Uranium

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OVERVIEW

Market conditions for uranium producers improved in 2003. With continuing improvement in the political climate for, and the public acceptance of, nuclear energy, as well as an increasing realization of the possibility of future electrical generating capacity shortfalls together with a continued focus on clean air, nuclear power appears poised to expand.

The uranium spot market price, following a lengthy period of stability, rose 42% in 2003, fueled by a series of supply disruptions, a sudden realization that inventory supply was not as plentiful as had been thought, and indications that some presumed future supply sources might not be as secure as had been believed. Canadian uranium producers are well positioned to capitalize on this market upturn as the transition to new production centres tapping high-grade, low-cost deposits in northern Saskatchewan is now nearing completion.

Canadian uranium production in 2003 amounted to a total of 10 455 tU, down some 10% from the 2002 total of 11 607 tU, due to a three-month closure of the McArthur River mine that was required to repair damage caused by water inflow that began on April 6, 2003. As Figure 1 shows, the world's two largest uranium-producing companies have operations in Canada. As of January 1, 2004, Canada's "known" recoverable uranium resources totalled 432 000 tU, compared with 439 000 tU as of January 1, 2003. This downward adjustment of some 2% is the result of mining depletion and ongoing deposit appraisal.

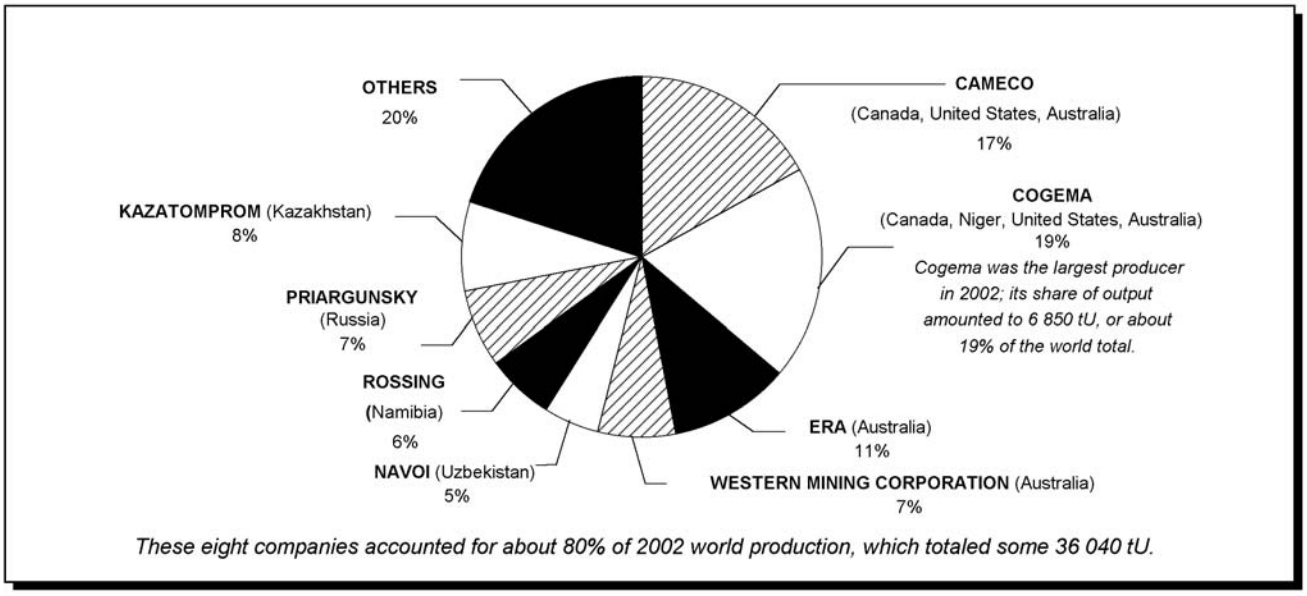
Following public hearings held in 2004, the Canadian Nuclear Safety Commission (CNSC) issued a Decommissioning Licence to AREVA Group/COGEMA Resources Inc. (CRI) for the Cluff Lake uranium production centre that had closed in December 2002. The CNSC also issued a Construction Licence to Cameco Corporation for surface construction activities in 2004 at Cigar Lake. The Cigar Lake mine is currently expected to begin production in 2007.

DOMESTIC PRODUCTION AND DEVELOPMENTS

In 2002, the most recent year with complete data available, production amounted to a total of 11 607 tU, a decrease of about 7% from the 2001 total, mainly due to reduced production at Rabbit Lake. Direct employment in Canada's uranium mining industry remained steady at slightly less than 1000 in 2002 (Table 1). Shipments from mining centres declined slightly in 2002, compared to 2001, although the total value of these shipments increased slightly (Table 2). These data primarily reflect the successful transition that uranium producers are continuing to make to the new high-grade production centres as resources near depletion at the older operations. Despite the slight decrease in 2002 production, however, uranium continues to rank among Canada's top 10 metal commodities in terms of output value. Table 3 documents the main operational characteristics of the existing uranium production centres in Canada in 2002, and Table 4 updates the status of new projects that represent Canada's future production capability. All current production and new projects awaiting development are located in the Athabasca Basin of northern Saskatchewan. One property that was considered for development, Kiggavik in Nunavut (Figure 2), is not likely to proceed in the foreseeable future due to uncertain regulatory requirements. Uranium production in Canada in 2002 (Figure 3) was once again dominated by Cameco Corporation and CRI.

On June 4, 2004, the Federal Court of Appeal unanimously agreed with the CNSC and CRI that a McClean Lake operating licence was obtained properly, overturning the September 2002 Federal Court of Canada decision that quashed that operating licence. The Federal Court of Appeal decision is good news for the uranium mining industry in Canada. Although operations had continued uninterrupted at McClean Lake since the September 2002 Court decision, they had done so under a cloud of uncertainty. The decision reduces uncertainty at McClean Lake and at other uranium mining projects that were a part of

Figure 1
World's Top Uranium Mining Companies in 2002



Source: *World Nuclear Association Pocket Guide*.
Note: Ranking reflects equity interest in production facilities, not market share.

the major environmental assessment process conducted in the 1990s pursuant to regulatory requirements that preceded the *Canadian Environmental Assessment Act* (CEAA).

CRI is part of the AREVA Group created in 2001 by the merger of COGEMA S.A. and Framatome ANP, as well as several other companies. On June 1, 2004, CRI's president and chief executive officer, Mr. Tim Gitzel, assumed the position of Executive Vice-President of the AREVA Mining Business Unit in Paris, France. With Mr. Gitzel's departure, Mr. Vincent Martin, who has been CRI's senior vice-president and chief operating officer, was appointed acting President.

