The Legacy of Abandoned Uranium Mines in the Grants Mineral Belt, New Mexico

Region 6

Superfund Division

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EPA

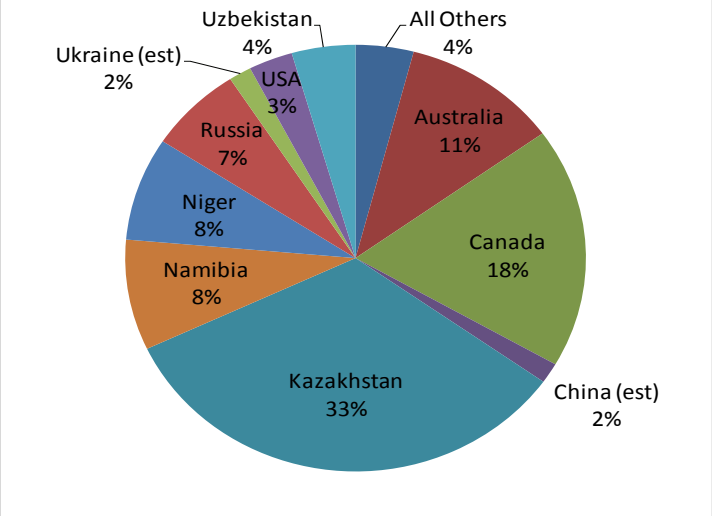
The Legacy of Uranium Mining

Uranium, Supply and Demand

The uranium market is subject to both supply-and-demand and geopolitical factors. In the early 1980s, the price of uranium fell due to a lack of new nuclear power plants in the U.S. and the importing of uranium from other countries. As a result, U.S. uranium mills shut down or scaled back operations. Uranium prices reached an all-time low in 2001, costing $7 per pound. The price of uranium gradually increased from $9.70 per pound in January 2002 to $45.75 per pound in June 2006, followed by a bubble culminating in mid-2007, that caused the price to peak at around $137 per pound. This was the highest price (adjusted for inflation) in 25 years. The high price during the bubble spurred new prospecting and the reopening of old mines. After mid-2007, prices began to fall and uranium traded closer to $45 per pound in 2010.

Uranium demands have outstripped uranium production since 1990. As the uranium prices fell, producers began curtailing operations or exiting the business entirely, leaving only a few actively involved in uranium mining and causing uranium inventories to shrink significantly. (http://www.world-nuclear.org/info/inf22.html)

2010 World Uranium Extraction



Ten countries are responsible for 96% of the global uranium extraction in 2010. (http://www.world-nuclear.org/info/inf23.html)

On March 11, 2011, an earthquake in Japan caused a tsunami that swept ashore, cutting power needed to cool the nuclear reactors at the Fukushima Daiichi facility. The Fukushima nuclear accident not only slammed uranium prices, but it re-energized anti-nuclear advocates. However, the long-term demand for uranium remains largely constant, despite Japan's nuclear disaster. (http://www.seekingalpha.com, Article by Simon Monger, Oct 31, 2011) In fact, some of the producers are just now getting all of the state and federal permits they need to begin production — permits which took several years to work their way through the regulatory process. Others sites are still early in the permitting process. Read more: http://trib.com/news/state-and-regional/article_841c5978-85eb-5fad-a050-ef3f05193292.html#ixzz1cUnANR3r

Jackpile Uranium Mine (historical) Aerial View

Uranium Mining and Mill Tailings

When uranium prices increase, interest grows in developing uranium mines. Historically, uranium mining in the U.S. occurred through conventional open pit and underground mining. In conventional mining, uranium ore is removed from deep underground shafts or shallow open pits. The ore is crushed and sent through the mill, where extraction processes concentrate the uranium into uranium-oxygen compounds called "yellowcake." The mill tailings are the fine-grained, sandy waste byproduct that remain after the milling process extracts and concentrates the uranium from the ore. Mill tailings, in slurry form during processing, are deposited in a constructed impoundment or "mill tailings pile."

