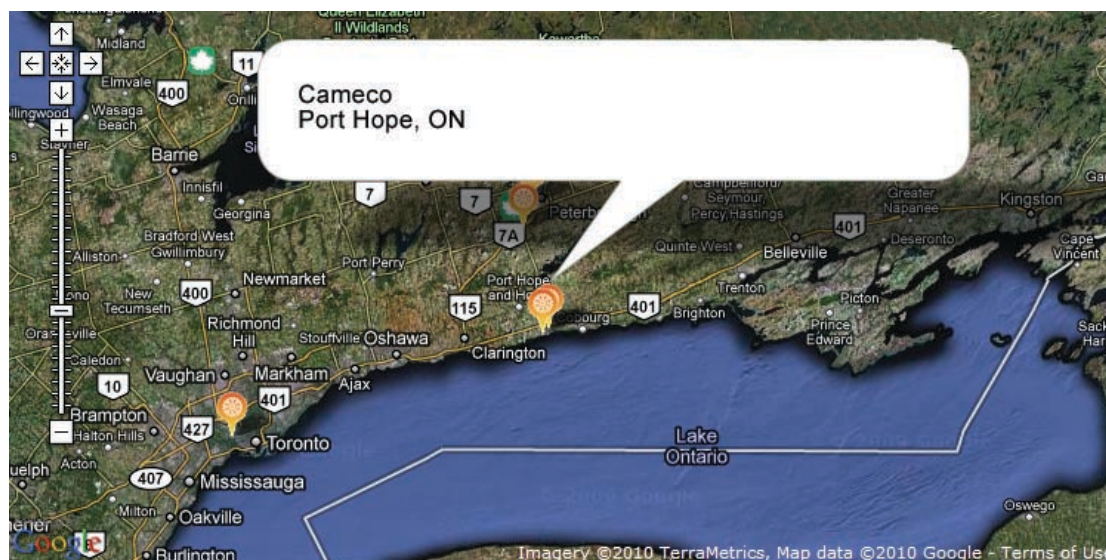
Total Uranium Loading (2009): 4.8 kg

* Note: Cameco Blind River refinery operations did not discharge during July 2009.

2.2.2 Port Hope Conversion Facility

Cameco Corporation also owns and operates a Class IB nuclear fuel conversion facility in Port Hope, Ontario (see Figure 11). The facility primarily converts uranium trioxide (UO_3) powder produced by Cameco's Blind River refinery to uranium dioxide (UO_2). The UO_2 is used in the manufacture of CANDU reactor fuel and uranium hexafluoride (UF_6), which, in turn, is exported for further processing into fuel for light water reactors. In addition, there is a specialty metals plant that has been used to convert uranium tetrafluoride into uranium metal shapes for shielding and counterweights for certain types of aircraft. The facility also includes analytical and research laboratories, radioactive waste storage, and recycling and decontamination capabilities.

Figure 11 | Location of Cameco Port Hope Conversion Facility, Port Hope, Ontario

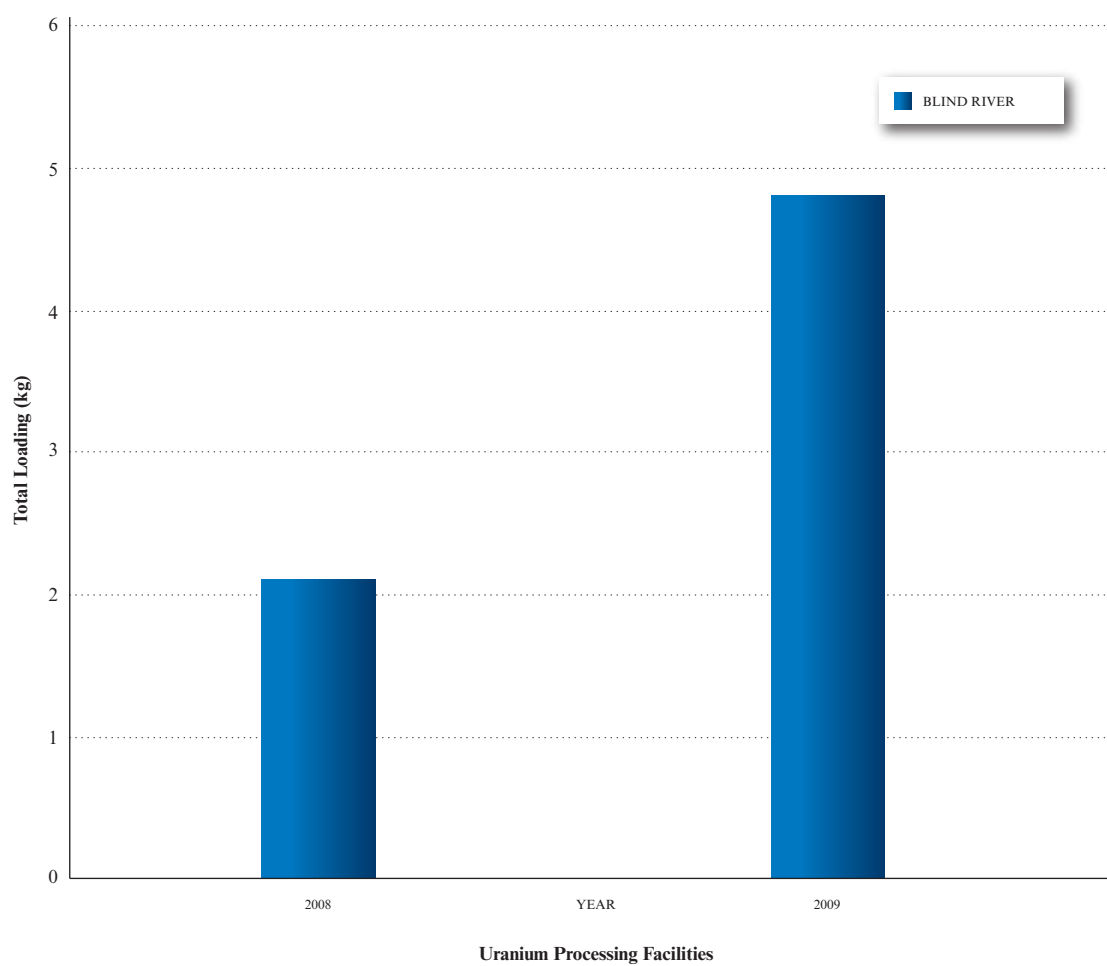


Since the 2007 installation of an evaporative treatment system, all process wastewater streams from the facility are collected, treated, and reprocessed or evaporated. Hence, there are no longer any routine releases of uranium process water to the Port Hope harbour.