In 2002, its final year of operation, the Cluff Lake facility was awarded the John T. Ryan trophy for achieving the lowest lost-time accident rate (0) for a metal mine in Canada. Cluff Lake also won this award in 1998, while McArthur River and Rabbit Lake won the national award in 1999 and 2000, respectively.

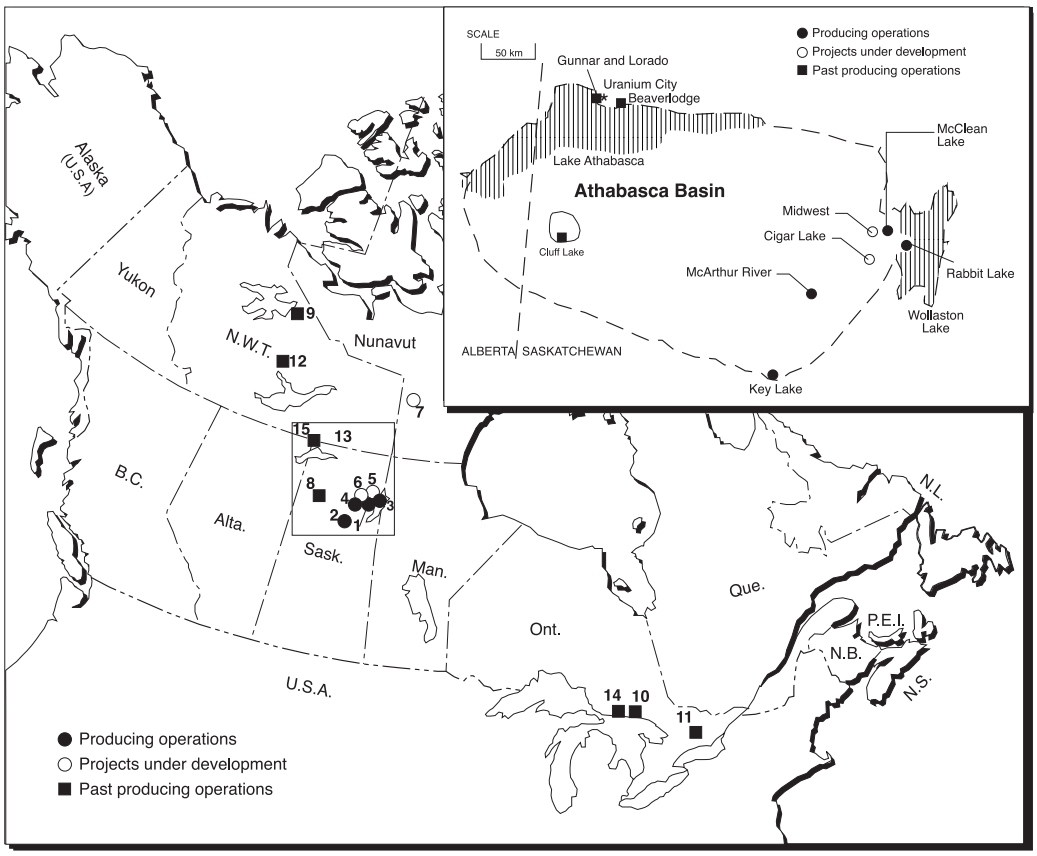
On June 18, 2004, the Saskatchewan Uranium Miners' Cohort Study Group announced that it had cancelled plans to conduct a study of the health of present and future uranium miners because it would not be scientifically feasible to do so. With radon exposures now between 100 and 1000 times lower than in past operations (i.e., prior to 1975), the Study Group concluded that any higher-than-normal rates of lung cancer from such low levels of exposure would be virtually impossible to measure.

The Cluff Lake facility and CRI's uranium exploration program in Saskatchewan achieved ISO 14001 environmental management system certification in 2004. The McArthur River mine and the Key Lake mill, the McClean Lake mine and mill, and the Blind River refinery and Port Hope conversion plant have already achieved this internationally recognized standard, which outlines the key requirements that companies should comply with in order to operate in an environmentally responsible manner. Thus, the front end of the nuclear fuel cycle in Canada meets rigorous international standards.

Elliot Lake, Ontario

Monitoring, water treatment, and minor engineering works remain the main activities at the decommissioned uranium mining facilities in Elliot Lake, Ontario. Since the last facility closed in 1996, uranium mining companies have committed well over $75 million to decommission all mines, mills and waste management areas in what was the centre of uranium production in Canada for over 40 years. To date, results from a variety of monitoring programs indicate that the decommissioned facilities are performing as anticipated.

Figure 2
Uranium Mining in Canada, 2003



Numbers refer to locations on map above.