Today, uranium production primarily uses the *in-situ* leaching process, where wells are drilled into rock formations containing uranium ore. Water, injected down the wells with oxygen and sodium bicarbonate, mobilizes the uranium in the rock so that it dissolves in the groundwater. Pumped to the surface, a processing plant separates the uranium from the water. Waste from this process is disposed in a tailings pile at a mill site. To read more, see website: http://www.nrc.gov/waste/mill-tailings.html

Uranium and Public Health

Uranium, radium and radon are naturally occurring radionuclides found in the environment. Uranium mill tailings contain the radioactive element radium, which decays to produce radon, a radioactive gas. The radium in these tailings will not decay entirely for thousands of years. The mill tailings pose a potential hazard to public health and safety. No information is available on the acute (short-term) non-cancer effects of the radionuclides in humans. Animal studies have reported inflammatory reactions in the nasal passages and kidney damage from acute inhalation exposure to uranium. Chronic (long-term) inhalation exposure to uranium and radon in humans may cause respiratory effects, such as chronic lung disease, while radium exposure has resulted in acute leukopenia, anemia, necrosis of the jaw, and other effects. Cancer is the major effect of concern from the radionuclides. Radium, via oral exposure, may cause bone, head, and nasal passage tumors in humans, and radon, via inhalation exposure, causes lung cancer in humans. Uranium may cause lung cancer and tumors of the lymphatic and hematopoietic tissues. EPA has not classified uranium, radon or radium for carcinogenicity. For more information, see EPA Integrated Risk Information System (IRIS) and the Agency for Toxic Substances and Disease Registry's (ATSDR) *Toxicological Profiles for Uranium, Radium, and Radon*.

Jackpile Uranium Mine (historical) Blasting Operations

Regulations

To provide for the safe and environmentally sound disposal, long-term stabilization, and control of uranium mill tailings and to minimize or eliminate radiation health hazards to the public, Congress enacted the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). UMTRCA has two major sections: Title I addresses uranium milling sites (tailings) that were inactive when the law was passed, and Title II addresses milling sites (tailings) licensed as of 1978.

Title I specifies the inactive mill sites for remediation. Under Title I, EPA establishes standards for cleanup and disposal of contaminated material. The U.S. Department of Energy (DOE)

Homestakes Mining Company Superfund Site Tailings Piles

identifies and remediates the sites and vicinity properties to the EPA standards. The U.S. Nuclear Regulatory Commission (NRC) evaluates and concurs with the DOE's remediation plans and concurs when site remediation is adequately completed. Upon completion of decommissioning, the DOE becomes the long-term site custodian under NRC General License and is responsible for performing the routine surveillance and maintenance activities.

Title II addresses mill tailings produced at active mill operations sites licensed by NRC or Agreement States. Title II amended the definition of byproduct material to include mill tailings and added specific authorities for the NRC to regulate this new category of byproduct material at licensed sites. Under Title II, the EPA establishes standards for cleanup and disposal of byproduct material. The NRC or Agreement State reviews license applications, issues licenses, conducts inspections, and oversees the decommissioning activities in meeting the EPA standards. The NRC reviews and concurs on the DOE's Long Term Surveillance Plans for conventional mills. The NRC or the Agreement State terminates the specific licenses for the mill operations sites. The NRC concurs in the Agreement State license termination. Upon completion of decommissioning, the DOE becomes the long-term site custodian under the NRC General License. To read more, see website: http://www.nrc.gov/about-nrc/organization/fsmefuncdesc.html

The regulatory responsibility for mining activities depends on the extraction method used. The states regulate conventional mining, the extraction of ore from deep underground shafts or shallow open pits. By contrast, the NRC regulates *in-situ* leach recovery. To read more, see website: http://www.nrc.gov/materials/uranium-recovery/extraction-methods.html

The distinction is that the NRC becomes involved in uranium recovery operations when the ore is processed and chemically altered. This happens either in a uranium mill, the next step in processing ore from a conventional mine, or during *in-situ*

recovery. For that reason, the NRC regulates *in-situ* recovery facilities, as well as uranium mills and the disposal of liquid and solid wastes from uranium recovery operations including mill tailings. The NRC regulates active uranium recovery operations in Wyoming, New Mexico, and Nebraska. However, the NRC does not directly regulate the active uranium recovery operations in Texas, Colorado, and Utah, as they are Agreement States, meaning that they have entered into strict agreements with the NRC to exercise regulatory authority over this type of material. To read more, see website: http://www.nrc.gov/reading-rm/basic-ref/glossary/in-situ-recovery.html

