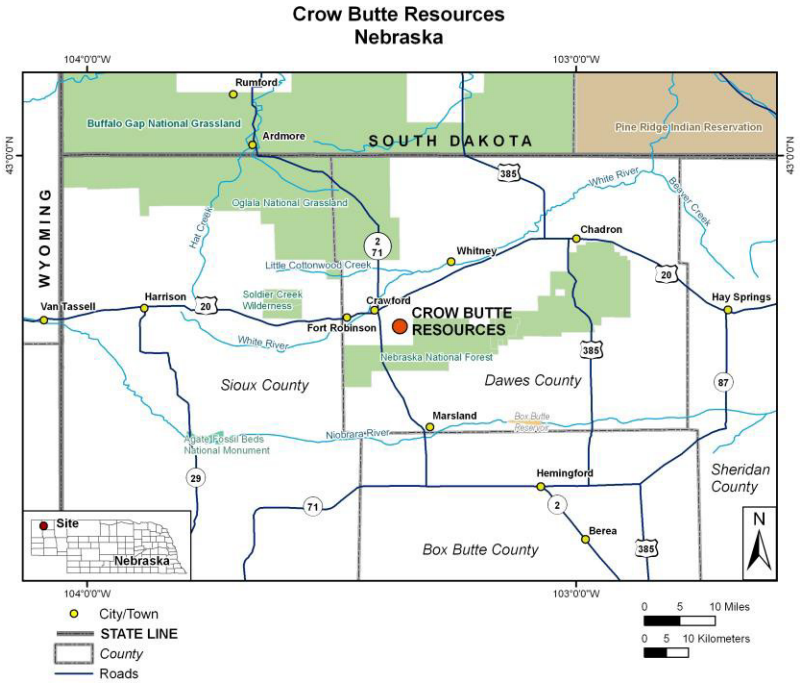
Crow Butte Uranium Recovery Facility

Site Location and Facility Description

The Crow Butte facility is located approximately 4 miles southeast of the City of Crawford in Dawes County, Nebraska. The facility was originally developed by Wyoming Fuel Corporation in 1986 and subsequently acquired and operated by Ferret Exploration Company of Nebraska. In 1994, Ferret Exploration Company changed its name to Crow Butte Resources, Inc. (CBR).