PRODUCING OPERATIONS

1. Rabbit Lake
2. Key Lake
3. McClean Lake
4. McArthur River

PROJECTS UNDER DEVELOPMENT

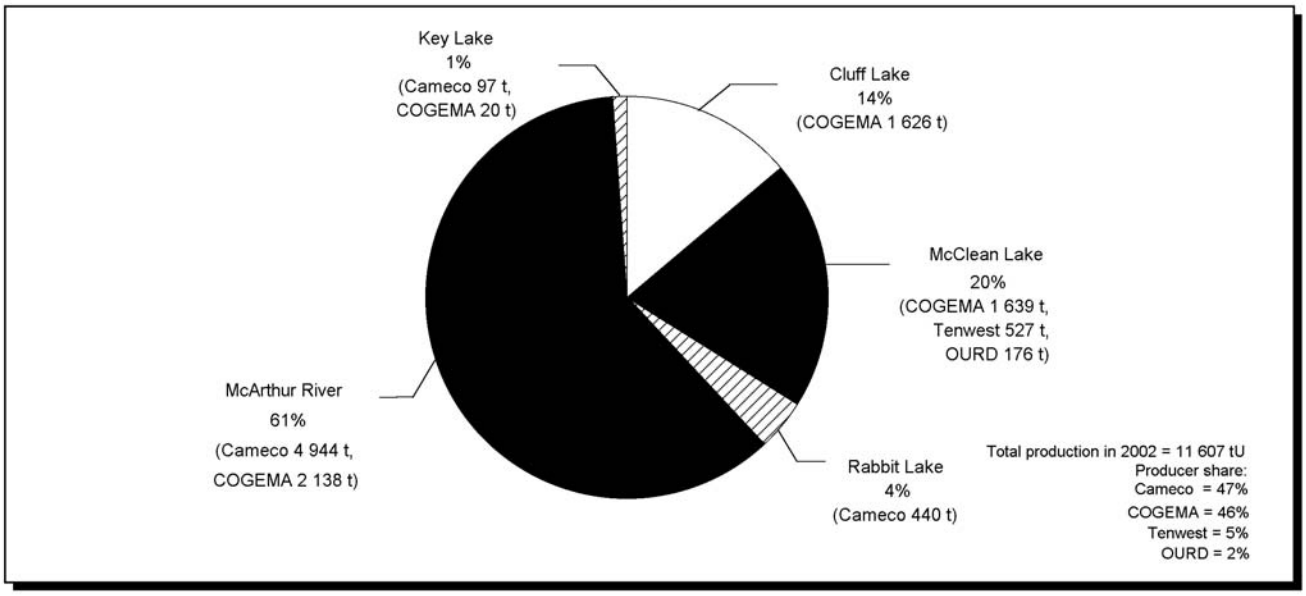
5. Midwest
6. Cigar Lake
7. Kiggavik

PAST PRODUCING OPERATIONS

8. Cluff Lake
9. Port Radium
10. Agnew Lake
11. Madawaska et al (Bancroft)
12. Rayrock (Marian River)
13. Beaverlodge et al
14. Quirke/Panel/Denison and Stanleigh et al (Elliot Lake)
15. Gunnar and Lorado et al

Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

Figure 3
Canadian Uranium Production and Ownership, 2002



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.
Cameco: Cameco Corporation; COGEMA: COGEMA Resources Inc.; OURD: OURD (Canada) Co., Ltd.; Tenwest: Tenwest Uranium Ltd.
Notes: Production reflects equity interest in production facilities. Tenwest is a wholly owned subsidiary of Denison Mines Limited.

Athabasca Basin, Saskatchewan

McArthur River

The McArthur River mine is a Cameco-CRI joint venture operated by Cameco. Production in 2003 declined to 5751 tU, compared to the 2002 total of 7082 tU, because a breach in a development drift on April 6, 2003, led to flooding at the base of the mine that resulted in the temporary suspension of operations. Mining resumed on July 2, 2003, about one month earlier than originally anticipated, and mining of the world's largest high-grade uranium deposit discovered to date has continued as planned since then.

Key Lake

Key Lake is a Cameco and CRI joint venture operated by Cameco. Local deposits were mined out in 1997, but the mill continues to operate as it is processing all McArthur River ore. In 2003, Key Lake produced a total of 5830 tU, a decrease of about 18% over the 2002 total of 7199 tU. A small contribution (79 tU) of total 2003 mill production is derived from Key Lake stockpiled mineralized waste rock that is used to **lower** the grade of McArthur River ore to produce a mill feed of about 3.4% U.

A proposal to increase annual production by 18% (from 7200 tU to 8500 tU) at McArthur River and Key Lake is currently the subject of a screening-level environmental assessment initiated in January 2003. A proposal to recycle uranium by-products from the Blind River refinery and the Port Hope conversion plant at Key Lake is also the subject of an ongoing screening-level environmental assessment initiated in December 2002. Following the closure of the last uranium mill in Elliot Lake, Ontario, recyclable by-products from the Blind River and Port Hope facilities in Ontario have been processed at the White Mesa mill in Utah.

McClean Lake

The McClean Lake uranium production facility is majority-owned and operated by CRI. In 2003, production amounted to 2318 tU, down slightly from the 2342 tU produced in 2002. Mining of the Sue C open pit was completed in early February 2002 and the McClean Lake mill is being fed principally with stockpiled ore from the Sue C deposit, which is expected to last until the end of 2005. A proposal to mine the Sue E deposit by the open-pit method is currently the subject of a screening-level environmental assessment initiated in October 2003.

In 2002, the Federal Court of Canada issued an order that quashed a 1999 McClean Lake operating licence on the grounds that an environmental assessment (EA) under the CEAA had not been conducted prior to issuing the licence. The McClean Lake project was reviewed by an environmental review panel pursuant to regulatory requirements that preceded the CEAA. An appeal court subsequently ordered the decision stayed pending the disposition of the appeal, which was heard on May 3 and 4, 2004.

The Government of Saskatchewan, as well as northern people and businesses represented by the Lac La Ronge Indian Band, Kitsaki Development Limited Partnership and Northern Resource Trucking, appeared as interveners in support of the CNSC and CRI during the appeal process. The June 4, 2004, Federal Court of Appeal ruled that the licence was obtained properly, overturning the September 2002 Federal Court of Canada decision. The Federal Court of Appeal also awarded costs to CRI.

Rabbit Lake

The Rabbit Lake production facility is wholly owned and operated by Cameco. Output in 2003 amounted to 2280 tU, up significantly from 2002 production of 440 tU as challenges, principally related to unstable ground conditions in the Eagle Point underground mine, were overcome. Following the identification of prospects for additional reserves near the existing mine, the development of an exploration drift was completed in early 2004 and drilling to define the potential reserves was initiated.

Rabbit Lake reserves are expected to provide feed for the mill until early 2005. Pending the identification of additional reserves, Rabbit Lake is expected to be dedicated to the processing of Cigar Lake ore in the latter half of this decade.

Cluff Lake

The Cluff Lake uranium production facility, wholly owned and operated by CRI, ceased production at the end of 2002. In preparation for closure, a comprehensive study environmental assessment of a decommissioning plan for the facility was initiated on April 15, 1999. On April 15, 2004, following a review of public comments and the environmental assessment report, the Minister of the Environment announced that the project is not likely to cause significant adverse environmental effects with the implementation of mitigation measures outlined in the report and that further assessment is not required. This decision was based on conclusions and recommendations in the comprehensive study report, public comments received during the 30-day consultation period, and the CNSC's response to these comments.

Following public hearings held on April 29, 2004, in Ottawa and June 9, 2004, in La Ronge, Saskatchewan, the CNSC issued a Decommissioning Licence to CRI for Cluff Lake. The licence, which is valid until July 31, 2009, allows CRI to decommission two underground mines, four open-pit mines, a mill, waste management systems, and associated site facilities. Decommissioning is expected to take between two and three years.

Cigar Lake

The Cigar Lake mine is a joint venture being developed by Cameco (Table 4). Cigar Lake is the world's second largest high-grade uranium deposit discovered to date with reserves totalling more than 85 000 tU at an average grade of over 17% U. On August 29, 2003, a screening environmental assessment of a proposal to dispose of potentially acid-generating Cigar Lake waste rock in the Sue C open pit at McClean Lake concluded that the environmental effects of the project are not likely significant. Cigar Lake waste rock is to be deposited in the mined-out Sue C pit during two, two-year-long haul campaigns (roughly 20 and 40 years into the Cigar Lake project life).

