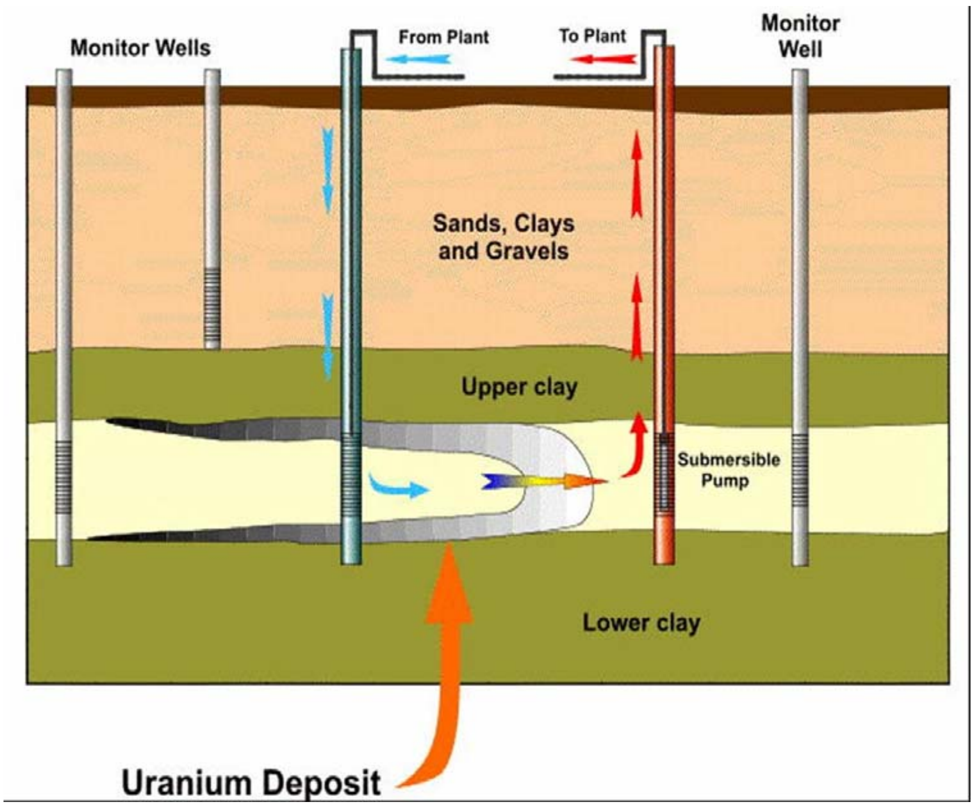
In Situ Leach Mining Rules Question and Answer Sheet

Why are the new in situ leach mining rules drafted? The rules were drafted in response to a renewed interest in South Dakota's uranium deposits, especially those that can be mined by in situ leaching. To prepare for the possibility of in situ leach mining operations moving into the state, the 2006 Legislature passed Senate Bill 62. Senate Bill 62 was designed to fill gaps in the state laws that govern uranium exploration and mining. This legislation authorized the Board of Minerals and Environment to promulgate rules for the construction, operation, monitoring, and closure of uranium and other in situ leach mines under the South Dakota Mined Land Reclamation Act (SDCL 45-6B). The Board of Minerals and Environment approved the new rules in 2007 and subsequently approved revisions to the rules in 2008.

Do the new rules open up the state to this type of mining? No. In situ leach mining was already authorized under the existing state mining laws that were enacted in 1982 (SDCL 45-6B). The new rules are designed to fill in regulatory gaps by identifying the specific requirements an applicant must meet to obtain a permit for and to operate an in situ leach mine.

What is in situ uranium leach mining? In situ leach mining involves injecting solutions into an ore body through wells to leach the uranium out of the rock, then collecting the fluid through recovery wells and processing it on the surface to remove the uranium. The solutions used to leach the uranium vary depending on the nature of the ore deposit. In South Dakota the injection fluid would probably be native groundwater fortified with oxygen and carbon dioxide. Since the ore is left in place in the ground, there is little surface disturbance and no tailings or waste rock is generated as with a conventional mine.



Generalized view of an in situ leach uranium mine.

Can other minerals be mined using in situ leaching? While the immediate concern in South Dakota is in situ leach mining of uranium, the process has been used elsewhere to mine other minerals such as copper, gold, sulfur and several different types of salt.