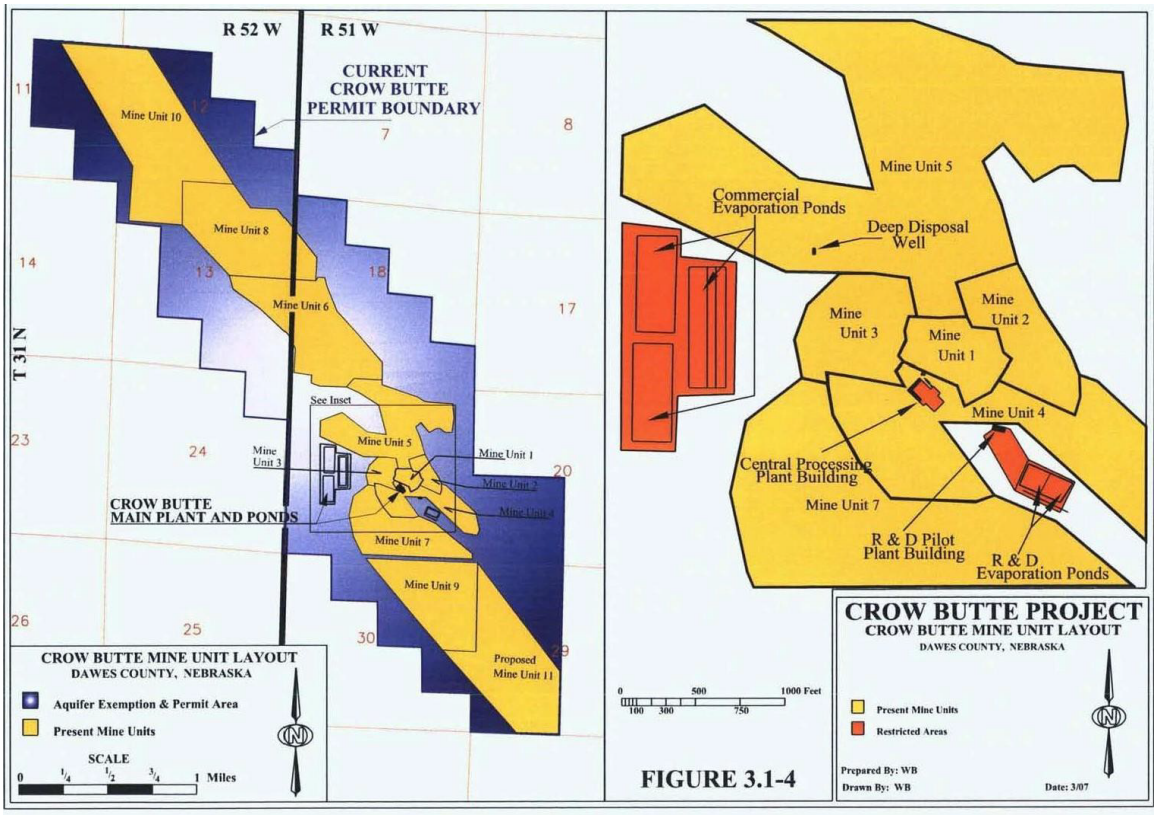


The original license area is approximately 3,300 acres, of which 89 percent is privately-leased land and the rest is owned by the federal, state, and local governments. The surface area affected over the estimated life of the project is approximately 1,100 acres. The license area includes the Central Processing Plant, 11 wellfields (mine units), two deep disposal wells, and five evaporation ponds.

The Crow Butte facility uses the in-situ recovery process to extract uranium from the Chadron sandstone aquifers 400 to 800 ft deep. Leaching solution enters the formations through the injection wells and flows to the recovery wells. Uranium-rich leaching solution is drawn from the recovery wells for processing into yellowcake at CBR's Central Processing Plant.

There are three commercial and two Research and Development (R&D) evaporation ponds, which comply with the design, installation, and operation criteria specified in NRC Regulatory Guide 3.11. Two commercial ponds, each 17.5 feet deep, were completed in 1990; the third commercial pond was competed in 1992 and is 17 feet deep. The capacity of each commercial pond is about 4.6×10^6 ft^3, exterior slopes are 2.5:1(horizontal to vertical), and interior slopes are 2:1. These ponds are equipped with primary and secondary liners, a leak detection system, and pumps and diversion channels that would allow transferring the content of a pond to another one in the event of a leak. The R&D ponds were completed in 1985; each pond has 2:1 interior

and exterior embankment slopes and overall depth of 15 feet. The maximum operating depth of each commercial or R&D pond is 12 feet.



Facility Licensing and Operating History

The source material license SUA–1534 was originally issued to Ferret Exploration Company of Nebraska, Inc., on December 29, 1989. Commercial operations at the Crow Butte facility started in April 1991. On December 20, 1995, CBR submitted a license renewal application to the NRC for the Crow Butte Uranium Project. NRC Staff issued the Safety Evaluation Report in February 1998. On May 30, 2007, CBR submitted a request to amend the license SUA-1534 to extend in-situ uranium recovery operations northwest of the City of Crawford. CBR proposes this extension, referred to as the North Trend Expansion Area, as a satellite facility to the main CBR plant. The current main facility is licensed for a total annual production of 2 million pounds of yellowcake. The North Trend Satellite Plant will have an expected annual production of 500,000 to 600,000 pounds of yellowcake. CBR applied for a license amendment application on November 27, 2007 to renew the current license for a standard 10-year period. NRC found the application acceptable to begin the technical review on March 28, 2008. NRC staff approved license Amendment Number 22 allowing the licensee to add a low-grade recovery circuit to the Central Processing Plant. The approved license amendment for plant expansion permitted the licensee to increase its flow throughput from 5,000 to 9,000 gallons per minute.

In its well fields, CBR uses a 7-spot pattern that comprises 6 injection wells on the vertices of a hexagon and one production well in the center. However, the precise orientation of injection and production wells is subject to operational needs and site conditions. All wells are completed so that each well can be used as either an injection or a recovery well. Consequently, wellfield flow

patterns can be changed, as needed, to improve uranium recovery and restore the groundwater in the most efficient manner. Within each mine unit, more water is produced than injected into the formation to develop an overall hydraulic cone of depression in the production zone. Therefore, the natural groundwater movement from the surrounding area is toward the wellfield. This provides additional control on the movement of the leaching solution. The difference between the amount of water produced and injected is the wellfield "bleed."