In January 2003, Cameco applied for a CNSC licence to begin construction of commercial facilities at the site where test mining has been conducted at various times since the discovery of the deposit in 1981. Since the September 2002 Federal Court of Canada decision that quashed a McClean Lake operating licence had introduced uncertainty with respect to environmental assessment requirements, the CNSC determined that an environmental assessment screening report pursuant to the CEAA must be prepared in support of the application for a construction licence.

On June 30, 2004, following a public hearing, the CNSC announced that the project, taking into account the mitigation measures identified in the screening report, is not likely to cause adverse environmental effects and that further review is not required. The CNSC then proceeded to consider a licence application from Cameco for construction of the Cigar Lake project. Cigar Lake is expected to begin production in 2007, pending receipt of the necessary licences and favourable market conditions.

Additional Production Possibilities

Beyond the existing and committed centres of uranium production mentioned above, there are two projects that could be brought on stream in the future, subject to market conditions and the receipt of environmental and regulatory approvals. Table 4 updates, as of June 30, 2004, recent developments at the mining projects that could contribute to Canada's future uranium production capability.

Other Developments Affecting Canada's Uranium Industry

In late 2003, Bruce Power Inc. restarted two of the laid-up Bruce A reactors (Units 3 and 4, an additional 1500 MWe) and Ontario Power Generation (OPG) restarted one of the laid-up reactors at the Pickering nuclear station (Unit 4, an additional 515 MWe). In early 2004, Bruce Power Inc. announced that it will examine the feasibility of restarting two additional Bruce A reactors (Units 1 and 2), develop a preliminary case to refurbish the four Bruce B reactors, and evaluate the feasibility of building one or more new reactors at the Bruce site. As of June 30, 2004, OPG was awaiting a decision from the Ontario government on the return to service of three additional units of the Pickering A station that were laid up in 1997.

On December 12, 2003, a screening-level environmental assessment of a proposal to implement the use of slightly enriched uranium fuel (1% U^{235} compared to 0.7% U^{235} in natural uranium) in the Bruce B reactors was initiated. The use of this new fuel will result in improved safety margins and may allow Bruce Power to operate the Bruce B reactors at full power instead of the current 90% power output.

On March 1, 2004, Cameco announced a US$333 million agreement to purchase a 25.2% interest in the South Texas Project (STP) nuclear station from a wholly owned subsidiary of American Electric Power. On May 30, 2004, Cameco announced that it did not anticipate acquiring the interest after two of the existing STP owners indicated that they intended to exercise their right of first refusal to purchase STP. As a result, under the terms of the original agreement, Cameco expects to receive US$7 million in compensation since the transaction will not proceed because the right of first refusal has been exercised.

EXPLORATION

Natural Resources Canada (NRCan) completed its annual assessment of Canada's uranium supply capabilities and reported[2] the results in October 2003. Uranium exploration activity remains concentrated in areas favourable for the occurrence of deposits associated with Proterozoic unconformities, notably in the Athabasca Basin of Saskatchewan and the Thelon Basin of the Northwest Territories and Nunavut. In 2002, overall uranium exploration expenditures amounted to $35 million, compared to the $25 million reported in 2001, while uranium exploration and surface development drilling totalled over 78 000 m, up from the 48 000 m reported for 2001.

In 2002, slightly less than half of the overall exploration expenditures can be attributed to advanced underground exploration, deposit appraisal activities and care-and-maintenance expenditures associated with those Saskatchewan projects awaiting production approvals. In comparison, the Saskatchewan government estimates that "grass-roots" uranium exploration in the province amounted to $15 million in 2002, up slightly from the 2001 total of $14 million. Table 5 summarizes uranium exploration activity in Canada from 1989 to 2002.

In recent years, the number of companies with major exploration programs in Canada has declined. The top five operators,[3] accounting for a major portion of the $35 million expended in 2002 were: Cameco Corporation, CRI, Kennecott Canada Exploration, Soquem Inc. and UEX Corporation. Expenditures by CRI include those of Urangesellschaft Canada Limited.

RESOURCES

NRCan's annual assessment of domestic uranium supply capability provides a compilation of Canada's "known" uranium resources based on the results of an evaluation of company data. Uranium supply from Canada in the next decade will come from known resources, estimates of which are divided into three major categories, *measured, indicated* and *inferred*, that reflect different levels of confidence in the reported quantities. Most of these resources are associated with deposits identified in Figure 2.

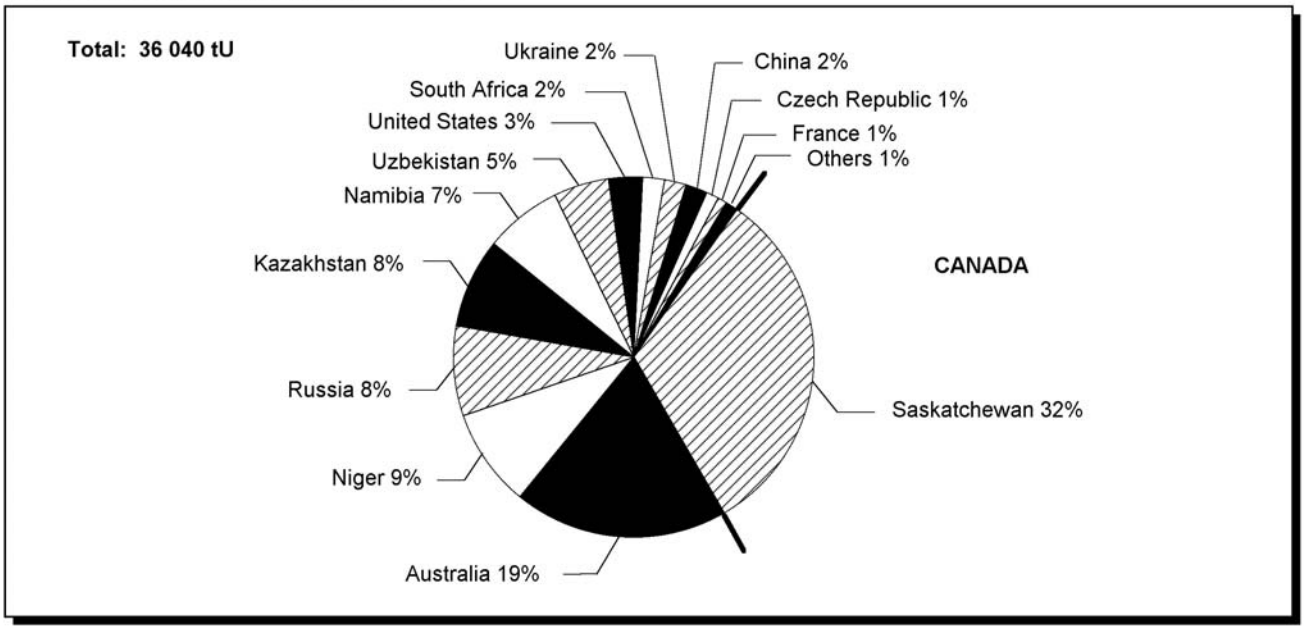
Recent NRCan assessments of Canada's uranium resources have been restricted to those recoverable from mineable ore at prices of $100/kgU or less. Table 6 shows the breakdown of the latest resource estimates compared with those of the previous year. As of January 1, 2003, total recoverable known uranium resources were estimated at 439 000 tU, compared with 452 000 tU as of January 1, 2002. This downward adjustment of some 3% is the result of depletion through mining and ongoing resource assessment.