2.2.3 Uranium Processing and Conversion Facilities Summary

Monthly mean uranium release concentrations from the Blind River facility were consistently below the OSO during 2009. The Port Hope conversion facility no longer discharges treated process water to the harbour, so there are no routine treated effluent uranium releases to report. Figure 12 compares the 2008 annual mass loadings of uranium from the Blind River refinery to those of 2009. Although there was an increase from 2.1 kg to 4.8 kg, the total annual uranium load to the aquatic environment from the Blind River facility continues to be low.

Figure 12 | Annual Mass Loadings from Uranium Processing and Conversion Facilities (2008 to Present)





2.3

2.3 Waste Management Facilities

2.3.1 Elliot Lake Waste Management Facilities

Elliot Lake Historic Sites Facility

For more than 40 years, there were as many as nine operating uranium mines in the area of Elliot Lake, Ontario. The last of these to permanently close were the Quirke and Panel Mines, which both closed in 1990, and the Stanleigh Mine, which closed in 1996.

Following the completion of decommissioning work in 2003, all sites were operated and maintained by Rio Algom Limited under a radioactive waste facility operating licence issued by the CNSC in 2004. The licence was renewed for an indefinite term effective January 1, 2006.

The mining structures on these properties have been demolished and the site has been restored in a manner that protects the environment and public health and safety.

Rio Algom Limited continues to operate and maintain eight tailings management areas and five effluent treatment plants in the watershed.

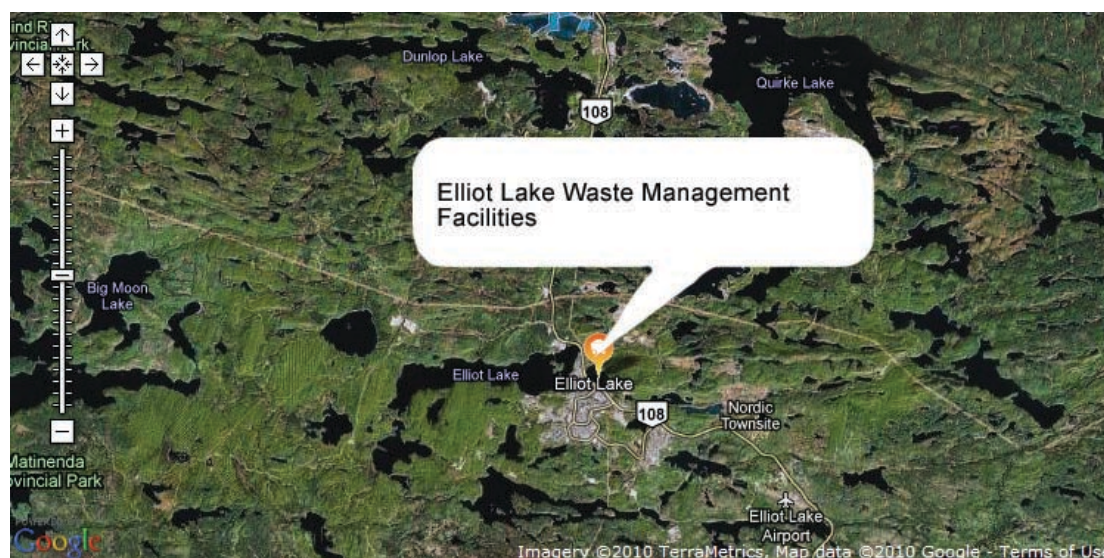
Denison Mining Facility

Denison Mines Inc. possesses CNSC uranium mine decommissioning licences for its two closed uranium mine facilities in Elliot Lake. Both of these sites — the Denison Mine and the Stanrock Mine — have been decommissioned for several years. Mine structures have been removed from both sites, and mine shafts have been capped and decommissioned according to CNSC requirements.

The CNSC licence covers the facilities and associated physical works, such as dam structures, roads, effluent treatment plants, fencing and tailings management areas that are subject to inspection programs and local and area-wide environmental monitoring programs. The Denison Mine site contains two tailings management areas that are covered by water and contain a total of 63 million tonnes of uranium mine tailings. The Stanrock site is a dry tailings management area with 6 million tonnes of uranium mine tailings. Denison Mines Inc. has 69 million tonnes of the total 168 million tonnes of uranium tailings and associated materials in the Elliot Lake area.

Figure 13 depicts the Serpent River watershed, the City of Elliot Lake and the locations of the tailings management areas (TMAs), which are within a radius of approximately 20 km from Elliot Lake. Drainage from all sites, with the exception of the Pronto site, enters the Serpent River watershed.

Figure 13 | Location of Elliot Lake Waste Management Facilities, Ontario



Source: 2008 Serpent River Watershed Monitoring Program Annual Water Quality Report, March 20, 2009.

As shown in Table 3, all of the releases for 2009 are below the OSO (0.1 mg/L), with the total annual load generally being in the tens of kilograms or lower. These releases are similar to those documented in 2008. This table also shows the importance of reviewing total load as well as concentration. Despite consistently low uranium concentrations, releases from Denison tailings management areas (TMA-1, TMA-2 and Rio Algom Limited's Spanish-American TMA) were approximately 83 kg. This is lower than the 2008 mass loading (103kg) for this area.

Table 3 | 2009 Uranium Releases to the Environment (Elliot Lake Waste Management Facilities)

Waste Management Facility	Annual Avg. (mg/L)	Standard Deviation (mg/L)	Total Loadings (kg)
Rio Algom			
Pronto	0.013	0.008	25.8
Nordic, Lacnor & Buckles	0.005	0.002	11.2
Panel	0.007	0.004	8.4
Quirke	0.016	0.003	49.6
Stanleigh	0.003	0.001	28.5
Denison Mines			
TMA-1, TMA-2, and Spanish-American TMA: Stollery Lake Outlet (D-2)	0.073	0.026	83.4
Seepage from TMA-2: Lower Williams (D-3)	0.010	0.008	2.5
Stanrock TMA: Orient Lake Outlet (DS-4)	0.003	0.001	2.6

2.3.2 Welcome and Port Granby Waste Management Facilities

The Welcome and Port Granby waste management facilities (WMFs) are regulated by CNSC through waste nuclear substance licences that came into effect on May 16, 2002. The facilities are located in Ontario, approximately 100 km east of the City of Toronto (See Figure 14).

A private company, Cameco Corporation, was created through the merger of Eldorado Mining and Refining Limited (a federal Crown corporation) and Saskatchewan Mining Development Corporation (a provincial Crown corporation) in 1998. Under the terms of the merger agreement, the Government of Canada (now Natural Resources Canada) retained responsibility for the wastes at the Welcome WMF and the Port Granby WMF. Cameco, however, agreed to manage the facilities on behalf of the federal government until the implementation of a long-term waste management plan. Since the cessation of waste placement, management of these facilities has involved the interception and treatment of contaminated leachate from the waste and the discharge of treated effluent to Lake Ontario.

Under the Port Hope Area Initiative, the Welcome and Port Granby WMFs are to be replaced by two new long-term waste management facilities scheduled for commissioning within the next five to seven years. These facilities will have engineered above-ground mound designs with multilayer covers and base liners and will include wastewater treatment systems that meet modern standards.

