U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

FACT SHEET

Office of Public Affairs
Phone: 301-415-8200
Email: opa.resource@nrc.gov

Uranium Recovery

Background

The production of fuel for nuclear power plants starts with taking uranium ore from the ground and then purifying and processing it through a series of steps. Uranium recovery focuses on extracting natural uranium ore from the earth and concentrating (or *milling*) that ore. These recovery operations produce a product, called "yellowcake," which is then transported to a succession of fuel cycle facilities where the yellowcake is transformed into fuel for nuclear power reactors. In addition to yellowcake, uranium recovery operations generate waste products, called byproduct materials, that contain low levels of radioactivity.

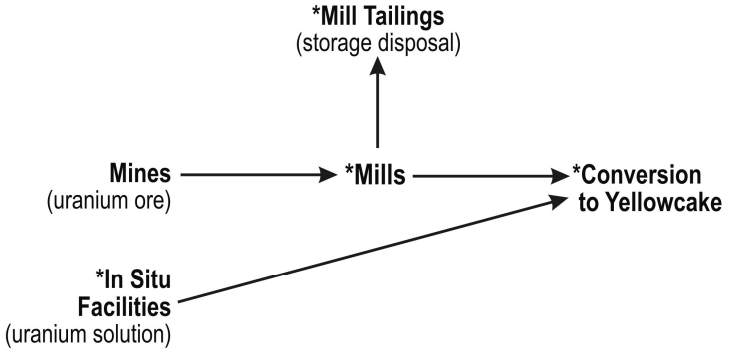
The NRC does not regulate uranium mining or mining exploration, but does have authority over milling of mined materials and in situ processes used to recover uranium, as well as mill tailings. Today's conventional uranium mills and in situ recovery (ISR) facilities are operating safely and in a manner that is protective of the environment. The NRC regulates these facilities in close coordination with other Federal agencies and State and Tribal governments and provides technical support and guidance to those Agreement States that have authority over uranium recovery activities.

Discussion

The NRC becomes involved in uranium recovery operations when the ore is processed and physically or chemically altered. This happens either in a conventional, heap leach uranium mill, or ISR. For that reason, the NRC regulates ISR facilities as well as uranium mills and the disposal of liquid and solid wastes from uranium recovery operations (including mill tailings). The NRC does not regulate conventional uranium mining in which the ore is not altered.

Conventional mining refers to when uranium ore is removed from deep underground shafts or shallow open pits. It is regulated by the Office of Surface Mining, the U.S. Department of the Interior, and the individual states where the mines are located.

A **conventional mill** processes uranium ore that has been removed from the earth by either open pit or underground mining. The ore is then crushed and sent through a mill, where extraction processes concentrate the uranium. Sulfuric acid dissolves the soluble components, including 90 - 95 percent of the uranium, from the ore. The uranium is then separated from the solution, concentrated, and dried to form yellowcake.