SUPPLY CAPABILITY

At the end of 2002, Canada's uranium supply capability declined as production at Cluff Lake ended. A continued smooth transition to other new mines, notably Cigar Lake, as well as approval of the proposal to expand McArthur River production by some 20%, combined with timely licensing approvals and improved market conditions, will be required to allow Canada's production capability to expand to its full potential of some 16 000 tU annually.

Developments in the international uranium market, the rate at which projects receive environmental approvals, and uncertainty regarding the costs associated with the development of the planned new projects preclude projecting future production capability levels with much certainty. Table 7 ranks Canada among the world's major producers, showing actual uranium production from 1998

Figure 4
World Uranium Production, 2002



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

through 2002. Figure 4 illustrates Canada's share of world output in 2002 compared with other major producing countries.

GOVERNMENT INITIATIVES

The *Nuclear Fuel Waste (NFW) Act* came into force on November 15, 2002. The Act requires nuclear utilities to form a Nuclear Waste Management Organization (NWMO). The NWMO was established by the nuclear utilities in the fall of 2002. The NFW Act requires that, by November 15, 2005, the NWMO submit to the Government a study setting out its proposed approaches for the long-term management of nuclear fuel waste and its recommendation on which proposed approach should be adopted. The Government of Canada will select one of the approaches for the long-term management of nuclear fuel waste from among those set out in the study and the NWMO will then be required to implement the selected approach. This implementation will be funded through monies deposited in the trust funds set up by the utilities and Atomic Energy of Canada Limited in accordance with requirements in the NFW Act.

URANIUM MARKET

Overview

Following two decades dominated by the liquidation of surplus uranium inventories, with the accompanying rationalization of uranium production, 2003 brought signs that the uranium market is beginning to come into balance. In April there was a flood in the underground workings at McArthur River that knocked out production at the world's largest mine for three months. Coming after a fire that had shut down Australia's Olympic Dam mine for an extended period in 2001/02, this incident focused industry attention on supply vulnerabilities in a world dependent upon only a few large facilities for the majority of production.

The thinness of spot supplies was first revealed in August 2003 when a producer sought to acquire a significant quantity of uranium on the spot market and received no bids. At about the same time, indications began to surface that Minatom, the Ministry of Atomic Energy of the Russian Federation, had reassessed its own uranium needs for the next few years and determined that it would have less

uranium available to sell in Western markets after about 2008. The future extension of the agreement between the Russian Federation and the United States under which surplus highly enriched uranium derived from Russian nuclear weapons is blended down to commercial enrichment levels and sold in the West for nuclear fuel was thus called into question. This agreement is responsible for supplying about 15% of global uranium requirements and its extension beyond 2013 had been taken as a given by market participants. These developments stimulated a good deal of public dialogue about the possibility of a "supply gap" developing later this decade.

The last quarter of 2003 brought a continuing stream of bad news for the nuclear fuel cycle. Minatom's commercial subsidiary announced that it was cutting off deliveries of uranium at the end of the year to an intermediary that had already committed to sell substantial quantities to U.S. utilities through 2008. Then a uranium hexafluoride conversion facility in the United States was shut down by the regulator following a series of operating incidents. This facility not only had about 30% of Western World conversion capacity, but it is also an extremely important transfer point for deliveries of uranium in the nuclear fuel cycle. The Olympic Dam mine suffered another operating incident and was out of production for about three weeks. Finally, in December it became public that the Rossing mine in Namibia would shut down by 2007 unless it was able to sell its output at sufficiently higher prices in order to justify an investment of more than US$100 million. Each of these events brought uncertainty to the market where none had existed before.

Investment in the uranium industry has been low over the past two decades due to spot market prices that have been driven below production costs by inventory liquidation. Many mines have closed and global production has been just over 50% of consumption through the past decade. Few major new deposits have been identified and development times typically exceed 10 years due to stringent regulatory requirements. Now, as it appears that inventories are beginning to dwindle, there is some question as to whether production can be increased quickly enough to meet demand through the rest of this decade. The situation has been exacerbated by the fact that the weakness of the U.S. dollar through 2003 has offset much of the spot price increase in the major producing countries. Notwithstanding the medium-term uncertainty facing the market, the already identified global uranium resource base is adequate to support the nuclear power industry for several more decades.

Uranium Prices

The uranium spot market price, as reported by Ux,[4] rose through the year from its opening value of US$10.20/lb U_3O_8 (a standard measure of uranium metal content) to $14.50/lb at the end of 2003 (Figure 5). This 42% increase was fueled by serious supply disruptions in the fuel cycle, a sudden realization that inventory supply was not as plentiful as had been thought, and indications that some presumed future supply sources might not be as secure as had been believed. This has led to a re-evaluation of the approach to the market taken by both uranium producers and nuclear utilities.

Table 8 indicates actual exports of Canadian-origin uranium to principal customers from 1997 to 2002. The destination of Canada's exports of uranium on a cumulative basis (1998-2002 inclusive) is illustrated in Figure 6, which highlights the importance of the United States as a customer.