What do the new rules cover with regard to construction, operation, monitoring and closure of in situ leach mines? The rules include the requirements an applicant must meet to obtain a state mine permit for and to operate an in situ leach mine. The rules address in situ leach facility design and construction, injection and recovery well construction, mine operation, monitoring and reporting requirements, ground water remediation, waste disposal, aquifer restoration, well plugging, surface reclamation and post closure monitoring and maintenance.

Do the new rules address financial assurance or bonding? No, these rules do not address reclamation bonding. Reclamation bond is covered under the mining statute, SDCL 45-6B, and it applies to both the closure and postclosure periods. Under SDCL 45-6B, a reclamation closure bond for an in situ mine will cover the costs for removing structures, surface reclamation, ground water restoration, capping, plugging, and sealing of all wells, disposal of solid or hazardous waste, and monitoring during the closure period. A postclosure bond under SDCL 45-6B would include long-term ground water restoration, monitoring, and inspection and maintenance activities during the postclosure period.

Why is there renewed interest in the uranium resources of the state? World demand for uranium is growing and inventories are steadily being depleted with new nuclear power plants coming online, especially in China and India. Governments worldwide are also struggling to find solutions for controlling green house gas emissions and producing affordable energy; making nuclear power an attractive alternative to fossil fuels. This demand has caused an increase in the price of uranium (U_3O_8), which has risen from $9.60 per pound in January 2002 to over $60.00 per pound in September 2008. This price increase is fueling the growing interest in uranium in South Dakota.

What types of State and federal permits are required to conduct uranium mining? The state would require a Large Scale Mine Permit, a Class III Underground Injection Control (UIC) Permit, a Storm Water Discharge Permit, a Water Rights Permit, and Well Driller Licensure. Required federal permits include an Environmental Protection Agency Class III UIC Permit and aquifer exemption, and a Nuclear Regulatory Commission Source Material License. Other permits that may be required, depending on the nature of the proposed mine, include a state Surface Water Discharge Permit, Ground Water Discharge Permit, and an Air Quality Permit. Local governmental permits or approvals may also be required.

How is ground water protected during in situ uranium leach mining? In situ leach mining can only be used on ore bodies that occur in an aquifer bounded above and below by low permeability rock strata, such as shale. This minimizes the potential for leach solutions to migrate upward or downward into other aquifers. To control the horizontal movement of leach solutions in an ore-bearing aquifer, recovery wells are pumped at a rate higher than the rate of injection. This creates a negative pressure gradient in the aquifer around the mined area so that the leach solutions move toward the recovery wells and away from unmined areas of the aquifer. In addition to injection and recovery wells, monitoring wells are placed around the perimeter of the operation to monitor for process fluid that may migrate beyond the production zone. If this occurs, the mine operator will modify solution injection and production pumping pressures to limit and contain the excursion. The operator may also take other corrective action measures such as pumping and treating to ensure the ground water quality is restored.

How is ground water quality restored after in situ uranium leach mining? At the completion of mining, all groundwater in the mined aquifers must be restored to standards making it suitable for its pre-mining use. There are several methods used to do this. One method is to pump groundwater from the affected zone of the aquifer and treat it by reverse osmosis or ion exchange to remove the chemical constituents. The treated water is then recirculated back through the aquifer. Another method is to add chemicals to the injection fluid to bind or precipitate dissolved chemical constituents within the aquifer so they are not mobile. Recently biological (bacteria) methods are being tried to remove or bind dissolved metals.

Are there any in situ uranium leach mining operations near South Dakota? There are two operating in situ uranium leach mines near South Dakota's borders. The Crow Butte mine located near Crawford, Nebraska is 25 miles south of the Nebraska/South Dakota border, and produces 800,000 pounds of uranium oxide per year. The Smith Ranch-Highland mine near Glenrock, Wyoming is 100 miles west of the South Dakota/Wyoming border, and produces 1,200,000 pounds of uranium oxide per year.

What are the most common environmental problems that have occurred at the Nebraska and Wyoming in situ uranium leach mines? Most of the reported problems are spills of injection and production fluid (broken pipes, etc.) and leaks detected in pond liners. Other problems include excursions of process fluid beyond the limits of the production zones. All excursions are required to be reported to the Nuclear Regulatory Commission and State regulators within 24 hours, and remedial actions must be taken by the operator.

