BACKGROUNDER
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Uranium Recovery

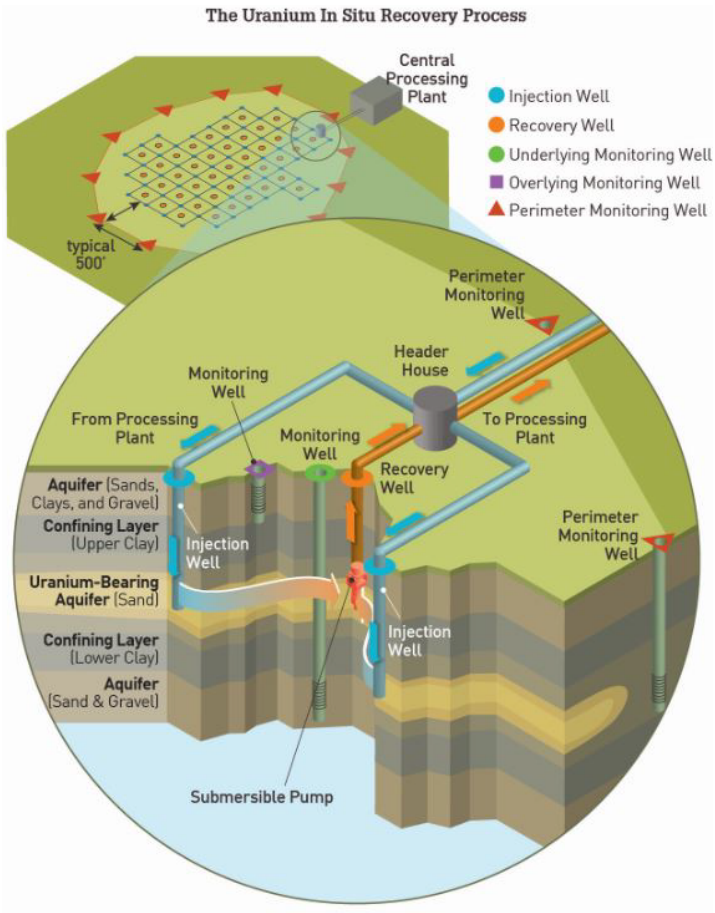
Nuclear reactors use uranium to make electricity. But there are many steps between mining the ore and turning it into fuel pellets for reactors. "Uranium recovery" is the term for taking the ore out of the earth and concentrating (or *milling*) it into "yellowcake." This powder is converted to uranium hexafluoride, which is enriched to increase the proportion of U-235. Enriched uranium is made into fuel.

The NRC plays a role when uranium ore is processed and physically or chemically altered. This happens at conventional mills, *in situ* recovery and heap leach facilities. The NRC also regulates the storage and disposal of liquid and solid wastes that result, working with other federal agencies and state and Tribal governments. The NRC provides support as needed to states that have taken over the authority to regulate uranium recovery, known as "Agreement States." Uranium mining and exploration are under the control of other federal agencies and the states, not the NRC.

Uranium Recovery Processes

A **conventional mill** processes ore that is taken from the ground and crushed. The mill further processes the ore and concentrates the uranium. Mills use chemicals to dissolve and remove 90-95 percent of the uranium from the ore. That uranium is separated from the solution, concentrated and dried. Waste from this process can be hazardous due to its radioactive and chemical content. Conventional milling produces a large amount of radioactive sandy residue known as mill tailings. These tailings are confined within an earthen structure. Wells are installed to monitor and detect any contamination of the groundwater.