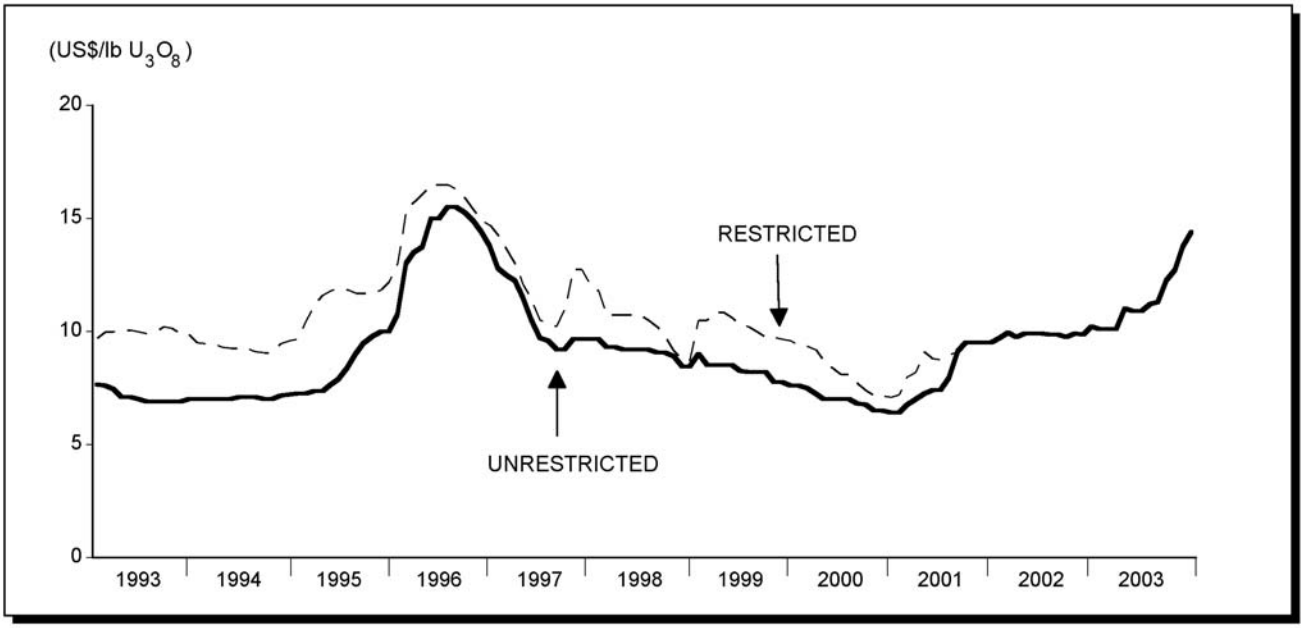
REFINING AND CONVERSION

Cameco operates Canada's only uranium refining and conversion facilities located at Blind River and Port Hope, Ontario, respectively. At the Blind River refinery – the world's largest – uranium mine concentrates from Canada and abroad are refined to uranium trioxide (UO_3), an intermediate product. The UO_3 is then trucked to the Port Hope facility, which has about one-quarter of the Western World's annual uranium hexafluoride (UF_6) conversion capacity and currently provides the only commercial supply of fuel-grade natural uranium dioxide (UO_2). UF_6 is enriched outside Canada for use in foreign light-water reactors while natural UO_2 is used to fabricate fuel bundles for CANDU reactors in Canada and abroad. About 80% of the UO_3 from Blind River is converted to UF_6 while the remaining 20% is converted to UO_2. Table 9 tabulates Canada's production of refined and converted uranium and notes the associated work force from 1999 to 2002, inclusive.

OUTLOOK

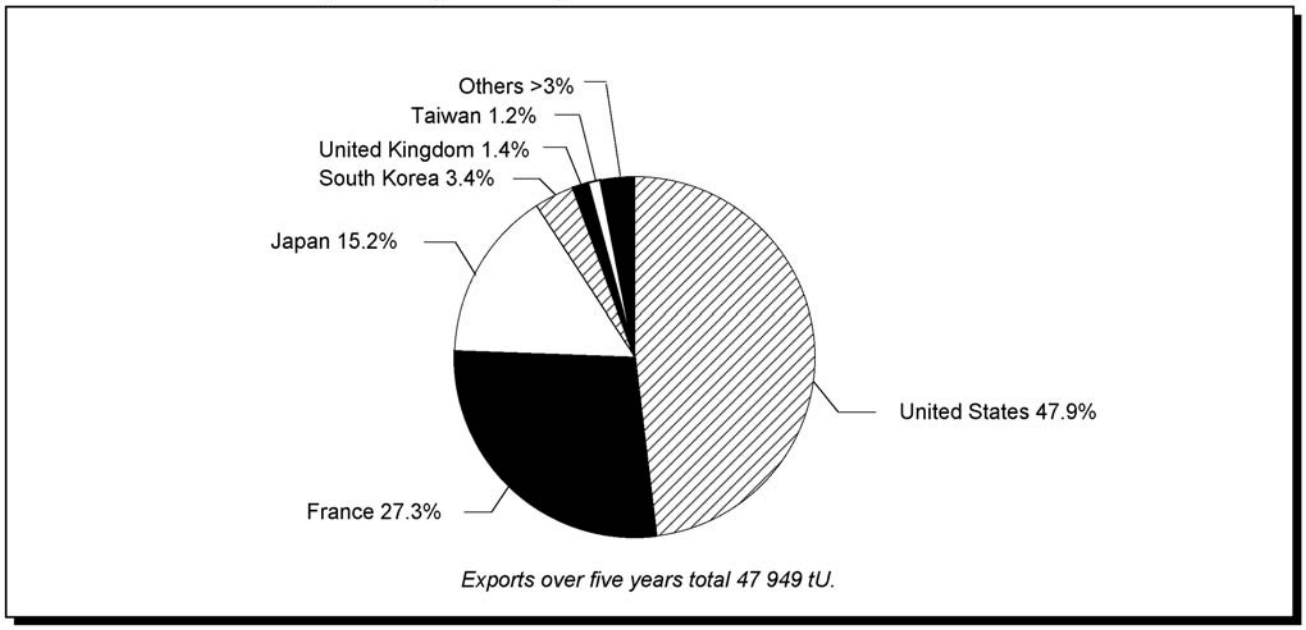
Improvement in the uranium market and the political climate for nuclear energy in 2003 was good news for uranium producers in Canada. This, combined with a focus on clean air and the development of additional electrical generation capacity, looks likely to translate into growth in the nuclear power sector. Improved market conditions are good news to Canadian producers as the transition to a new generation of uranium mines in northern Saskatchewan is nearing completion. Continued success in bringing these environmentally sustainable operations on stream, notably the Cigar Lake mine, will ensure that Canada remains the world's premier uranium producer well into the twenty-first century.

