

Uranium Mining and Milling: The Facts on a Well-Regulated Industry

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About uranium and why it is mined

[Uranium](#) is a naturally occurring radioactive element used for fuel in [nuclear power reactors](#). Canada, one of the world's largest uranium producers, accounts for 18 percent of global production and exports 90 percent of its uranium.

Uranium is mined so it can be processed at a milling facility in order to recover the uranium concentrate. The uranium concentrate is then shipped to [processing and fabrication facilities](#) that create fuel for [nuclear power reactors](#).

How is the uranium mining and milling industry regulated?

The [Canadian Nuclear Safety Commission](#) (CNSC) regulates and licenses all existing and proposed uranium mining and milling operations in Canada. The CNSC manages this industry's licensing, certification and compliance, in accordance with the requirements of the [Nuclear Safety and Control Act](#) (NSCA) and its Regulations, which reflect Canadian and international safety standards. The CNSC and its staff focus on [health, safety, security and the environment](#), and ensure Canada implements its [international obligations on the safe use of nuclear materials](#).

No person may prepare a site for, construct, operate, decommission or abandon a uranium mine or mill without first applying for and receiving a CNSC licence.

Who regulates surface exploration for uranium?

Each province or territory is responsible for regulating and monitoring exploration activities within its jurisdiction, and for informing the public about them. Uranium exploration poses the same low risks to public health or the environment, as any exploration methods (such as drilling small core samples). It does not significantly modify the natural environment. Uranium exploration presents a very low risk of



Figure 1: Winter aerial view of AREVA's McClean Lake uranium mill and the tailings management facility, in northern Saskatchewan

Quick facts

- Currently, the CNSC employs over 800 full-time staff who ensure the safe operation of nuclear facilities, including uranium mines and mills.
- At this time:
 - the only operating uranium mines and mills are located in northern Saskatchewan.
 - an application has been received for an advanced underground uranium exploration project in northern Quebec.
 - the CNSC has applications for two new mines: the Millennium project in northern Saskatchewan and the Kiggavik project in Nunavut.

increasing [radiation](#) or [radon](#) exposure to the public and to the environment.

For more information on uranium exploration regulations and guidelines in your area, please contact your provincial or territorial government.

How does the CNSC license new mines and mills?

The CNSC's [licensing process](#) for uranium mines and mills follows the stages laid out in the [Uranium Mines and Mills Regulations](#), proceeding progressively through site preparation and construction, operating, decommissioning, and abandonment (or release from licensing) phases. Using this lifecycle approach to licensing, the CNSC issues licences for all phases in the lifecycle of a uranium mine and mill.

The CNSC has strict requirements and ensures that licensees have financial guarantees in place – during all lifecycle phases – to cover the eventual decommissioning costs of their facilities. In addition, under the [CNSC Cost Recovery Fees Regulations](#), the CNSC charges all costs associated with the regulatory activities back to licensees.

CNSC staff assess the information that applicants have submitted in their licence applications. CNSC staff also consider input from other federal, provincial and territorial government bodies that regulate health and safety, environmental protection, emergency preparedness, and the transportation of dangerous goods.

During licensing, the CNSC determines if the [licence applicant](#) is qualified and has proposed adequate provisions to protect the health and safety of people and the environment. Applicants must also demonstrate required measures to maintain national security and implement Canada's international obligations for the peaceful use of nuclear energy. In addition, some projects may require an [environmental assessment](#) (EA) under the [Canadian Environmental Assessment Act](#). An EA can predict the environmental effects of a proposed project, and identify measures to prevent or minimize these effects before the project is carried out.

How does the CNSC ensure licensees comply with requirements?

After a licence has been issued, the licensee is required to comply with the requirements of the NSCA and its Regulations, as well as any licence conditions.

CNSC staff review the performance of [operating](#) and [decommissioned mines and mills](#) in 14 safety and control areas, including worker health and safety, radiation protection and environmental protection.



Figure 2: A CNSC inspector takes a gamma radiation measurement at Cameco's Rabbit Lake Eagle Point Mine.

Did you know?

- The CNSC will only issue a licence if it is satisfied the proposed nuclear facility or activity is safe for the health, safety and security of persons and the environment.
- The CNSC ensures streams, lakes and rivers downstream of uranium mining projects are safe for people, plants, fish and other animals.
- Uranium mine and mill licences are issued for an average of five years.
- Uranium mines and mills are routinely inspected by CNSC and provincial inspectors. In 2011, CNSC inspectors conducted an average of four inspections at each operating site.
- The CNSC is responsible for regulating more than 20 decommissioned tailings management sites across Canada associated with closed uranium facilities.

CNSC staff track worker safety, radiation doses and environmental performance through compliance activities. These include facility inspections, review of licensee application requests and licensee reports, and detailed reviews of environmental and radiation data analysis. Inspections are conducted with other regulatory agencies, such as the provincial or territorial departments of environment and labour, the [Northern Saskatchewan Environmental Quality Committee](#) and representatives from other federal government departments (for example, Environment Canada and Fisheries and Oceans Canada).

CNSC inspectors work closely with inspectors from the provincial departments of labour to monitor licensees' occupational health and safety programs, including those for radiation protection, [to ensure workers are safe](#). The CNSC regulates radon levels in uranium mines and mills to limit radon exposure to workers, since long-term exposure to high levels of radon increases the risk of lung cancer. For example, engineering designs and control processes are required to remove radon, which develops from the natural decay of uranium. Radon gas is continuously monitored, controlled and

safely ventilated away from workers. During inspections, CNSC staff evaluate licensees' programs for protecting workers from radiation doses. Due to these strict controls, doses at today's uranium mines and mills are well below the CNSC's regulatory limits, and uranium workers have a lung cancer risk comparable to that of the general population.