An **in situ recovery** plant chemically alters the uranium ore underground before it is pumped out for processing. In the ISR process, wells are drilled into rock with uranium ore. Water, usually mixed with oxygen, hydrogen peroxide and sodium bicarbonate, is injected down the wells to dissolve the uranium in the rock. Operators control the solution underground

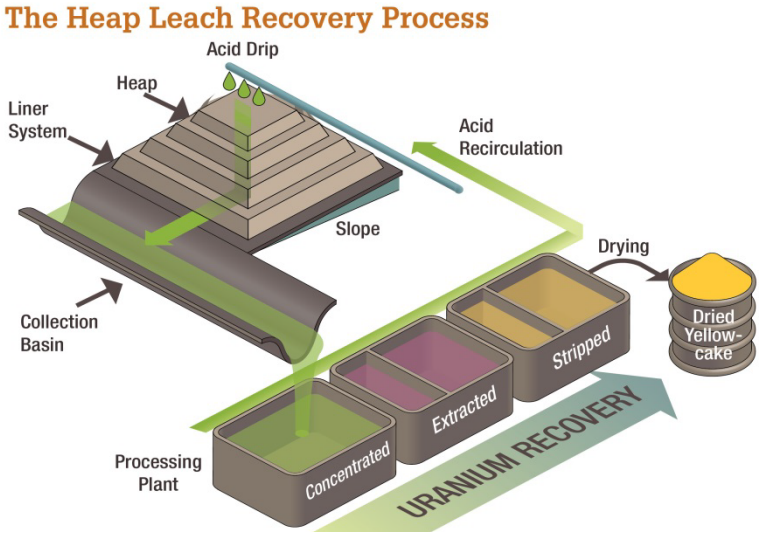


Injection wells ● pump a solution of native groundwater, usually mixed with sodium bicarbonate and oxygen, into the aquifer (groundwater) containing uranium ore. The solution dissolves the uranium from the deposit in the ground and is then pumped back to the surface through recovery wells ●, all controlled by the header house. From there, it is sent to the processing plant. Monitoring wells ● ■ ▲ are checked regularly to ensure that injection solution is not escaping from the wellfield. Confining layers keep groundwater from moving from one aquifer to another.

by pumping out more than is injected. The solution goes to a plant that separates and concentrates the uranium. Wells must be monitored to ensure that extraction fluids do not leave the facility or contaminate groundwater above acceptable levels. Waste from this process, usually filters and piping, can be disposed in a tailings pile at a mill site or a licensed disposal facility.

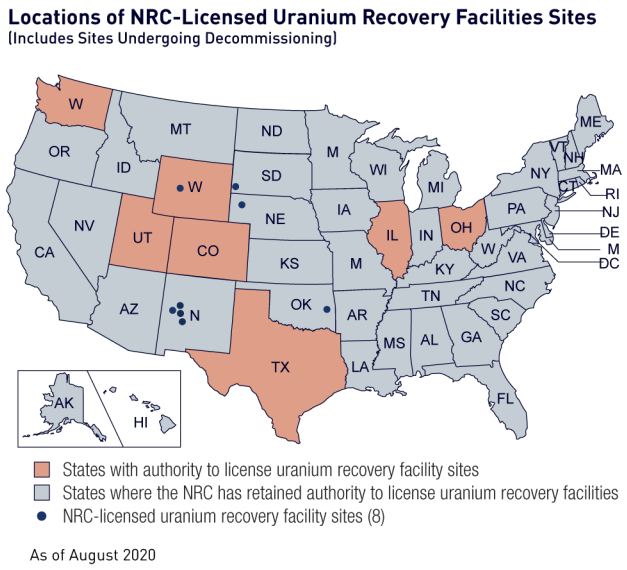
Liquid wastes can be disposed using licensed deep wells, evaporation ponds or spray irrigation, or can be treated and discharged to surface water. ISR facilities do not generate tailings. The NRC focuses closely on monitoring and restoring groundwater to protect public health and the environment.

In **heap leach operations**, small pieces of ore are piled on a plastic or clay liner. The liner is designed to keep liquids from reaching the soil. An acidic solution is sprayed over the ore to dissolve the uranium. The uranium-rich solution drains into pipes to be transferred to a processing plant, where uranium is concentrated and dried. No NRC-licensed heap leach facilities remain in operation. The process has also been used to extract ore at conventional mills.