Figure 5
Trend in Uranium Spot Prices, 1993-2003



Source: TradeTech.

Figure 6
Canadian Uranium Exports, by Country of Final Destination, 1998-2002



Source: Canadian Nuclear Safety Commission.

REFERENCES

1 John French, Advisor, Uranium Markets (tel. 613-995-7474), has contributed to the text in those sections dealing with international uranium market developments and uranium prices.

2 *Canada's Uranium Industry - Transition Continues as Cluff Lake Closes*, NRCan mailing, October 2003.

3 In certain cases, the identified operator has reported the total expenditures of a joint-venture effort. Therefore, contributions by other parties not responding to the NRCan survey are accounted for in the $35 million total expenditure for 2002.

4 The Ux Consulting Company, LLC (UxC) was founded in March 1994 as an affiliate of The Uranium Exchange Company (Ux). UxC publishes *The Ux Weekly and the UxC Market Outlook Reports* on uranium, enrichment, and conversion. UxC also prepares special reports on key topics of interest.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to chapter 64. (2) Information in this review was current as of June 30, 2004. (3) This paper on uranium and other information on developments in Canadian nuclear policy can be accessed on the Internet at http://nuclear.nrcan.gc.ca. (4) This and other reviews, including previous editions, are also available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

TABLE 1. URANIUM PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 2000-2002

Production Centre and Producer	Company Work Force (1) (Dec. 31) 2000	2001	2002	Annual Output (2) (tU) 2000	2001	2002
ATHABASCA BASIN, SASKATCHEWAN						
Cluff Mining (CRI, 100%)	105	98	56	1 443	1 288	1 626
Key Lake JV (Cameco operator)	260	289	281	402	299	117
Rabbit Lake JV (Cameco, 100%)	156	66	186	2 790	1 755	440
McClean Lake JV (CRI operator) operator)	258	238	172	2 308	2 540	2 342
McArthur River JV (Cameco operator)	225	263	260	3 740	6 639	7 082
Cigar Lake JV (pre-production)	22	19	19	–	–	–
Total	1 026	973	974	10 683	12 522	11 607

Sources: Company annual reports; Canadian Nuclear Safety Commission open files.
– Nil.
(1) Figures are for company payroll employees only; on-site contractors (mining, construction, services, etc.) are not included. (2) Primary output only. With the closure of Rio Algom Limited's Stanleigh operation at Elliot Lake in mid-1996, by-products from Cameco's refinery/conversion facilities are no longer processed in Canada.

TABLE 2. VALUE (1) OF URANIUM SHIPMENTS (2) BY PRODUCERS IN CANADA, 1998-2002

	Unit	1998	1999	2000	2001	2002 (p)
Total producer shipments	tU	9 984	10 157	9 921	12 991	12 855
Total value of shipments	$ millions	500	500	485	600	615

Source: Natural Resources Canada.
(p) Preliminary.
(1) Value of shipments is estimated from an average market price. (2) Shipments in tonnes of uranium (tU), contained in concentrate, from ore-processing plants.

TABLE 3. OPERATIONAL CHARACTERISTICS OF EXISTING CANADIAN URANIUM PRODUCTION CENTRES, 2002

Operating Entity (Operator)/Location	Ore-Processing Plant (1) Capacity Nameplate	Recovery Overall	Annual Throughput Total Ore	Ore Grade
	(t/d)	(%)	(t)	(%)
Cluff Mining (CRI)/ at Cluff Lake, Saskatchewan	800	98	71 530	2.30
McClean Lake JV (CRI)/ at McClean Lake, Saskatchewan	300	97	121 980	1.94
Rabbit Lake (Cameco Corporation)/ at Rabbit Lake, Saskatchewan	2 300	97	98 230	0.64
Key Lake JV (Cameco Corporation)/ at Key Lake, Saskatchewan (2)	750	99	211 263	3.41

Sources: Corporate annual reports; Canadian Nuclear Safety Commission open files.
(1) Figures are rounded. (2) All McArthur River ore is processed at Key Lake mill.

TABLE 4. CANADIAN URANIUM MINING PROJECTS PLANNED FOR PRODUCTION AS OF JUNE 30, 2004

Project, Province or Territory/Operator	Owners Share	Deposit Type/ Discoverer and Discovery Date	Resources (Company Estimates as of January 1, 2004)	Ore Grade and Notes on Deposits	Mining Method, Milling Rate and Capacity	Project Particulars and Status	Location of Project/ Notes of Interest
	(%)						
Cigar Lake, Sask./ Cameco Corporation	Cameco (50.025), CRI (37.100), Idemitsu (7.875), TEPCO (5)	Unconformity-related/ CRI, 1981	Overall property 135 000 tU *mineable*	Overall property grade of 16% U; grades vary from 5% to 70% U; orebody at depth of 450 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake and Rabbit Lake; contributing from 2300 to 6900 tU/y	$555 million project; test mining completed in 1992; EIS submitted in October 1995; Joint Panel reports November 1997; government response April 1998; EA process for construction licence initiated in June 2003	670 km N of Saskatoon; 500-m-deep shaft sunk; brine freezing of ground is required to mine the ore; production to begin as early as 2007
Midwest, Sask./CRI	CRI (54.8), Redstone Resources Inc. (20.7), Tenwest Uranium Ltd. (20), OURD (4.5)	Unconformity-related/ Esso Minerals Canada, 1977 (interests of Bow Valley, Numac Oil & Gas, *et al* bought by partners)	Overall property 13 400 tU *mineable*	Overall property grade of 3.7% U; grades vary from 2% to 30% U; orebody at depth of 200 m	"Non-entry" underground; "jet-boring" mining method or open-pit; milling at McClean Lake; contributing 2300 tU/y	$80 million co-venture with McClean; in 1993, Joint Panel rejects proposal; new EIS in 1995; final hearings August 1997; Joint Panel report November 1997; government response April 1998	710 km N of Saskatoon; 185-m-deep test-mine shaft; new operator, CRI revised EIS; start-up subject to feasibility study; project placed in care and maintenance in 2003
Kiggavik, Nunavut/ Urangesellschaft Canada Limited	Urangesellschaft (79), CRI (20), Daewoo Corporation (1)	Unconformity-related/ Urangesellschaft, 1977	Overall property 15 000 tU *mineable*; (more incl. Andrew Lake *et al*)	0.41% U average overall; Centre pit depth 100 m, Main pit 200 m	Open-pit mining methods; mill feed at 1200 t/d; output rate of 1200 tU/y originally expected	EIS submitted but project deemed deficient by Panel; new EIS required before project start-up	75 km W of Baker Lake; start-up not expected in the foreseeable future; >11-year mine life with tributary ore included

Notes: OURD (Canada) Co., Ltd. is a subsidiary of the Overseas Uranium Resources Development Corporation (OURD) of Japan. Urangesellschaft Canada Limited, operated by CRI, is a subsidiary of COGEMA S.A., which is wholly owned by the AREVA Group of France. Idemitsu Uranium Exploration (Canada) Ltd. is a wholly owned subsidiary of Idemitsu Kosan Co. Ltd. of Japan. TEPCO Resources Inc., is a subsidiary of Tokyo Electric Power Co., Inc. (TEPCO), Japan's largest nuclear power utility. Redstone Resources Inc. is a subsidiary of Franco-Nevada Mining Corporation Ltd. Tenwest Uranium Ltd. is a wholly owned subsidiary of Denison Energy Inc.