Table 4 provides the 2009 monthly mean uranium concentrations and associated total annual load for uranium in the effluent streams for the Welcome and the Port Granby WMFs.

Figure 14 | Location of Welcome and Port Granby Waste Management Facilities



Table 4 | 2009 Monthly Average Uranium Concentrations Released to the Environment (Welcome and Port Granby WMFs)

Month	Welcome WMF (mg/L)	Port Granby WMF (mg/L)
January	0.17	0.68
February	0.14	0.79
March	0.14	0.83
April	0.01	0.90
May	0.21	0.79
June	0.09	0.90
July	0.07	0.75
August	0.10	1.10
September	0.25	1.30
October	0.34	0.92
November	0.29	0.66
December	0.26	1.45
Annual Average (mg/L)	0.17	0.92
Standard Deviation (mg/L)	0.10	0.24
Load (kg)	20.3	77.2

Releases at the Welcome WMF (with the exception of April, June, July and August, 2009) exceeded the OSO (0.1 mg/L). The total annual load was 20.3 kg and was similar to 2008 (21.1 kg).

Differences in the chemical composition of influent caused releases from the Port Granby WMF to be markedly higher than those at the Welcome facility. In 2009, monthly average uranium concentrations were consistently well above the OSO. These elevated concentrations produced a total annual load of 77.2 kg, which is ~35% lower than the 2008 loading (115.1 kg).

In 2008, the CNSC issued the Request for Information pursuant to Subsection 12(2) of the *General Nuclear Safety and Control Regulations: Effluent Discharge Releases at the Welcome and Port Granby Waste Management Facilities*. During 2009, all required actions of the 12(2) letters for the Welcome and Port Granby WMFs were completed. From the information provided, the CNSC required Cameco to take actions to mitigate effects on the environment and to control the releases of nuclear and hazardous substances into the environment. The CNSC's request required two actions:

- Cameco was to submit an action plan by the end of May 2010, to increase the capacity of the collection ponds and avoid emergency discharges to Clark's ditch during heavy precipitation, which had occurred between January and April.
- Cameco was to submit the results of acute toxicity testing performed during 2009 to the CNSC.

With regards to the acute toxicity testing, in 2009 Cameco submitted their results in the annual reports for Welcome and Port Granby WMFs. No measurements had been taken between January and April, however monthly testing began in May. The results showed that all samples passed the acute toxicity testing with 0% mortality based on a 48 hour result and 96 hour result.

In 2009, Cameco was also requested to address the feasibility of extending the Port Granby WMF's discharge pipeline into Lake Ontario. These issues and other site modifications and improvements to be taken by Cameco will be presented in the 2010 annual uranium report.

Physical modifications to the Port Granby WMF completed in 2009 included changes to the overflow structure in the west gorge reservoir to improve overflow control. Physical modifications to the Welcome WMF completed in 2009 included the installation of an interim outfall into Lake Ontario (January) and the subsequent installation of two new effluent pipelines (December) to replace the previously used single pipeline, to convey treated water from the Welcome WMF to Lake Ontario.

2.3.3 Waste Management Facilities Summary

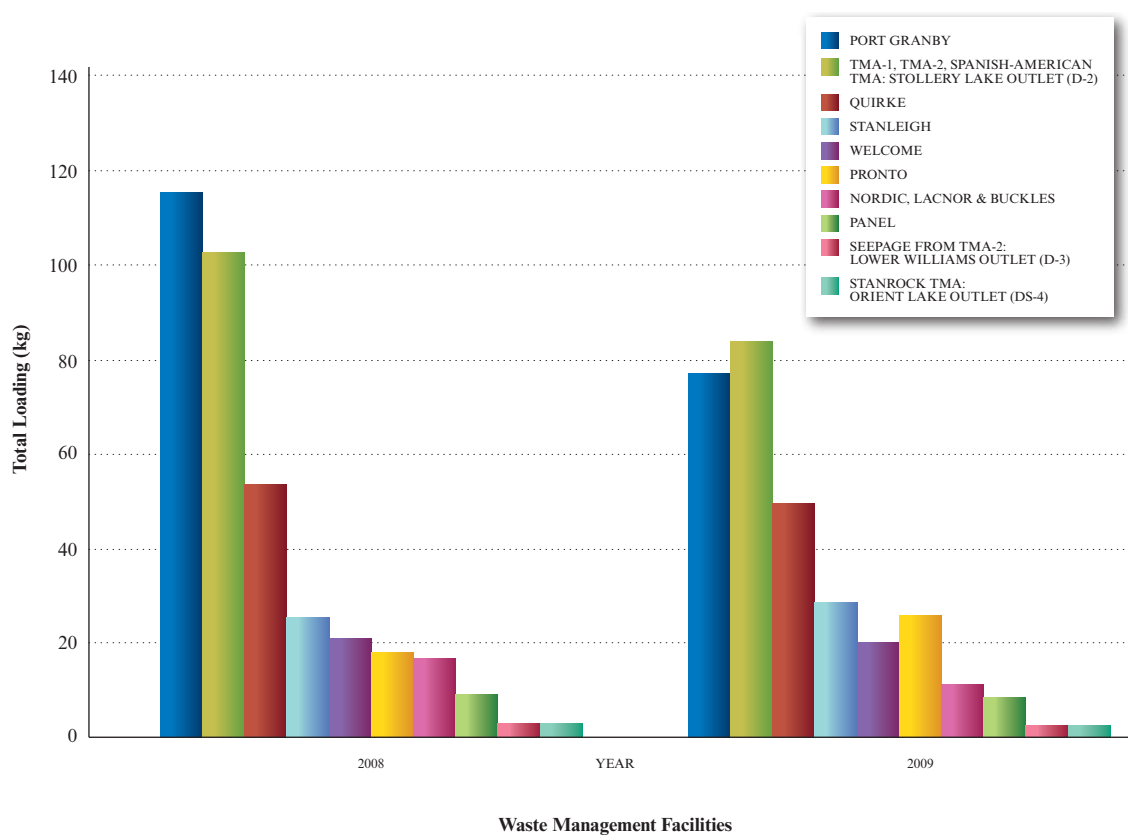
The existing water collection and treatment systems at the Welcome and Port Granby WMFs are currently meeting the licence discharge limits for Radium-226, arsenic and pH. Although a discharge limit for uranium is not included in the Welcome and Port Granby WMF licences, Cameco is measuring uranium in treated effluent and reports the results to the CNSC. As shown in Table 4, during 2009, the discharged effluent quality from these facilities exceeded the uranium OSO of 0.1 mg/L. Improvements to the current effluent treatment processes at Welcome and Port Granby WMFs will occur under the Port Hope Area Initiative.