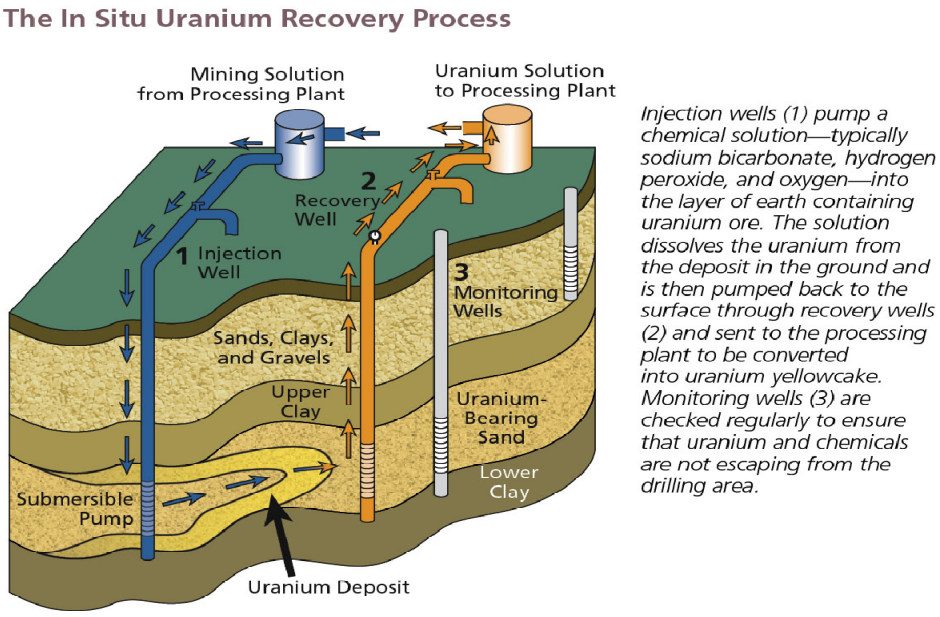


*Regulated by NRC

Waste from this process poses a potential hazard to public health and safety due to its radioactive and chemical content. Conventional milling produces a substantial amount of "mill tailings." NRC regulates the recovery process and the safe storage and disposal of mill tailings. During operation of conventional mills and ISR facilities, monitoring wells are required to help assure that fluids used to extract uranium do not leave the facility and contaminate groundwater above acceptable levels.

In **heap leach operations**, small pieces of uncrushed ore are placed in a "heap" on an impervious pad of plastic or clay with perforated pipes under the heap. An acidic solution is then sprayed over the ore to dissolve the uranium it contains. The uranium-rich solution drains into the perforated pipes where it is collected and transferred to a processing plant where the solution is concentrated and dried to produce yellowcake.

For **in situ recovery** (ISR), the uranium ore is chemically altered underground before being pumped to the surface for further processing. In the ISR uranium extraction process, wells are drilled into rock formations containing uranium ore. Water, usually fortified with oxygen and sodium bicarbonate, is injected down the wells to mobilize the uranium in the rock so that it dissolves in the ground water. The location of the uranium-bearing solution is controlled by pumping more water out of the formation than is pumped into it. The uranium-bearing solution is pumped to a central processing plant, which uses ion exchange to separate the uranium and concentrate it. Waste from this process is specific in nature (e.g. filters, piping), is relatively small in volume, and can be disposed in a tailings pile at a conventional mill site or at a licensed disposal facility. Liquid wastes are generally disposed of in permitted deep disposal wells, evaporation pads, spray irrigation, or treated and discharged to surface water. Unlike conventional mining, tailings are not generated at ISR facilities. Monitoring and restoration of ground water is important to protect public health and the environment and is an important focus of the NRC.

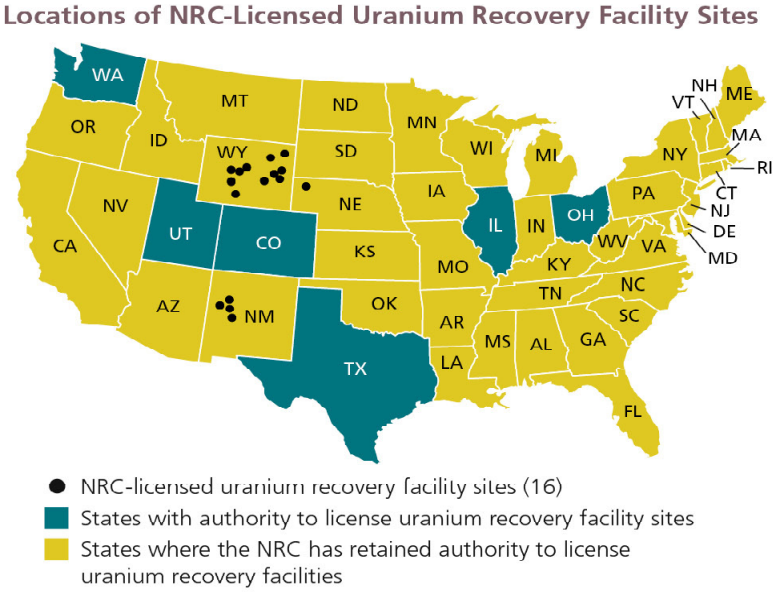


NRC's Regulatory Role under UMTRCA

With the enactment of UMTRCA, mill tailings and other associated wastes generated after 1978 became subject to NRC regulation. Contamination associated with hard rock and open pit mines that produced uranium ore was not addressed by UMTRCA. The statute established a remedial action program operated by the Department of Energy under Title I of UMTRCA for uranium mills that were not licensed and largely abandoned at the time the law was enacted. The NRC regulates the mills that were licensed after November 8, 1978, under Title II of the law. Consistent with UMTRCA, the Environmental Protection Agency promulgated standards for both the "inactive" and the "active" tailings sites in 1983, which the NRC has since been implementing and enforcing through its comprehensive regulatory program.