The DOE is responsible for post-closure by providing: long-term surveillance and maintenance of environmental remedies; access to historical records and information; contractor benefits continuity; and beneficial reuse of Federal property no longer needed for Departmental missions. The DOE conducts long-term surveillance and maintenance activities at its sites in accordance with approved NRC Long-Term Surveillance and Maintenance Plans. The DOE evaluates and participates in additional studies and conducts ground water monitoring to address potential data gaps. More information on DOE, including fact sheets on each of the sites it manages, is available at: http://www.lm.doe.gov.

EPA Underground Injection Control (UIC) program under the Safe Drinking Water Act (SDWA) mandates protection of underground sources of drinking water from injection, including *in-situ* mining. Two general requirements apply to *in-situ* uranium mining. Mining operators must obtain a permit under the applicable UIC program. With delegation of the UIC program under SDWA to the State of New Mexico, the permit goes through the state. Following permit approval, the New Mexico Environment Department (NMED) files an aquifer exemption request through EPA. An aquifer exemption removes the mineral bearing freshwater source from designation as an underground source of drinking water. The NRC guidance and licenses require operators to prevent off-site excursions of fluids used in uranium production into ground water aquifers during operations, and to restore ground water after operations are completed. EPA works with its federal partners and state co-regulators to ensure that *in-situ* practices do not adversely affect ground water.

EPA shares authority with NRC and the State of New Mexico in overseeing operations at *in-situ* leaching facilities. However, if the operation occurs on federal lands, the federal land management agency will also have a role. The NRC and NMED regulate *in-situ* leaching facility operations, including the injection of fluids, using environmental, radiation, and ground water protection standards developed by EPA in accordance with the UMTRCA. In addition to NRC requirements, operators of injection wells used at *in-situ* leaching facilities also must apply for and receive a Class III well permit and, if needed, a Class I well permit for disposal of fluids under the authority the UIC program. NMED issues permits for Class III solution mining wells.

Johnny M Mine Entrance

Spencer Mine Headframe

Other federal and state responsibilities include, in part, the following:

EPA -- Assess contaminated structures. Where structures pose a health risk to current or future occupants, take appropriate response actions using Superfund authority. Screen abandoned uranium mines that may warrant emergency removal actions or detailed investigations. Identify potentially responsible parties to cleanup mine sites.

Bureau of Land Management -- Survey, assess and cleanup legacy uranium mines on Bureau of Land Management property using CERCLA authority.

State of New Mexico -- In 1973, New Mexico became a Nuclear Regulatory Commission Agreement State and started regulating milling operations. In 1986, at the request of the State, the Nuclear Regulatory Commission re-assumed its regulatory authority from New Mexico for Title II sites located within the state.

NMED -- Protect ground and surface water supplies and address risks to private wells.

New Mexico Energy, Minerals, and Natural Resources Department – Assess and maintain a database of uranium mine sites. Administer programs that affect surface reclamation of mines and develop surface reclamation Designs for uranium mine.

New Mexico Department of Health -- Conduct public health surveillance to gather data and assess exposure to uranium.

The Legacy of Uranium

The Navajo Nation

From 1944 to 1986, the extraction of nearly four million tons of uranium ore occurred on Navajo lands in Arizona, New Mexico, and Utah. Today the mines are closed, but a legacy of uranium contamination remains from more than 500 abandoned uranium mines, homes built with contaminated mine waste rock, and contaminated water wells. In 2008, the EPA led the development a federal Five-Year Plan in conjunction with the Bureau of Indian Affairs, Indian Health Service, ATSDR, DOE, NRC, and the Navajo Nation. The Plan addresses contaminated homes, water sources, and abandoned mines. The Plan lays out a logical framework for addressing the highest risks while understanding longer-term problems. Navajo Nation Five-Year Plan, website: http://epa.gov/region09/superfund/navajo-nation/index.html.