Figure 15 compares the 2008 annual mass loadings of uranium from all waste management facilities to those of 2009. Overall, there was approximately a 16% decrease (from 368 kg to 310 kg), with particularly lowered values from Port Granby.

During 2009, all required actions of the 12(2) letters for the Welcome and Port Granby WMFs were completed. From the information provided, the CNSC required Cameco to take actions to mitigate effects on the environment and to control the releases of nuclear and hazardous substances into the environment.

Considering the upcoming full remediation of the Welcome and Port Granby WMFs and their recent improvements, the CNSC believes these facilities can continue to operate in accordance with their licence requirements until remediation occurs under the Port Hope Area Initiative.

Figure 15 | Annual Mass Loadings from Waste Management Facilities (2008 to Present)



Containment Practices for Facilities Managing High-Concentration Uranium Solutions

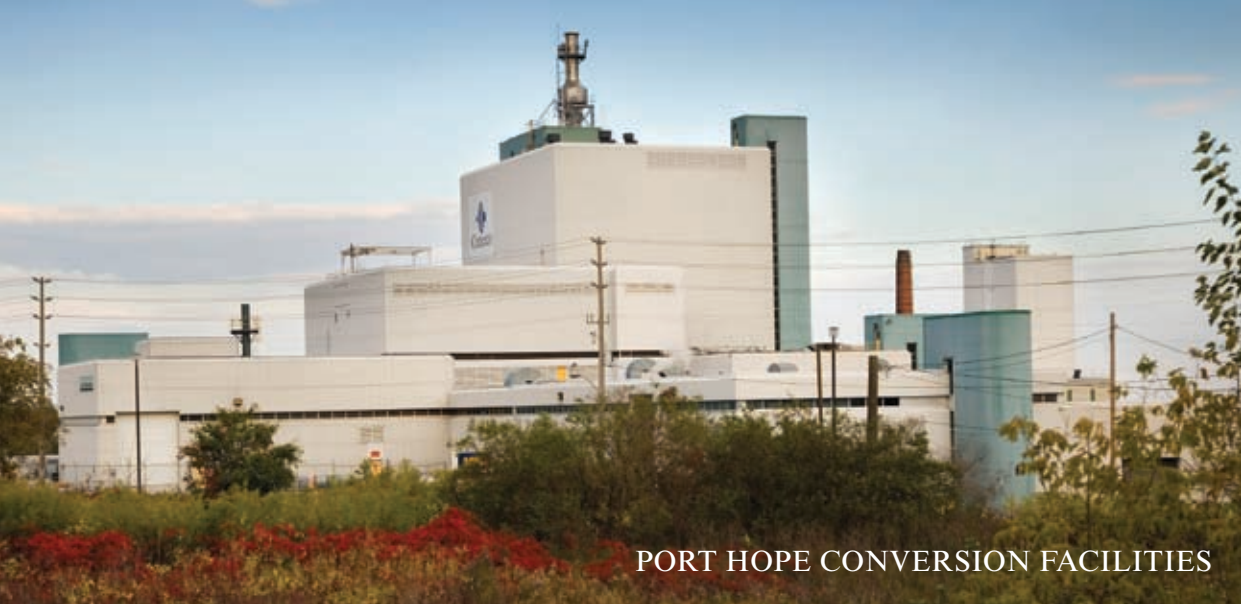
3



SAFE HANDLING AND STORAGE OF URANIUM DIOXIDE

Containment Practices for Facilities Managing High-Concentration Uranium Solutions

During 2007 and 2008, leaks of uranium-bearing solutions through building foundations to underlying soils and groundwater were detected beneath two Cameco facilities: the Port Hope conversion facility (2007) and the Rabbit Lake mill (2008). Results of root cause investigations were communicated to other CNSC licensees, emphasizing the importance of adequately maintaining foundations and sumps and ensuring separation between primary and secondary containment.



PORT HOPE CONVERSION FACILITIES

3.1

3.1 Port Hope Conversion Facilities

Following the July 2007 discovery of sub-surface contamination, Cameco voluntarily shut down its UF_6 plant and the CNSC took regulatory action requiring Cameco to complete several remedial activities. The plant reopened after upgrades to its sub-surface civil structures and liquid management systems and was restarted in accordance with a plan reviewed and accepted by CNSC staff.

Cameco's UO_2 plant went into extended maintenance from mid-October 2008 to mid-January 2009 and implemented lessons learned from the UF_6 plant rehabilitation. These activities confirmed similar uranium solution seepage through the sump floor to the groundwater. As a result, several facility improvements were initiated for remediation.

CNSC staff reviewed and accepted Cameco's corrective action plans for each plant and verified their completion. Both plants remained shut down until Cameco completed the required actions.

An enhanced preventative maintenance program was implemented to ensure that a similar loss through the foundation was not occurring at Cameco's Blind River refinery. In addition to normal scheduled maintenance activities at the facility, foundation and subsurface soils were assessed to ensure there was no process solution loss through the foundations. Core samples were collected from the floor areas in the UO_3 plant and analyzed for uranium. These samples showed no indication of uranium migration through the protective floor.

3.2



RABBIT LAKE MILL

3.2 Rabbit Lake Mill

In January, 2008, seepage was discovered in the low pH clarifier excavation adjacent to the Rabbit Lake mill. The event was reported to both the CNSC and the Saskatchewan Ministry of Environment.

Areas of the Rabbit Lake mill that were selected for repair and secondary containment under the secondary containment upgrade (SCU) project were prioritized and completed following the initial Rabbit Lake risk assessment plan. Priority areas were completed and work continued to progress on lower priority areas. Findings from the TapRoot® investigation were entered into the Cameco Incident Reporting System (CIRS) for tracking and resolution.

The Rabbit Lake operation subsequently implemented administrative controls whereby the practice of using areas of the mill floor for process containment was reviewed and changed.

In July 2008, Cameco submitted its completed hydrological investigation, which indicated that the initial loss of containment area was fully contained by the excavated sump, and that potential groundwater contamination from other sources was also contained in the Rabbit Lake in-pit drainage system. Additional groundwater monitoring wells were installed and are being monitored.

After Cameco made major upgrades to the CIRS to improve its functionality, the CNSC continued its regular inspections of the system during 2009. It also reviewed data from additional groundwater monitoring wells that were installed.

Management of Uranium Releases: Special Activities

4



4.1 CNSC Effluent Charter: Process for Establishing Release Limits for Nuclear Facilities

The NSCA and its regulations provide the authority and general framework for setting regulatory limits on effluents from nuclear facilities. However, neither the NSCA nor the regulations contain specific numerical effluent limits. In the absence of specified limits, the CNSC has regulated effluent quality through the incorporation of other applicable federal legislation (e.g. the *Metal Mining Effluent Regulations* for uranium mines) directly into licences. This approach does not address a number of radionuclides, nor many other potential hazardous substances within effluent waste streams.