Much of the contamination that exists today at uranium mines and associated uranium recovery facilities occurred prior to implementation of the current statutory and regulatory framework. Although NRC's focus is on mills and the agency does not have responsibility for regulating conventional mining sites, NRC is cooperating with other Federal Agencies in a coordinated effort to address uranium contamination at legacy mine sites in the Navajo Nation under a Five-Year Plan. Similarly, NRC is working with EPA and the State of New Mexico to address uranium contamination in the Grants Mineral Belt in and around Grants, New Mexico.

UMTRCA amended the Atomic Energy Act to authorize the framework for NRC to establish agreements with states to regulate uranium recovery facilities in lieu of NRC regulation. Through these agreements, the NRC works with the Agreement States to protect people and the environment. The NRC has established agreements with Texas, Colorado, Utah, and Washington to regulate uranium recovery facilities in their states. The State of New Mexico's agreement with the NRC included uranium recovery facilities until this part of the program was withdrawn by the State in 1986. NRC evaluates State regulatory activities through the Integrated Materials Performance Evaluation Program to ensure that these programs remain adequate to protect public health and safety and compatible with the National program. Currently, the NRC regulates active uranium recovery operations in Wyoming, New Mexico, and Nebraska. The NRC and Agreement States regulate conventional mills and ISR facilities.



Licensing, Operations and Decommissioning

The NRC has a well-established and comprehensive regulatory framework for ensuring that uranium recovery facilities are appropriately licensed, operated, monitored and decommissioned to protect public health and safety.

Licensing

The NRC conducts comprehensive safety and environmental reviews on every new application for a uranium recovery facility. The safety review scrutinizes the applicant's qualifications, design safety, operational programs, and site safety to ensure that the facility will meet NRC requirements. NRC standards conform to standards promulgated by EPA. The NRC also performs an environmental review to fulfill its obligation under the National Environmental Policy Act (NEPA). The NRC developed a Generic Environmental Impact Statement for ISR operations in the western United States that analyzes environmental impacts common to these facilities. For each new application, the NRC prepares a supplemental Environmental Impact Statement (EIS) to review impacts specific to that site.

By issuing or amending a current license, the NRC authorizes the licensee to construct and operate (with specified conditions) a uranium recovery facility, expand an existing facility, or restart an existing facility at a specific site, in accordance with established laws and regulations. A uranium recovery license is valid for 10 years and can be renewed in 10-year increments.

The public and other stakeholders are provided multiple opportunities to participate in the regulatory process. This may include participating in public meetings, requesting an adjudicatory hearing on the issuance of a license, amendment, or renewal, and commenting on EIS and other documents. Opportunities for public involvement are typically announced by NRC in a Federal Register notice or public meeting notice on the NRC website. The NRC also has a strategy for outreach and communication with Indian tribes potentially affected by uranium recovery sites.

Safety of Operations

After issuing a license for a new uranium recovery facility, the NRC focuses its regulatory actions on protecting the health and safety of the public and the environment. The NRC provides continued oversight of the operations through periodic licensing reviews, inspections, assessment, and enforcement.
Inspections of uranium recovery facilities licensed by the NRC are essential to ensure that they conduct their operations in compliance with applicable regulatory requirements. Inspection frequencies range from several times a year (for operating facilities) to once every two years (for facilities in standby mode or decommissioning).

NRC inspections focus on those areas that are most important to safety and security, using objective measures of performance. In general, these inspections address a variety of topics, including management organization and controls, radiation protection, chemical processes, radioactive waste management, emergency preparedness, fire safety, environmental protection including groundwater protection, and onsite construction.

NRC inspectors prepare an inspection report upon completion of each inspection. Copies of these reports are available to the public through the NRC's Agencywide Documents Access and Management System (ADAMS) via the agency's website. These inspection reports can be located by searching with a licensee's name or docket number.

Violations of NRC requirements are evaluated to determine their impact on safety. If a violation is of low safety-significance, it may be discussed with the licensee with no formal enforcement action taken. In such instances, the licensee is expected to resolve the problem and prevent recurrence. However, if the violation is of greater safety-significance, the NRC may levy a written notice of violation and, in certain circumstances, a fine that is announced in a press release.