Non-Navajo Land in New Mexico

The Grants Mining District located in the northwestern New Mexico was the major uranium-producing region in the United States from the 1950s until late into the 20th century. The legacy of uranium mining affects over 320 square miles of the San Mateo Creek Watershed. In 2010, the EPA collaborated with ATSDR, DOE, NRC, DOI, and the State of New Mexico to develop a plan for non-Navajo land affected by uranium mining. The Plan establishes objectives to assess health risks and environmental impacts from potential releases to soil, surface water, and ground water, and physical hazards from open adits and shafts, coordinated among federal, state and tribal participants responsible for protecting human health and the environment. The five-year plan serves as a roadmap for the future recovery of the Grants Mining District. Grants Mineral Belt Five-Year Plan, website: http://www.epa.gov/earth1r6/6sf/newmexico/grants/nm_grants_index.html

Jackpile Mine, Pueblo of Laguna

The Jackpile Mine, once the world's largest open pit uranium mines is located on the Pueblo of Laguna near the village of Paguate. In 1953, the Anaconda Copper Company began mining the site, and operations ceased in 1982 under Atlantic Richfield Company. The Bureaus of Indian Affairs and Land Management adopted a Record of Decision in 1986 with the objective of reclaiming and stabilizing the Jackpile Uranium Mine site. EPA is assessing the site for possible listing on the National Priorities List (NPL). To read more about the NPL, see website: http://www.epa.gov/superfund/sites/NPL

Homestake Mining Company Superfund Site

The Homestake Mining Company Site is located in Cibola County, just north of the village of Milan and the town of Grants, New Mexico. In 1958, uranium milling began under a license issued by the Atomic Energy Commission. The Homestake Mining Company operated the mill from 1958 until 1990 and the NRC decommissioned and demolished the mill between 1993 and 1995. During those years, seepage from mill tailings impoundments contaminated the ground water, and activities at the mill left the soil contaminated. The Site is undergoing reclamation under the NRC in coordination with NMED and the EPA. To read more, see website: http://www.epa.gov/region6/6sf/newmexico/homestake_mining/index.html

United Nuclear Corporation Superfund Site

The United Nuclear Corporation Site is located 17 miles northeast of Gallup, on the southern border of the Navajo Indian Reservation in Church Rock, McKinley County, New Mexico. The Site includes a former uranium ore processing mill (25 acres) and tailings disposal area (100 acres). The tailings cells are capped with an interim radon barrier as part of the reclamation activities directed by the NRC. Two evaporation ponds constructed on top of the cells are part of the EPA ground-water remedy. To read more, see website: http://www.epa.gov/region6/6sf/pdffiles/0600819.pdf

Other Uranium Mills Within the San Mateo Basin

Ambrosia Lake Sub-district

Ambrosia Lake - Phillips Mill Site (Active from 1958 to1982): A Title I site, under DOE custody for long-term surveillance, maintenance and ground water monitoring under the NRC general license provisions.

Anaconda-Bluewater Site (Active from 1953 to 1982): A Title II site, reclaimed and transferred to DOE in 1997 for long-term surveillance, maintenance and ground water monitoring under the NRC general license provisions.

Rio Algom-Ambrosia Lake site (Active from 1958 to 2002): A Title II site, under the jurisdiction of the NRC for reclamation.

Laguna Sub-district

L-Bar Mill Site (Active from 1977 to 1981): A Title II site, reclaimed and transferred to DOE in 2004 for long-term stewardship.

Marquez Sub-district

Bokum Mill Site: The NRC terminated its source material license following multiple inspections, which confirmed that no ore was produced or processed at the site.

EPA works with its federal, state and tribal partners to address abandoned uranium mines and to identify parties responsible for cleanups. Efforts are in progress to address properties and structures contaminated by historic uranium mining for the Navajo Nation and the Grants Mineral Belt in New Mexico. EPA will continue its regulatory work with the NRC and the states to help ensure that *in-situ* leaching injection and recovery operations are protective of ground water resources. EPA remains firmly committed to protecting public health and the environment by addressing the environmental effects of legacy uranium mines.

For more information, contact:
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