The CNSC has therefore required the development of environmental codes of practice for uranium mines and mills to establish action and administrative levels for COPCs identified through ecological risk assessments or past operating practice. These control levels are based on the normal operating levels of the effluent treatment systems and are used to identify and trigger corrective actions when deviations from normal operating conditions occur.

With the additional responsibilities associated with the NSCA for both environmental protection and hazardous substances, and in response to the CNSC's desire for more clearly specified limits directly within licences, it was determined that a formal review of the CNSC's current practice relative to other international and national means of establishing release limits was required.

To this end, CNSC staff initiated a project entitled *Process for Establishing Release Limits for Nuclear Facilities*. Its overall objective is to develop and document a formal procedure for establishing effluent limits for both nuclear and hazardous substances released from nuclear facilities. These procedures will meet the principles of pollution prevention and regulatory requirements under the NSCA. The project consists of five core activities.

By December of 2009, the project's first three core activities were completed. The first core activity documented the international practices used for establishing release limits for radionuclides and compiled releases of radionuclides from international nuclear facilities into a central database. The second core activity documented international and Canadian practices for establishing release limits for hazardous substances and compiled releases of hazardous substances from international nuclear facilities into the database. The assessment of international practices involved Australia, the United States, France, the United Kingdom, other EU member states and South Africa. The third core activity documented current CNSC practices and compiled releases of radionuclides and hazardous substances from CNSC licensed facilities into a central database.

In 2010, as part of the fourth core activity, CNSC staff will review the national and international practices used for establishing release limits documented in core activities 1 to 3, in order to make recommendations. The recommendations reviewed will be provided in the 2010 report.

4.2 Environment Canada Guidelines: Water Quality Guideline for Uranium

Environment Canada released a draft Canadian water quality guideline for the protection of aquatic life for public review in July 2009. The proposed guidelines for uranium in fresh water, total recoverable, unfiltered, were 5.5 µ/L for long-term exposure and 40 µ/L for short-term exposure. Prior to this date, there had not been a proposed national water quality guideline for the protection of aquatic life. Comments were accepted during the public review period. It is expected that the final guidelines for uranium will be released upon full evaluation of the comments received.

CNSC/Environment Canada 2009 Annual Meeting

5



CNSC/Environment Canada 2009 Annual Meeting

The Annex to the MOU states:

“The Department and Commission staff will meet annually or more frequently by mutual consent to assess progress on the implementation of this Annex and on the effectiveness of the control measures to reduce the effluent toxicity of the above mentioned facilities.”

CNSC staff (from the Directorate of Environmental and Radiation Protection and Assessment) and Environment Canada staff (from the Environmental Protection Operations Division, Ontario) meet formally every year to address issues relating to the Annex to the MOU and to coordinate other activities related to sharing regulatory and technical expertise. These meetings have also served as a venue for coordinating additional cooperative activities that are not specific to the Annex.

Routine coordinated regulatory activities with respect to CNSC licensees continued during 2009. These included participation of CNSC staff in the national *Metal Mining Effluent Regulations* technical advisory panels for each of the uranium mines, as well as coordination with Environment Canada and the Department of Fisheries and Oceans to address issues related to fish impingement and entrainment and thermal effluent at nuclear power plants. A formal meeting was postponed until 2010, when a two-day workshop was being planned to address several common issues both within and outside the MOU.

Conclusion

6



Conclusion

This report's key findings and conclusions of this report are summarized as follows:

CNSC staff assessments confirm that during 2009, CNSC-licensed facilities did not release uranium in effluent that resulted in significant risk to the environment, and that uranium discharge concentrations from all operating uranium mines and mills were below the CNSC screening objective of 0.1 mg/L. Moreover, uranium discharge concentrations from all CNSC-regulated facilities (including mines and mills, processing and conversion facilities, and waste management facilities) were below the screening objective, with the exception of the Welcome and Port Granby waste management facilities.

In 2009, there was a considerable decrease in Port Granby's annual mean monthly discharge concentration from 1.63 mg/L to 0.92 mg/L. This resulted in a 33% decrease of loadings (from 115.1 kg to 77.2 kg) to the environment. It should be noted that Welcome and Port Granby are part of the Port Hope Area Initiative, under this initiative full remediation of the sites is planned. It is expected that releases will continue to decrease.

The Rabbit Lake mill operation continues to discharge the highest load of uranium to the environment. However, its load in 2009 was approximately 45% lower than in 2008. In 2009 the uranium concentration consistently remained below the screening objective with an annual average concentration almost 50% of that in 2008. These results support the conclusion that the risk management objective following the PSL2 conclusions of CEPA toxic has been achieved.

In 2009, a decreasing trend was observed for total releases from uranium mines and mills and other CNSC-regulated facilities compared to those in 2008. In 2009, the total annual loading released from uranium mines and mills was just over half of that from 2008 (from 711 kg to 378 kg). Similarly, the total annual loading released from waste management facilities decreased by approximately 16%, from 368 kg in 2008 to 310 kg in 2009. Loadings from uranium processing and conversion facilities continue to be very low, but increased from 2.1 kg in 2008 to 4.8 kg in 2009.

The 2009 overall uranium mass loading to the environment from all CNSC-licensed facilities was 36% lower than in 2008 (from 1081 kg in 2008 to 693 kg in 2009). This overall decrease demonstrates the effectiveness of the optimization screening objective of 0.1 mg/L for uranium in effluent, and is evidence that the CNSC continues to be proactive in pollution prevention and in regulating adequate control.

As in 2008, the uranium mining sector of the metal mining industry was the best-performing mining sector, relative to the MMER effluent limits, with no exceedances in 2009. Although the MMER have no limit for uranium releases, they do specify a maximum limit for radium 226 and other parameters of concern from a mining perspective. They also require that all effluent from mining operations be non acutely lethal to fish. A copy of the MMER annual report can be obtained at www.ec.gc.ca/publications.

In conclusion, the CNSC and Environment Canada continue to meet their regulatory commitments and responsibilities associated with the safe regulation and risk management of uranium releases from nuclear facilities.

