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 (Figure 1). 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 includes the Central Processing Plant, 11 wellfields approximately 1,100 acres. The license area over the estimated life of the project is (mine units), a deep disposal well, and 5 evaporation ponds (Figures 2 and 3).

The Crow Butte facility uses the *in-situ* recovery process to extract uranium from the Basal Chadron sandstone aquifers at a depth that varies from approximately 400 to 800 feet below the ground surface. 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.

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 U.S. Nuclear Regulatory Commission (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 license SUA-1534 to extend *in-situ* uranium recovery operations northwest of the City of Crawford. CBR proposed 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.

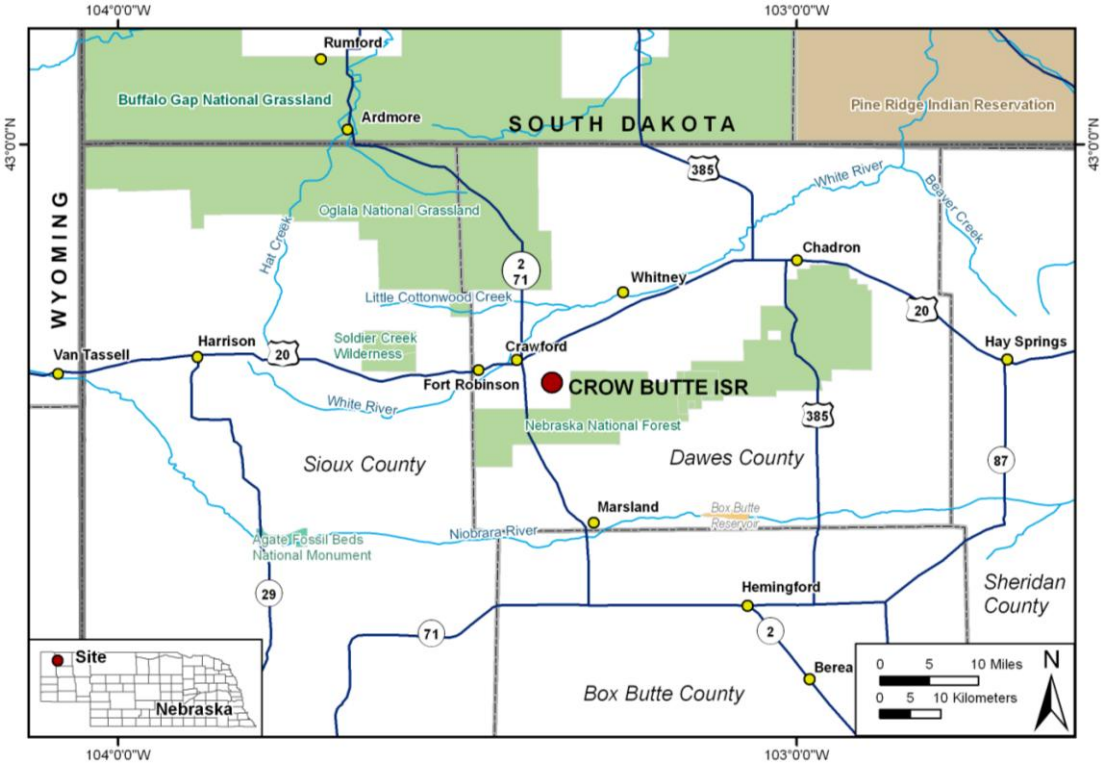

Figure 1. Crow Butte Uranium Recovery Site Location Map

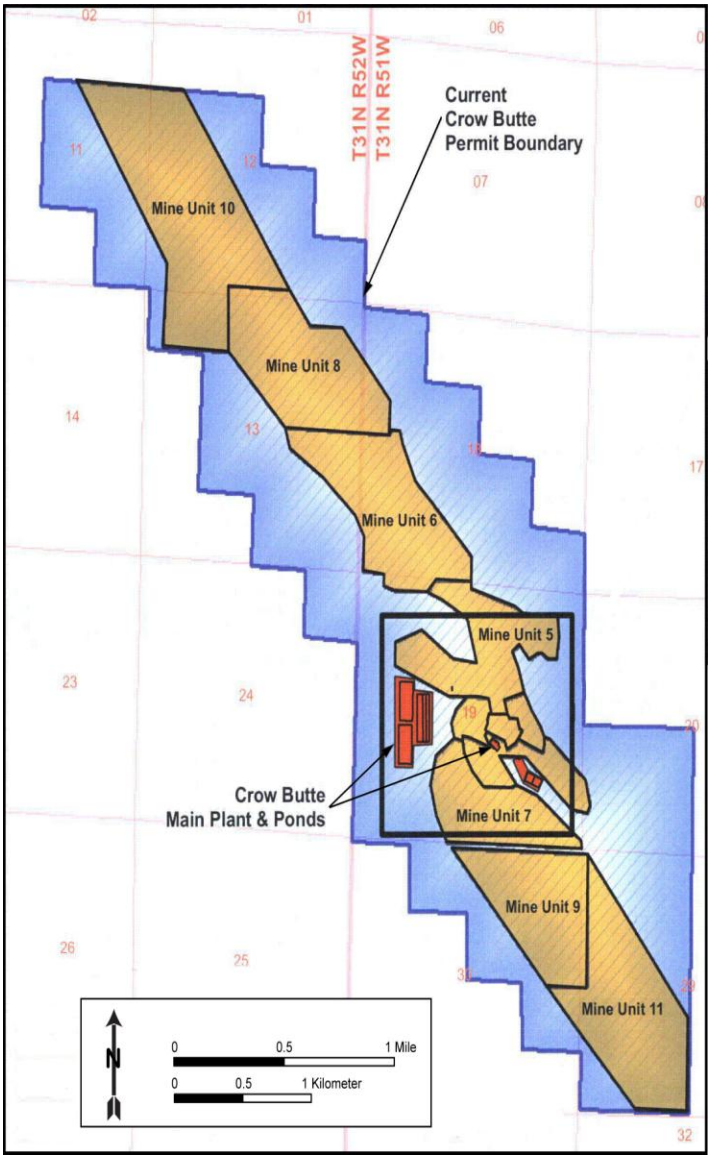

Figure 2. Crow Butte Mine Unit Layout

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 CBR to increase its flow throughput from 5,000 to 9,000 gallons per minute.