Is radon gas from in situ uranium leach mining monitored and regulated? Radon is a heavy gas that is a product of uranium decay and it is highly radioactive. As radon accumulates in low areas and buildings, the main concern with radon at an in situ mine site would be in recovery plants, satellite plants and well houses. Federal regulations require measurements of various types of radiation, including radon, at specific locations throughout a mine site. Although the federals regulations are generally geared toward worker protection, they do include provisions for protection of the public. Under federal rule, the total radiation dose to individual members of the public from a licensed operation can not exceed 0.1 rem in a year (i.e., one chest x-ray is equal to 0.025 rem). The draft state regulations require monitoring and ventilation systems designed to detect and control radon gas buildup in recovery plants and other facilities. In addition, uranium operations must comply with the Clean Air Act national emission standards for hazardous air pollutants.

Where would new uranium exploration and mining occur in South Dakota? A prime target for exploration and potential uranium mining is northwest of Edgemont in Fall River and Custer counties in and near the areas that were mined for uranium historically.

Has uranium been mined historically in South Dakota? Yes, from 1951 to 1973.

Where in South Dakota was uranium mined historically? Fall River County had the most production, followed by Harding and Custer Counties.

How much uranium was produced? One million tons of ore containing about 3,200,000 pounds of U_3O_8 were produced from deposits in South Dakota (USGS, 1975). A mill at Edgemont processed 1.98 million tons of ore and produced 6.86 million pounds of uranium oxide (some of the ore came from out of state).

How was the South Dakota uranium mined and processed? In Fall River and Custer Counties, mining was conducted as small conventional underground and surface mines in sandstone deposits. The ore was shipped to conventional mills for processing. The only uranium mill built in South Dakota was at Edgemont and it was closed in 1974.

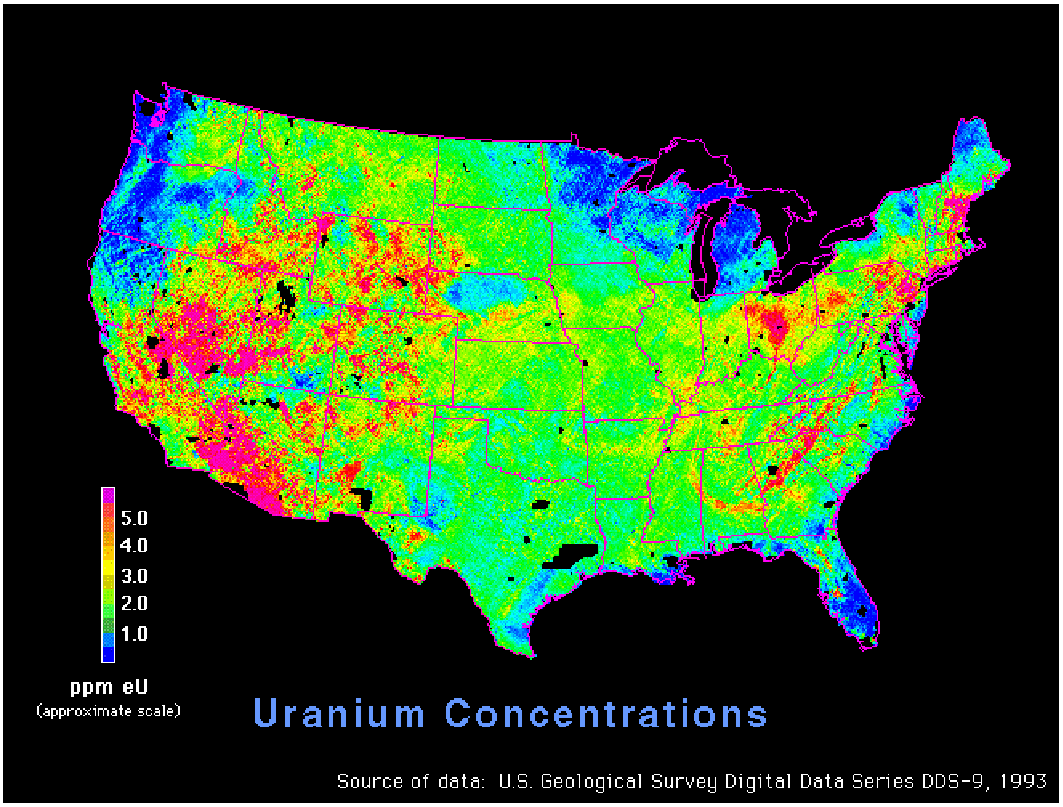
The uranium ores mined in Harding County were associated with lignite coal deposits. The lignite deposits were mined by surface methods; the overburden was stripped away exposing the lignite. At first, uranium was concentrated by burning the lignite ore at the mining areas. Later, stockpiled lignite ore was shipped to the Edgemont mill and to a processing site at Griffin, North Dakota where it was burned in heaps before processing.