References

1. Cameco Corporation. *Key Lake Operation: Annual Report 2009*. March 2010.
2. Cameco Corporation. *Rabbit Lake Operation: Annual Report 2009*. March 2010.
3. Cameco Corporation. *McArthur River Operation: Annual Report 2009*. March 2010.
4. Areva Resources Canada Inc. *McClean Lake Operation: Annual Report 2009*. March 2010.
5. Cameco Corporation. *Cigar Lake Project: Annual Report 2009*. March 2010.
6. Cameco Corporation. *Blind River Refinery: Annual Compliance Report 2009*. March 2010.
7. Cameco Corporation. *Port Hope Facility: Annual Compliance Report 2009*. March 2010.
8. Cameco Corporation. *Blind River Refinery: Quarterly Report 2009 (Q1 to Q4)*. 2010.
9. Cameco Corporation. *Port Granby Waste Management Facility: Annual Report 2009*. March 2010.
10. Cameco Corporation. *Welcome Waste Management Facility: Annual Report 2009*. March 2010.
11. Rio Algom Limited. *2009 Operating Care and Maintenance Annual Report*, March 2010.
12. Denison Mines Inc. *2009 Operating Care and Maintenance Annual Report*, March 2010.
13. Canadian Nuclear Safety Commission & Environment Canada. *Risk Management of Uranium Releases from Uranium Mines and Mills: 2007 Annual Report*. March 2009.
14. Canadian Nuclear Safety Commission & Environment Canada. *2008 Annual Report on Uranium Management Activities*. October 2010.
15. *Nuclear Safety and Control Act*. May 2000.
16. Canadian Nuclear Safety Commission. *General Nuclear Safety Control Regulations*. May 2000.
17. Canadian Nuclear Safety Commission. *Uranium Mines and Mills Regulations*. May 2000.
18. Environment Canada & Health Canada. *Release of Radionuclides from Nuclear Facilities (Impact on Non-Human Biota): Priority Substance List Assessment Report*. May 2003. ISBN # 0-662-3541-9. Retrieved from www.ec.gc.ca/substances/ese/eng/psap/final/radionuclides.cfm
19. SENES Consultants Limited. *Uranium in Effluent Treatment Process*. Prepared for the Canadian Nuclear Safety Commission, March 2006.
20. Environment Canada. *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations in 2009*, 1/MM/19. September 2009.

Appendix A

COPY OF THE MEMORANDUM OF UNDERSTANDING AND ASSOCIATED ANNEX

APPENDIX A: Memorandum of Understanding (MOU) Between the Canadian Nuclear Safety Commission and Environment Canada

WHEREAS the Canadian Nuclear Safety Commission (hereinafter, “the Commission”) and Environment Canada (hereinafter, “the Department”) have independent but related mandates in regard to the protection of the environment and activities carried out under their respective mandates have the potential to affect the programs and responsibilities of the other;

WHEREAS the Regulatory Policy¹ of the Government of Canada requires that federal departments and agencies take full advantage of opportunities to coordinate their activities with each other;

WHEREAS the Commission regulates, pursuant to the Nuclear Safety and Control Act (NSCA), the development, production and use of nuclear energy and the production and use of nuclear substances, prescribed equipment and prescribed information in order to:

- i. prevent unreasonable risk to the environment and to the health and safety of persons;
- ii. prevent unreasonable risk to national security; and
- iii. achieve conformity with measures of control and international obligations to which Canada has agreed;

WHEREAS the Department under the *Department of the Environment Act* has powers, duties and functions relating to the preservation and enhancement of the quality of the natural environment, including water, air and soil quality; renewable resources, including migratory birds and other non-domestic flora and fauna; water; meteorology; the enforcement of rules and regulations arising from the advice of the International Joint Commission relating to boundary waters and questions arising between the United States and Canada in so far as they relate to the preservation and enhancement of environmental quality;

WHEREAS the Department regulates, pursuant to the *Canadian Environmental Protection Act* (CEPA, 1999), has the mandate to:

- i. ensure that preventive and remedial measures are taken to protect the environment;
- ii. establish nationally consistent levels of environmental quality;
- iii. apply knowledge, science and technology to resolve environmental problems;
- iv. protect the environment from the release of toxic substances; and
- v. assess whether substances in use in Canada are toxic or capable of becoming toxic;

WHEREAS the Department has been assigned responsibility for the administration and enforcement of subsection 36(3) of the *Fisheries Act*, which deals with the deposit of deleterious substances into water frequented by fish;

THEREFORE, the Commission and the Department agree to consult and cooperate in accordance with the following sections of this Memorandum of Understanding in order to minimize regulatory duplication and to use government resources effectively.

I. Principles

1. The parties, in carrying out their respective mandates will cooperate and support each other, as appropriate, in meeting their responsibilities in relation to environmental conservation and protection and in other areas of mutual interest.
2. The parties will take all reasonable steps, consistent with their respective mandates, to see that their environmental protection policies and measures are complementary and designed to provide effective environmental protection.
3. The parties will provide each other the opportunity to advise on policies and programs that may affect the mandate of the other, in a manner that allows for timely and substantive advice.
4. The parties will foster strong working relations by establishing mechanisms and links to share information, taking into account legal constraints on the sharing of confidential business information.

II. Implementation

The Department agrees to:

1. Inform and advise the Commission on the Department's current policies, programs, standards and regulations concerning the protection of the environment, and the management of toxic substances of concern to the Commission;
2. Provide the opportunity to the Commission to provide guidance, information and advice prior to developing, amending or terminating the policies, programs, standards or regulations referred to in the above paragraph that may affect the facilities and activities regulated by the Commission;
3. Cooperate with the Commission on regulatory matters of mutual concern involving the nuclear industry, including:
 - a. developing and managing programs and processes for the implementation of obligations pursuant to the *Canadian Environmental Protection Act* (CEPA, 1999), as they relate to facilities and activities regulated by the Commission;
 - b. consulting with the Commission, on request, in the review of applications before the Commission, and where appropriate, providing advice on matters concerning the protection of the environment;
 - c. promoting awareness among licensees of the Commission of the Department's mandated requirements;
 - d. verifying compliance with the regulatory requirements of either the Commission or the Department;
 - e. sharing environmental information; and

- f. informing the Commission of any review or investigation by the Department of a non-compliance incident under its jurisdiction that may have occurred at a facility regulated by the Commission; and where appropriate, consulting and coordinating with the Commission, prior to taking regulatory enforcement actions at facilities, or on activities licensed by the Commission;
- 4. Consult and cooperate with the Commission in the development of any national or international standard, agreement, convention, or commitment that could affect the regulation of the nuclear industry by the Commission;
- 5. Cooperate with the Commission in matters of mutual interest related to nuclear emergency preparedness and response;
- 6. Cooperate with the Commission on the conduct of environmental studies, assessments or research projects of potential interest to the regulation of the nuclear industry, and in the sharing of expert assistance and financial resources for such purpose; and
- 7. Coordinate public communication and consultation activities with the Commission on matters of mutual interest and responsibility.