Licensing

Each new uranium recovery application must meet requirements of the NRC or the Agreement State in which the site is located. The NRC has agreements with six states allowing them to regulate uranium recovery. Washington, Utah, Wyoming, Colorado and Texas are actively overseeing uranium recovery. The NRC regularly evaluates each state through a formal program to ensure they are adequately protecting public health and safety and have programs compatible with the NRC's. The NRC regulates active uranium recovery operations in New Mexico, Nebraska and South Dakota.



Safety reviews by the NRC or Agreement State focus on an applicant's qualifications, design safety, operating plans and site safety. The NRC also does an environmental review as required by the National Environmental Policy Act. The NRC developed a generic Environmental Impact Statement to assess common impacts for sites in the western United States. For each application, the NRC prepares a site-specific supplemental EIS.

A license may allow the licensee to construct and operate a new facility or expand or restart an existing one. Licensees must meet all regulations and laws as well as specific license conditions. Licenses are for 10 years and can be renewed for additional 10-year periods.

There are several ways to be part of the NRC's decision process. Stakeholders, including the general public, can participate in public meetings, request a hearing, and comment on the EIS and other documents. The NRC notifies the public of these opportunities in the *Federal Register* or in meeting notices on the NRC website. The NRC also has a program to work with Native American tribes that may be affected by uranium recovery.

Safety of Operations

The regulator's involvement does not end when it issues a license. The NRC and states inspect facilities regularly to confirm they are meeting the requirements. Inspections may occur several times a year at operating facilities. For facilities in standby mode or being decommissioned, they would occur once every two years.

Inspections focus on the areas most important to safety and security, using objective measures of performance. These inspections might look at construction, management organization and controls, radiation protection, chemical processes, radioactive waste management, emergency preparedness, fire safety, and environmental protection. NRC inspectors prepare a report after each inspection. Copies are available to the public through the NRC's documents database. These inspection reports can be located by searching for a licensee's name or docket number.

The NRC evaluates any violations of the requirements to determine their impact on safety. If the safety significance is low, the NRC may discuss the violation with the licensee but not take formal enforcement action. In such a case, the licensee must resolve the problem and prevent recurrence. If the violation has safety significance, the NRC may write a notice of violation. In some cases, the NRC may fine the licensee and issue a press release.

Decommissioning

ISR facilities, conventional mills and heap leach facilities must be decommissioned at the end of operations. Licensees are required to remove contaminated structures, decontaminate groundwater and soil, stabilize sites, and safely dispose of radioactive waste. ISR licensees must also decommission well fields. That work is complete when the groundwater has been restored to NRC requirements.

These steps must be completed to the NRC's satisfaction before the license is terminated. The NRC will only terminate a license for uranium recovery after the site has been cleaned up and stabilized and meets the NRC requirements. Once the license is terminated, the federal government or a state government takes over mill tailings sites for long-term care. The NRC continues to regulate these sites.

NRC's Regulatory Role under UMTRCA

As uranium mining and milling grew in the 1950s and 1960s to support both commercial nuclear power and the military, concerns about health and environmental hazards from mill tailings also grew. In the early days, the Atomic Energy Commission (and later the NRC) regulated mills because they possessed uranium. But it was unclear how the government should regulate mill tailings, which contain both radioactive and chemical wastes. Mill tailings and discarded uranium ore ended up as backfill at

numerous sites, including in building foundations, around water and sewer lines, and in roadbeds. This use exposed some members of the public to elevated radiation dose rates and radon.

In 1978, Congress passed the Uranium Mill Tailings Radiation Control Act. Title I created a Department of Energy program to clean up uranium mills that were not licensed and were largely abandoned. After DOE cleans up these sites and contains the mill tailings, it acts as the long-term steward, with the NRC providing oversight. The NRC regulates mills licensed after Nov. 8, 1978, under Title II of the law. In 1983, the Environmental Protection Agency created standards for both inactive and active tailings sites. The NRC implements and enforces those standards.

For more information, visit our uranium recovery webpage.

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