Decommissioning

ISR licensees are required to decommission well fields when those wells are no longer producing uranium. Decommissioning of the well fields includes restoration of the groundwater to meet NRC requirements.

ISR facilities and conventional mills must be decommissioned at the end of operations. Licensees are required to remove contaminated structures, decontaminate soil, stabilize sites, and safely dispose of radioactive waste. These steps must be completed to NRC's satisfaction before a license is terminated in accordance with established requirements. In all circumstances, NRC terminates a license for uranium recovery only after it has been determined that the site has been remediated and stabilized in accordance with the applicable requirements. After license termination, conventional mill or heap leach facilities are transferred to the Federal government or a state government. The NRC continues to regulate these sites during the long-term care period.

Current and Future Licensing

There are a number of uranium recovery sites licensed by the NRC. Some of these are in various stages of decommissioning and one is in standby status with the potential to restart in the future.

The NRC recently licensed three uranium recovery facilities in Wyoming. The licensing review process required extensive coordination with the Bureau of Land Management, the EPA, the Wyoming Department of Environmental Quality, and the Wyoming State Historic Preservation Office. As part of the environmental review under NEPA and consistent with the National Historic Preservation Act, the NRC also consulted with State and Tribal agencies that expressed interest in protecting environmental and culture sites near these facilities.

The NRC is conducting licensing reviews for additional new facilities or expansions of existing facilities in Wyoming and Nebraska. Based on letters of intent from uranium recovery companies, the agency is expecting to receive numerous applications for new uranium recovery facilities, or restarts and expansions of existing facilities, in the next several years. The current listing of license applications is available on the NRC website at http://www.nrc.gov/materials/uranium-recovery/license-apps/ur-projects-list-public.pdf.

Locations of NRC-Licensed Uranium Recovery Facilities

Licensee	Site Name, Location
In Situ Recovery Facilities	
Uranium One	Willow Creek, WY
Crow Butte Resources, Inc.	Crow Butte, NE*
Hydro Resources, Inc.°	Crownpoint, NM
Power Resources, Inc.	Smith Ranch and Highlands, WY*
Uranium One	Moore Ranch, WY
Conventional Uranium Mill Recovery Facilities	
American Nuclear Corp.†	Gas Hills, WY
Bear Creek Uranium Co.†	Bear Creek, WY
Exxon Mobil Corp.†	Highlands, WY
Homestake Mining Co.†	Homestake, NM
Kennecott Uranium Corp.°	Sweetwater, WY
Pathfinder Mines Corp.†	Lucky Mc, WY
Pathfinder Mines Corp.†	Shirley Basin, WY
Rio Algom Mining, LLC†	Ambrosia Lake, NM
Umetco Minerals Corp.†	Gas Hills, WY
United Nuclear Corp.†	Church Rock, NM
Western Nuclear, Inc.†	Split Rock, WY

Note: For further details on NRC-related uranium recovery facility applications in review and applications, restarts, and expansions, see the Web Link Index. This table does not include uranium recovery facilities licensed by Agreement States.

* Satellite facilities are located within the State.
† These sites are undergoing decommissioning.
° Kennecott has an operating license but is in "standby" mode. Hydro has an operating license, but the facility has not yet

Legacy Contamination

Uranium mining and milling in the United States expanded considerably in the 1950s, 60s, and 70s driven by expanded demand for uranium to support both military uses and commercial nuclear power. Concerns about the potential health and environmental hazards associated with uranium mill tailings led to Congressional hearings in the late 1970s. At that time, the Atomic Energy Commission (and later the NRC) regulated the mills because they possessed source material, but the government's authority to regulate the tailings that result remained somewhat uncertain. The uranium mill tailings contain both radioactive and chemical wastes left over from the processing of uranium ore to recover uranium and other valuable elements. Lax controls over the mill tailings allowed their use as backfill in thousands of locations including building foundations, water and sewer lines, roadbeds, and baseball fields, exposing members of the public to elevated radiation dose rates and radon. These concerns compelled Congress to enact the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) as an amendment to the Atomic Energy Act.

For further information, visit our uranium recovery website at http://www.nrc.gov/materials/uranium-recovery.html.

September 2011