The Commission agrees to:

- 1. Inform and advise the Department on the Commission's current policies, programs, standards and regulations concerning the protection of the environment and the management of toxic substances in relation to nuclear facilities and activities;
- 2. Provide the opportunity to the Department to provide guidance, information and advice prior to developing, amending or terminating the policies, programs, standards or regulations referred to in the above paragraph that may involve the use, release or management of substances designated as toxic under CEPA, and other contaminants of mutual environmental concern;
- 3. Cooperate with the Department on joint regulatory matters concerning the nuclear industry, including:
 - a. developing and managing programs and processes for the implementation of obligations pursuant to the Nuclear Safety and Control Act (NSCA), as they relate to facilities and activities regulated by the Department;
 - b. providing the Department with the opportunity, on request and where appropriate, to review applications before the Commission and provide advice on matters concerning the protection of the environment;
 - c. promoting awareness of the Department's requirements among licensees of the Commission;
 - d. verifying licensee compliance with the regulatory requirements of either the Commission or the Department;
 - e. providing the Department with the opportunity, on request and where appropriate, to participate in joint compliance inspections of facilities and activities licensed by the Commission;
 - f. sharing environmental information; and
 - g. informing the Department of any review or investigation by the Commission of a non-compliance incident under its jurisdiction that may involve substances designated as toxic under CEPA or other contaminants of mutual environmental concern; and where appropriate, consulting and coordinating with the Department, prior to taking regulatory enforcement actions involving the environment.

4. Consult and cooperate with the Department in the development of any national or international standards, agreements or conventions concerning the protection of the environment;
5. Cooperate with the Department in matters of mutual interest related to nuclear emergency preparedness and response;
6. Cooperate with the Department on the conduct of environmental studies, assessments or research projects of potential interest to the regulation of nuclear facilities and activities, and in the sharing of expert assistance and financial resources in the conduct of these studies, assessments or research projects; and
7. Coordinate public communication and consultation activities with the Department on matters of mutual interest and responsibility.

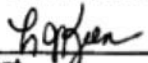
III. Terms of the MOU

1. The primary points of contact under this MOU, and responsible for its administration, are the Vice-President, Operations Branch, CNSC, and the Regional Director General, Ontario Region, Environment Canada who will meet annually during the normal planning process.
2. The parties will make every reasonable effort to resolve at the working level any conflicts that arise from this Memorandum of Understanding. Failing resolution at the working level, conflicts may be referred for resolution to the offices named pursuant to paragraph 1 above, or to the signatories to this Memorandum.
3. Subject to paragraph 4, the parties will provide or honour without charge to the other party the services agreed to and the commitments made in this Memorandum of Understanding.
4. The parties recognize that the delivery of certain services agreed to in this Memorandum of Understanding, or the honouring of certain commitments made in this Memorandum, may be subject to cost recovery regulations or may require, on a case by case basis, financial arrangements between the Commission and the Department to offset, in whole or part, the associated costs. Where such arrangements are necessary, the parties agree to consult and cooperate to develop mutually satisfactory arrangements.
5. The parties agree to consult in advance concerning any significant changes in the level or nature of service that either party may request, or intends to request, of the other party pursuant to this Memorandum of Understanding.
6. The parties agree to collaborate on identifying opportunities for training and staff exchanges in areas of mutual interest.
7. This Memorandum of Understanding becomes effective on the date of the last signature, and shall remain in effect until modified or withdrawn. The Memorandum may be revised by the mutual consent of the Department and the Commission. Either party may withdraw from the agreement by providing at least six (6) months notice in writing to the other party, specifying its intention to withdraw and the effective date of withdrawal.

Signed in duplicate in the English and French languages.

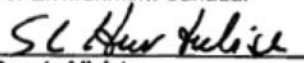
Signed on: 23/09/03

For the Canadian Nuclear Safety Commission:


President

Signed on: 10/7/03

For Environment Canada:


Deputy Minister

ANNEX 1

To the Memorandum Of Understanding (MOU) Between Environment Canada And The Canadian Nuclear Safety Commission - Risk Management Process For Radionuclides As Assessed Under The *Canadian Environmental Protection Act, 1999*

Assessment of Radionuclides under the *Canadian Environmental Protection Act, 1999*

Pursuant to the provisions of the *Canadian Environmental Protection Act, 1999* (CEPA, 1999), Environment Canada (the Department) completed an assessment of releases of radionuclides from nuclear facilities, consisting of sectoral assessments for impacts on non-human biota.

The assessment concludes that uranium and uranium compounds contained in effluents from uranium mines and mills meet the environmental toxicity criteria set out in paragraph 64(a) of CEPA, 1999. The assessment recommends that the investigation of options to reduce exposure to uranium and uranium compounds contained in effluents from such facilities be considered a high priority.

Considerations / Principles for Cooperation

Pursuant to paragraph 3(a) under Section II (Implementation) of the MOU between the Department and the Canadian Nuclear Safety Commission (the Commission) and under the terms of this Annex, the Department and the Commission agree to develop and implement a program to reduce or control the exposure of non-human biota to uranium and uranium compounds contained in effluents from such facilities.

Under the *Nuclear Safety and Control Act* (NSCA), the Commission has the mandate to ensure that the operation of nuclear facilities, such as uranium mines and mills, does not pose unreasonable risks to the environment. The NSCA came into force on May 31, 2000. Environmental protection is integral to the new regulatory mandate, and the NSCA provides a broad range of regulatory powers respecting environmental protection.

It has been determined that it is possible to prevent or control the amount of uranium and uranium compounds released to the environment in effluents from uranium mines and mills under the NSCA. The Department and the Commission will work cooperatively to ensure preventive or control measures are developed and implemented in a manner that is consistent with and comparable to CEPA 1999.

It is on this basis, and to avoid regulatory duplication, that it has been recommended that the Minister of the Environment and the Minister of Health take no further action at this time, pursuant to subsection 77(6) of CEPA 1999. The Commission will develop preventive or control measures under the NSCA with support from the Department.

Nothing in this Annex modifies or restricts the mandate, responsibilities or authorities of the Minister of the Environment, of the Minister of Health or of the Canadian Nuclear Safety Commission.

Development of Preventive or Control Measures

The Commission will appoint a risk manager and initiate the process to develop preventive or control measures for releases of uranium and uranium compounds from specified uranium mines and mills where the effluent has been identified as likely to be causing harm to aquatic organisms, within three months of the date of the release of the final CEPA assessment report. These mines and mills include Rabbit Lake, Key Lake and Cluff Lake.

Commission staff will consult with stakeholders on the proposed preventive or control measures in a public process.

Commission staff will consult with the Department during the options review and approval process.

While developing the preventive or control measures under the NSCA, the Commission can utilize, depending on the circumstances, licence conditions, orders, or requests for analyses and modification of designs, equipment or procedures, to ensure that effluent releases are not likely to cause significant environmental harm.

Preventive or control measures will include an Environmental Emergency Plan to prevent or mitigate the environmental effects of accidental releases of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment.

In the case of the Rabbit Lake Mine/Mill, a study of technical options to improve the quality of effluent of the mine/mill will be completed within 26 months of November 1, 2003, which corresponds to the coming into force of the Rabbit Lake licence renewal. The design, installation and commissioning of the control measures will be completed within the following 16 months.

In the case of the Key Lake Mine/Mill, environmental performance objectives will be developed and implemented within 12 months of the date of release of the CEPA assessment report.

Commission staff will verify that effluent management improvements and the treatment facilities that have been installed are effective and that the effluent is no longer causing significant toxicity.