TABLE 5. URANIUM EXPLORATION ACTIVITY IN CANADA, 1989-2002

	Expenditures (1)	Drilling (2)	Million-Dollar Projects (3)
	($ millions)	(km)	(no.)
1989	58	158	11
1990	45	66	6
1991	44	67	4
1992	46	79	4
1993	40	62	5
1994	36	67	8
1995	44	75	10
1996	39	79	8
1997	58	104	6
1998	60	95	6
1999	49	89	3
2000	46	77	3
2001	25	48	3
2002	35	78	7

Source: Natural Resources Canada.
(1) Direct exploration and drilling expenditures in current dollars; from the late 1980s, includes advanced underground exploration and deposit appraisal expenditures; from the mid-1990s, may also include care-and-maintenance costs associated with deposits awaiting production approvals. (2) Exploration and surface development drilling; excludes development drilling on producing properties. (3) Number of projects where direct exploration and drilling expenditures exceeded $1 million in current dollars.

TABLE 6. ESTIMATES OF CANADA'S URANIUM RESOURCES RECOVERABLE FROM MINEABLE ORE, (1) **JANUARY 1, 2002, AND JANUARY 1, 2003**

Price Ranges Within Which Mineable Ore is Assessed (2)	Measured		Indicated		Inferred	
	1/1/02	1/1/03	1/1/02	1/1/03	1/1/02	1/1/03
			(000 tU)			
Up to $50/kgU	301	288	10	10	86	86
$50 to $100/kgU	–	–	37	37	18	18
Total	301	288	47	47	104	104

Source: Natural Resources Canada.
– Nil.
(1) Actual or expected losses in mining recovery and ore processing have been accounted for; these factors were individually applied to resources tributary to existing or prospective production centres. In underground operations, mineable ore is generally 75-85% of the ore-in-place; higher mining recoveries are achievable in open-pit operations. Canada's weighted average ore processing recovery for existing conventional operations exceeded 97% over the 2002/2003 survey period. (2) The Canadian dollar figures reflect the price of a quantity of uranium concentrate containing 1 kg of elemental uranium. The prices were used in determining the cut-off grade at each deposit assessed, taking into account the mining method used and the processing losses expected. The price of $100/kgU was used by Natural Resources Canada to illustrate those resources that were of economic interest to Canada during the survey period.
Note: $1/lb U_3O_8 = $2.6/kgU.

TABLE 7. PRODUCTION OF URANIUM IN CONCENTRATES BY SELECTED MAJOR PRODUCING COUNTRIES, 1998-2002

	1998	1999	2000	2001	2002
	(tonnes U)				
Canada	10 920	8 210	10 680	12 520	11 610
Australia	4 910	5 980	7 580	7 580	6 850
China	500	500	500	700	730
France	510	440	310	180	20
Gabon	730	290	–	–	–
Kazakhstan	1 270	1 350	1 740	2 110	2 820
Namibia	2 760	2 690	2 710	2 240	2 330
Niger	3 730	2 920	2 900	2 920	3 080
Russia	2 000	2 000	2 000	3 000	2 850
South Africa	990	980	870	880	820
Uzbekistan	1 930	2 130	2 350	1 950	1 860
United States	1 810	1 810	1 460	1 010	900
Other (1)	1 730	1 770	1 860	1 710	2 170
Total (2)	33 790	31 070	34 960	36 800	36 040

Sources: *Uranium: Resources, Production and Demand*, a biennial report published jointly by the Nuclear Energy Agency of the OECD and the International Atomic Energy Agency, and miscellaneous corporate, national and international reports.
– Nil.
(1) Includes Argentina, Belgium, Brazil, Bulgaria, the Czech Republic, Germany, Hungary, India, Pakistan, Portugal, Romania, Spain and Ukraine. (2) Totals are of the listed figures only and represent global production.
Note: Country figures are rounded to the nearest 10 tU.

TABLE 8. EXPORTS OF URANIUM OF CANADIAN ORIGIN, 1997-2002

Country of Final Destination	1997	1998	1999	2000	2001	2002
	(tonnes of contained uranium (1))					
Argentina	–	–	–	1	–	5
Belgium	–	–	–	110	126	–
China	–	–	–	–	–	213
Czech Republic	–	–	–	246	–	–
France	587	67	1 819	3 505	3 302	4 385
Germany	184	–	–	–	–	42
Japan	1 968	1 310	1 116	2 386	1 127	1 366
Mexico	–	–	–	–	93	114
South Korea	315	444	309	172	496	217
Spain	160	–	121	97	180	126
Sweden	450	147	–	–	–	73
Taiwan	–	–	107	26	212	220
United Kingdom	374	345	–	193	58	88
United States	6 187	5 962	3 674	4 230	4 437	4 683
Total	10 225	8 274	7 146	10 966	10 031	11 534

Source: Canadian Nuclear Safety Commission.
– Nil.
(1) Some of this uranium was first exported to an intermediate country for conversion and/or enrichment prior to transfer to the country of final destination.
Note: Numbers may not add to totals due to rounding.

TABLE 9. URANIUM PROCESSING PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1999-2002

Process and Location (Nameplate Capacity)	Production				Site Work Force			
	1999	2000	2001	2002	1999	2000	2001	2002
	(tonnes U)				(number)			
Refining at Blind River (18 000 tU as UO_3)	11 369	9 605	(1) . .	(1) . .	98	98	98	98
Conversion at Port Hope (12 500 tU as UF_6 and 2800 tU as UO_2)	11 231	9 327	10 958	12 428	272	267	264	271

Source: Cameco Corporation.
. . Not available.
(1) For commercial confidentiality reasons, Cameco no longer reports a production figure for Blind River.