Were these historic uranium operations reclaimed? For the most part these historic operations were abandoned because there were no laws requiring reclamation. Many of the abandoned uranium mine sites are located on property managed by the U.S. Forest Service (Forest Service). In recent years the Forest Service has reclaimed several abandoned mines in Fall River County, such as the Blue Lagoon, Gladiator and Dead Horse mines. Plans are being developed to reclaim others in the Cave Hills area of Harding County, including the Riley Pass Mine. The uranium mill at Edgemont was reclaimed by its owner, the Tennessee Valley Authority (TVA), from1986 to 1989. TVA removed contaminated uranium mill buildings, tailings sands and slimes, and contaminated soil from the mill site and nearby areas, and placed them in an engineered depository southeast of Edgemont. The areas excavated during mill site cleanup were backfilled with clean soil, graded for proper drainage, and revegetated.

Would a present day uranium mining operation be left abandoned like the uranium mines from the 1950's and 1960's? No, State and federal mining laws developed in the 1970's and 1980's require mine operators to reclaim lands disturbed by mining. Mine operators are also now required to post a bond to guarantee reclamation of all affected public and private lands and restoration of groundwater impacted by the operation.

<u>What are the natural background concentrations of uranium in South Dakota?</u>

Uranium and its associated radioactive decay products are naturally occurring and there are trace amounts in most rock types, stream sediments and soils in the United States. The average uranium concentration in soils in the United States is about three parts per million (U.S. Department of Health and Human Services, 1999). Ground water concentrations probably average from one to two parts per billion (Webb and Rahn, 1994), and concentrations in most natural waters range from one-tenth to ten parts per billion (U.S. Geological Survey, Heakin, 2000). Some parts of the country, especially in the west, have higher than average uranium levels due to the geology. The U.S. Geological Survey map below shows this variation in uranium levels throughout the United States.



Generally speaking, the elevated natural uranium levels in the west are the result of volcanic activity and related mountain building in the geologic past. Both volcanic ash and granitic rock produced during this process contain above average concentrations of uranium that can be mobilized into the environment through natural weathering processes.

The map shows several areas in western South Dakota that have elevated natural uranium levels including the Badlands area, the Black Hills, and several small areas in Harding County that correspond to the Cave Hills and Slim Buttes. The elevated uranium levels in the Badlands area and in Harding County can be attributed to beds of rock containing volcanic ash. These beds, which make up the topography of the Badlands, were deposited roughly between 20 and 40 million years ago as the result of intense volcanic activity to the west. These beds, known by geologists as the Arikaree and White River groups, have been largely removed by erosion in Harding County, but some remnants remain in the higher elevations. The elevated uranium in and around the Black Hills probably has several sources including the granitic core, metamorphic rocks such as the uranium containing conglomerates near Nemo, volcanic ash, and secondary enrichments in the Inyan Kara group, the geologic formation mined historically near Edgemont.

What are the concentrations of uranium in ground water in South Dakota?

The geologic history of western South Dakota has resulted in naturally elevated levels of uranium in soils and water in several areas. Natural weathering processes have released and mobilized uranium from parent materials into the environment. Oxygenated ground water containing this uranium is responsible for creating the known deposits of uranium and can contain concentrations higher than the current drinking water standard of 30 parts per billion.

Areas with high concentrations of uranium in rocks and soils often have ground water with elevated levels of naturally-occurring uranium. For example, a U.S. Geological Survey study by Bowles (1967) on using ground water as a guide to finding uranium deposits in the southern Black Hills, noted uranium concentrations in ground water were reduced from 12 to 13 parts per billion to 3 to 4 parts per billion as the water migrates through the Lakota and Fall River formations, demonstrating ongoing deposition of uranium. Another U.S. Geological Survey report by Heakin (2000) on the water quality of springs and public supply wells on the Pine Ridge Indian Reservation found median values of uranium in nine springs ranged from 2.1 to 13 parts per billion. The study also found uranium levels in 44 wells that ranged from less than detection to 59 parts per billion, with an average of 15 parts per billion for all the wells. Three wells exceed the current EPA drinking water standard for uranium of 30 parts per billion. A study by Gill and Moore (1955) on the uranium deposits in the Slim Buttes of Harding County, found that uranium bearing lignites were associated with natural springs containing uranium in concentrations of 30 parts per billion or more.