The CNSC assesses monitors and tracks licensees' environmental performance to verify that releases to the environment are not harmful and are below regulatory limits. Since 1994, an ongoing monitoring study in northern Saskatchewan has assessed the cumulative impacts of radon, radionuclides and heavy metals on the local environment. Results have shown that uranium mines have no effect on radon levels, and that uranium, radium-226, lead-210 and polonium-210 levels in fish were often below detection levels. When measurable, these levels were no different around mine sites when compared to those at both nearby and remote reference sites.

Licensees are required to notify the CNSC of significant events or situations outside normal operations, or situations that may have public interest. Significant events are reported to the [Commission Tribunal](#) via early notification reports, which, depending on the nature and severity of the event, may be followed up with detailed compliance assessments, corrective actions and/or [regulatory action](#).



Figure 3: To decrease radiation exposure, a Cameco employee operates a remote-controlled truck to retrieve uranium ore from an underground extraction chamber at the McArthur River mine.

Source: Photo courtesy of Cameco

Health effects on uranium mines and mills workers

- Studies demonstrate that present-day uranium workers, and the public living near a uranium mine or mill, are as healthy as the general Canadian population.
- Personal dosimeters are worn by workers to measure their radiation exposure, with measurements reviewed regularly by CNSC staff and submitted to Health Canada's National Dose Registry.
- The yearly dose limit per uranium worker is 50 mSv (milliSieverts) and 100 mSv over a five-year period.
- In 2010, the average annual dose to miners was 1.37 mSv and the maximum dose was 10.7 mSv, well below the CNSC annual limit of 50 mSv.

How can the public participate in the regulation of uranium mines and mills?

Once an application has been received, the CNSC initiates a licensing process that provides several opportunities for [public involvement](#). The CNSC emphasizes public engagement and participation, and members of the public are welcome to observe Commission Tribunal hearings and meetings in person, [watch them online](#) or [formally participate as intervenors](#).

The CNSC also responds to invitations from communities to talk about its role in the regulation of uranium mining. The CNSC is open to discussions and public meetings related to any of its regulated activities, such as proposed or current uranium mining and milling facilities.

In addition to public participation, the CNSC has a [duty to consult with Aboriginal Peoples](#), whose established or potential treaty rights may be affected by nuclear facilities or activities.

What type of waste do uranium mines and mills produce?

Mine waste rock and tailings are two of the main types of waste that result from uranium mining and milling.

- **Clean waste rock and waste rock:** Mining produces both clean waste rock and waste rock that must be removed to retrieve the uranium ore. Clean waste rock is not harmful to the environment and is placed in surface rock piles for future use. Waste rock is usually found close to the ore body and contains low concentrations of radionuclides or heavy metals (mineralized waste). These must be managed during operations and properly disposed of so that contaminants are not released to the environment.
- **Tailings:** Milling uranium ore produces tailings. Tailings are what is left over once the uranium has been removed from the ground rock and resemble fine sand. They contain long-lived radionuclides (such as thorium-230 and radium-226) produced from the decay of uranium, as well as trace metals like arsenic and nickel. They also contain chemical residues from the milling process.



Figure 4: Representatives from the Métis Nation of Saskatchewan address the Commission Tribunal at a Commission Tribunal hearing in Saskatoon.

Public and environmental health facts

- Throughout 2010, uranium mining effluent discharges remained below the regulatory limits.
- Studies and monitoring have shown that:
 - there are no significant impacts to the health of the public living near uranium mines and mills.
 - uranium mining and milling activities do not increase radon levels above background levels in the environment away from the mine site.
 - human exposure to radon and radiation from modern uranium mining is very low and does not increase the risk of cancer.

How is waste from uranium mines and mills regulated and managed?

Canada's long-standing experience in uranium mining has resulted in stringent regulations and world-leading practices for the protection of health and safety of persons and the environment. These practices have evolved over time to reflect changes in scientific knowledge as well as the public's expectations.

Clean waste rock, waste rock and uranium mill tailings are typically stored on the mining or milling sites themselves. Clean waste rock from the mining operation is usually placed in rock piles and segregated from waste rock as it is mined. Clean rock can be used in construction as concrete or in the building of roads. Clean waste rock that is left over once mining has ceased is left in piles on the earth's surface, contoured to fit in with the natural environment and re-vegetated.

Waste rock is usually stored temporarily on the earth's surface, in piles that have collection systems to treat water that may run off or filter through the piles. After mining is completed, waste rock can be placed back in the environment from which it was mined, used as backfill in underground mines, or placed in a mined-out pit. It can also be left on the surface and placed under an engineered cover to reduce water infiltration.

How does the CNSC ensure a mine is closed down safely?

The final stage for a mine or mill is its shutdown, decommissioning and end-state environmental monitoring. The CNSC requires a licensee to have a financial guarantee in place during all phases of the facility's lifecycle to cover the cost of decommissioning. This ensures that decommissioning is included in planning at all stages in a facility's lifecycle. Decommissioning and reclamation plans for mines and mills must be assessed and approved by the CNSC before work can proceed.

For example, there are former uranium mining and milling sites in Saskatchewan, Ontario and the Northwest Territories. These inactive sites are being managed in the long term by their former owners or the federal, provincial or territorial government. Long after a mine is decommissioned, the CNSC and provincial/territorial regulators continue to verify that the licensee complies with all licence conditions and regulatory requirements to ensure long-term stability.



Figure 6: Before decommissioning: Cluff Lake uranium mill in 1999.
Source: Aerial photo courtesy of AREVA Resources Canada



Figure 7: After decommissioning: Site of the Cluff Lake uranium mill in 2006, 2 years after site decommissioning activities began.
Source: Aerial photo courtesy of AREVA Resources Canada

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