The liquid waste generated at the plant site is primarily the production bleed. CBR disposes of the liquid waste through injection into the deep disposal wells, completed in the Sundance and Morrison Formations below the Pierre Shale, or through solar evaporation in the ponds. The deep injection wells are equipped with sensors to monitor their status.

The Crow Butte facility is licensed to produce 2 million pounds of yellowcake annually and currently operates 11 mine units in various phases. Mine Unit 1 has been restored and decommissioned; Mine Units 2 through 8 are undergoing groundwater restoration; Mine Units 9 through 11 are in the production phase. Per Nebraska Department of Environmental Quality Permit NEO122611, CBR cannot have more than five mine units in production and five mine units in restoration at any one time.

Groundwater Protection and Airborne Effluent and Environmental Monitoring Program

The geological units found in northwestern Nebraska include the Brule Formation, the Chadron Formation, the Pierre Shale, the Dakota, Morrison, and Sundance Formations. The Chadron and Brule Formations are included in the White River Group, which is overlain by the Arikaree and Ogallala Groups. The Chadron Formation is the host for local uranium mineralization. At the Crow Butte site, the Basal Chadron sandstone is overlain by 120–250 ft-thick Middle and Upper Chadron units and 500–650 ft-thick Brule Formation. These two overlying geological layers provide a thick upper confinement between the ore-bearing Basal Chadron aquifer and the geologically younger Arikaree group that consists of fine-grained geologic materials interbedded with loosely cemented sandstone layers. Within the Crow Butte facility extraction zone, the Basal Chadron sandstone is approximately 80 ft thick. The 1,500 ft-thick Pierre Shale forms a confining layer beneath the ore-bearing zone.

The Crow Butte facility is equipped with monitoring wells around the wellfields for early detection of potential excursions to protect public health and safety. CBR implemented the groundwater and surface water monitoring programs in Mine Unit 1, at which NRC approved the groundwater restoration plan.

Rn-222 is the only radioactive airborne effluent. The facility employs a vacuum dryer system for yellowcake processing. The operation of the vacuum dryer and wet condenser systems do not generate airborne effluents. Pregnant lixiviant contains Rn-222 gas, which is released into the atmosphere from vents in the injection surge tanks and ion exchange columns. To minimize exposure to in-plant workers, Rn-222 gas in vessels within the main plant enters a manifold before it is exhausted to the atmosphere by an induction fan. The exhaust system includes redundant fans. Discharge stacks are located away from the building ventilation intakes.

CBR uses air and environmental sampling to determine radioactivity areas and monitors personal exposure during operations. The in-plant monitoring program addresses area and individual breathing zone sampling for airborne uranium particulates and area sampling for

airborne concentrations of radon decay products. Area sampling for airborne natural uranium is performed weekly at one location for the dryer room and monthly at four other in-plant locations.

The environmental monitoring program consists of air particulate, radon, surface water, sediment and ambient gamma exposure rate sampling. CBR has seven monitoring stations at various locations around the site including one background station. The seven monitoring stations are used to measure natural uranium, radium-226, and lead-210 concentrations in air.

CBR measures direct radiation levels, and samples radon gas and airborne particulates at several monitoring locations. Airborne particulates are sampled quarterly for airborne uranium, Ra-226, and Pb-210. Radionuclide concentrations are also monitored in the sediment of the Squaw and English Creeks and impoundments. Vegetation sampling was performed during a 5-year period of operations starting in 1992. Surface and subsurface soil samples were taken during preoperational monitoring and will be compared to sampling results after operations cease. Dosimeters were used to monitor direct radiation exposure at the seven monitoring locations and recorded increased radiation levels for about 2 years, which overlap with a change in normal operations at the facility. Two groundwater monitor wells are installed in the Brule aquifer in the commercial pond area and one groundwater monitor well in the R&D pond area. These wells are sampled quarterly for indications of leaks in the ponds and analyzed for alkalinity, conductivity, chloride, sulfate, and sodium.

Current Issues

On February 5, 2018, CBR announced its plan to cease production at its U.S. operations due to continued low uranium prices. As of March 23, 2018, the Crow Butte mine had reduced production flows from Mine Units 7, 8, 9, 10, and 11. There has been no change to the restoration plans at Crow Butte and restoration activities will continue.

Contacts

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