Environmental performance objectives identified in the preventive or control measures will be based on implementation of all reasonable precautions to control the release of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment as a result of a Commission-licensed activity.

In the case of the Cluff Lake Mine/Mill, the mine/mill has ceased operations and was granted a Decommissioning Licence for a five-year term, valid until July 31, 2009. The Cluff Lake Mine/Mill is, therefore, not subject to immediate risk management measures.

The Commission will continue to ensure that uranium and uranium compounds contained in effluent from all nuclear facilities are not causing significant environmental harm.

The Department will identify a point of contact to coordinate assistance to the Commission.

The Department will assist the Commission through the provision of training and guidance documents, and/or the conduct of specific studies.

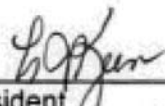
The Department and Commission staff will meet annually or more frequently by mutual consent to assess progress on the implementation of this Annex and on the effectiveness of the control measures to reduce the effluent toxicity of the above-mentioned facilities.

Releases of radionuclides from nuclear facilities will be regularly monitored by the Commission to evaluate whether risk management initiatives are needed for ionizing radiation. The Department and Commission staff will meet annually or more frequently by mutual consent to review and assess any new information related to the environmental risk from ionizing radiation and take action if necessary.

The Department and the Commission agree to prepare and make public a joint annual report outlining progress on the implementation of this Annex within six months after the end of the calendar year for which it is prepared. Signed in duplicate in the English and French languages.

Signed on: Dec 13, 2004

For the Canadian Nuclear Safety Commission:



President

Signed on: DEC 02 2004

For Environment Canada:



Deputy Minister

1. Government of Canada Regulatory Policy, 1999

Appendix B: Glossary

ALARA (as low as reasonably achievable)

Every reasonable effort to maintain exposures as far below the regulated dose limits as practical, taking into account the state of technology, economics of improvements in relation to the state of technology, economics of improvements in relation to benefits to the public health and safety and other societal/socioeconomic considerations, and in relation to the use of nuclear energy and licensed material in the public interest.

Code of Practice: Effluent

An administrative framework applied to identify when effluent quality is deteriorating, indicating the potential loss of treatment control. Effluent contaminant concentrations are identified and, if exceeded, require the operator to perform specific actions (as documented in the Code of Practice) to decrease contaminant concentrations. The Code of Practice identifies specific treatment plant actions as well as reporting requirements to the CNSC.

µg/L (micrograms per litre)

A concentration measurement that describes the quantity of a substance within a liquid media. 1 µg/L is the same as one part per billion (1 ppb), meaning there would be 1 g of uranium distributed in 1 million litres of water.

Biota

All living organisms, including humans.

CEPA toxic

Substance determined to be toxic as defined under the *Canadian Environmental Protection Act* (CEPA 1999).

“A substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions that

- (a) *have or may have an immediate or long-term harmful effect on the environment or its biological diversity;*

- (b) *constitute or may constitute a danger to the environment on which life depends; or*

- (c) *constitute or may constitute a danger in Canada to human life or health.”*

Class I nuclear facility

These facilities include the following:

- nuclear fission or fusion reactors
- vehicles equipped with reactors
- particle accelerators
- uranium, thorium or plutonium processing and product manufacturing plants
- disposal facilities for nuclear substances generated at another nuclear facility

Commissioning

The process during which systems and components of facilities and activities, having been constructed, are made operational and verified to be in accordance with design specifications and to have met the required performance criteria. Commissioning may include both non-radioactive and radioactive testing.

Decommissioning

Administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility. This does not apply to a repository or to certain nuclear facilities used for mining and milling of radioactive materials, for which closure is used.

Deleterious substances

As defined in the *Federal Fisheries Act*;

- (a) any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water, or

(b) any water that contains a substance in such quantity or concentration, or that has been so treated, processed or changed, by heat or other means, from a natural state that it would, if added to any other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water, and without limiting the generality of the foregoing includes

(c) any substance or class of substances prescribed pursuant to paragraph (2)(a),

(d) any water that contains any substance or class of substances in a quantity or concentration that is equal to or in excess of a quantity or concentration prescribed in respect of that substance or class of substances pursuant to paragraph (2)(b), and

(e) any water that has been subjected to a treatment, process or change prescribed pursuant to paragraph (2)(c).

Dewatering water

Groundwater intercepted by pumps to prevent it from flowing into open pits or into the underground workings of a mine.

Effluent

The waste stream (in particulate, gaseous or liquid form) from a facility released into the environment.

Ion exchange process

A usually reversible exchange of one ion with another, either on a solid surface or within a lattice. A commonly used method for treatment of liquid waste.

Loadings

A quantity of a substance (e.g. water, sediment, nutrients, pollutants) introduced into a receiving media. Loading may be from humans (e.g. pollutant loading) or natural (e.g. natural background loading) sources, and is

typically described as the mass (of introduced substance) per unit volume air or water (the receiving media).

Liquid effluent loadings are calculated by multiplying the concentration of a contaminant in the effluent by the volume of effluent released. For example, releasing 20,000 L of effluent containing 1 µg/L of uranium results in the release of 0.02 g of uranium to the environment; hence, the loading to the environmental system in this case is 0.02 g.

Memorandum of Understanding (MOU)

A document describing a bilateral or multilateral agreement between parties. It expresses a convergence of will between the parties, indicating an intended common line of action.

Modelling parameters

Numerical values used to characterize properties of contaminants (e.g. octanol-water partitioning coefficient) and environmental media (e.g. organic matter fraction of soil) that are used in models to predict the environmental fate and transport of contaminants for the Environmental Risk Assessment.

Optimization Screening Objective (OSO)

The CNSC is using a value of 0.1 mg/L for the concentration of uranium in treated effluent as an Interim Design Objective for new facilities and as an Optimization Screening Objective for existing facilities. This value is used to identify those facilities which, while not exceeding any regulatory limits, should review their treatment process to determine whether the present system can be optimized or upgraded to meet the CNSC's expectations for ALARA.

Precipitation pond

A precipitation pond retains treated water, allowing increased time for chemical reactions to occur between treatment agents and contaminants. This results in the ‘precipitation’ or settling of solids and associated contaminants from the water column.

Priority Substances Lists (PSL1 and PSL2)

The Priority Substances Lists (PSL1 and PSL2) were established by the ministers of the Environment and of Health. They identify substances to be assessed on a priority basis to determine whether they are toxic (as defined under Section 64 of the CEPA) and pose a risk to the health of Canadians or to the environment.

Radionuclide

A nucleus of an atom that possesses properties of spontaneous disintegration (i.e. radioactivity). Nuclei are distinguished by their mass and atomic number.

Reverse osmosis

Movement of a solvent out of a solution under pressure through a semipermeable membrane into pure solvent or a less concentrated solution at lower pressure. This process can be used to increase the radionuclide concentration in a solution.