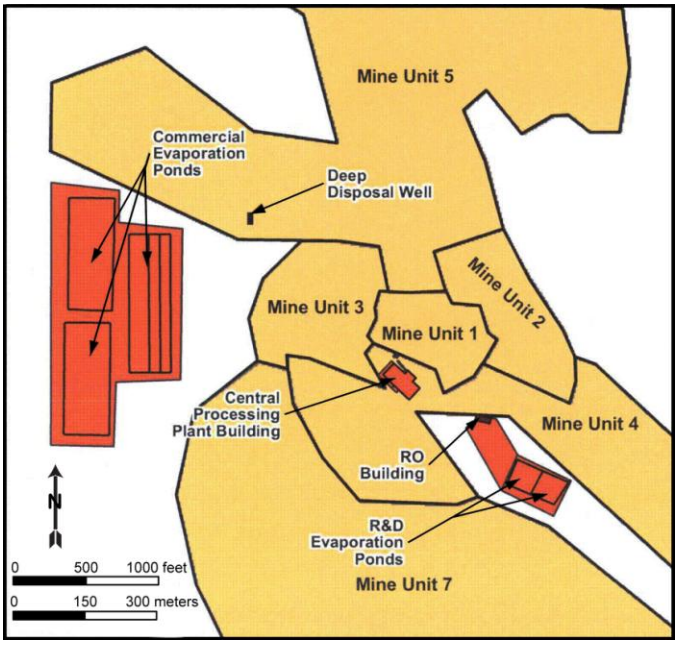

Figure 3. Crow Butte Main Plant Site Layout

In its well fields, CBR uses a seven-spot pattern that comprises six injection wells on the vertices of a hexagon and one production well in the center. However, the precise location 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 wellfield (mine unit), more water is produced than is injected into the formation to develop inward groundwater flow toward the production zone. This inward flow prevents the movement of the leaching solution away from the wellfield. The difference between the amount of water produced and injected is known as the wellfield "bleed."

The liquid waste generated at the plant site is primarily composed of the wellfield "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 evaporation in several onsite ponds. The deep injection wells are equipped with sensors to monitor their performance to ensure their safe operation.

[1]Source: Crow Butte Resources, Inc. "Application for Nebraska Department of Environmental Quality (NDEQ) Class III Underground Injection Control (UIC) Permit." Crawford, Nebraska: Crow Butte Resources, Inc. 2010.
[2]Ibid.

The Crow Butte facility currently has 11 wellfields in various phases of operation. Wellfield 1 has been restored and decommissioned; Wellfields 2 through 5 are undergoing groundwater restoration; Wellfields 6 through 10 are in the production phase; and Wellfield 11 is under construction. Per Nebraska Department of Environmental Quality Permit NEO122611, CBR cannot have more than five mine units in production and five wellfields in restoration at any one time. Therefore, production in Wellfield 11 cannot start until groundwater restoration begins in Wellfield 6.

Groundwater Protection and Airborne Effluent and Environmental Monitoring Program

The regional geological units found in northwestern Nebraska include the Brule Formation; the Chadron Formation; the Pierre Shale; and 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 Basal Chadron Sandstone is the host for local uranium mineralization at the Crow Butte site. Within the wellfields, the Basal Chadron sandstone is approximately 40 to 80 feet thick. The Basal Chadron sandstone is overlain by 120- to 250-feet-thick Middle and Upper Chadron units. These two overlying aquitards provide confinement between the ore-bearing Basal Chadron aquifer and the geologically younger Arikaree group aquifer of the Brule Formation. The 1,500-feet-thick Pierre Shale acts as the confining layer beneath the ore-bearing zone.

Each wellfield at the Crow Butte facility is equipped with groundwater monitoring wells in and around the wellfields for early detection of potential excursions to protect public health and safety. These monitoring wells are located in the ore zone aquifer in a “ring” surrounding the production zone and in the overlying and underlying aquifers. NRC approves the location and depth of each well. Each monitoring well is sampled every 2 weeks to determine the presence of an excursion. If an excursion is found, it must be reported to NRC and corrected. CBR also monitors surface water at the site to identify and correct any contamination arising from operations.

Radon-222 is the primary radioactive airborne effluent. The facility employs a vacuum dryer system for yellowcake processing. The operation of the vacuum dryer and wet condenser systems is designed to minimize airborne particulate effluents.

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, radium-226, and lead-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 Research and Development (R&D) evaporation pond area (Figure 3). These wells are sampled quarterly for indications of leaks in the ponds and analyzed for alkalinity, conductivity, chloride, sulfate, and sodium.

Additional Information

For more information about the Crow Butte uranium recovery facility, visit the NRC uranium recovery website at http://www.nrc.gov/info-finder/materials/uranium/ or contact the NRC facility project manager, Ronald Burrows, at (301) 415-6443 or ronald.burrows@nrc.gov.