SECTION 8.0

ALTERNATIVES

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8.0 ALTERNATIVES

This section describes the applicant's proposal along with alternative methods for uranium recovery from the available ore source and compares the potential environmental effects of the various recovery operations.

8.1 Summary of the Proposed Activity

FEN proposes to operate a commercial uranium in-situ leach facility located in northwest Nebraska, approximately 4 miles (6.4 km) southeast of Crawford. The Process Facility will be located in Section 19, Township 31 North, Range 51 West, Dawes County, Nebraska.

The land for development of the commercial facility has been leased by FEN.

Construction of the commercial facility is planned to begin in 1988 and time of construction prior to operation of the plant is estimated at 9-12 months. The total permit area is 2560 acres and the surface area to be affected by the commercial project will be approximately 500 acres. Facilities will include a process building, an office building, solar evaporation ponds, parking, access roads and wellfields.

After the construction period, the commercial facility is projected to be in operation for ten to over 20 years. Restoration and reclamation will be done concurrent with operation plus an additional three (3) years at the end of the project for aquifer restoration and reclamation of all disturbed areas including the remaining wellfields, facility locations, evaporation ponds, and access roads.

Uranium will be recovered by in-situ leaching from the Basal Chadron Sand at a depth of approximately 400 to 800 feet. The overall width of mineralization in the area ranges from less than 1000 feet to 5000 feet. The ore body ranges in grade from 0.05% to greater than 0.5% U_3O_8 with an average grade estimated at 0.26% equivalent U_3O_8 and 0.31% chemical U_3O_8.

The proposed project will, after year 3, consist of a total of approximately 720 wells with 240 wells in each of three phases. The three phases are development, operation, and reclamation. Each phase will consist of 100 production wells, 120 injection wells, and 20 monitor wells.

The in-situ leaching process will consist of an oxidation step and a dissolution step. The oxidants to be used in the facility will either be hydrogen peroxide or gaseous oxygen. A sodium bicarbonate lixiviant will be used for the dissolution step. The sodium bicarbonate lixiviant will be used at a strength ranging from 0.5 to 5.0 g/l and a range of .01 to 1.5 g/l hydrogen peroxide or oxygen equivalent will be used for the oxidation step.

The uranium bearing solution resulting from the leaching of uranium underground will be recovered and uranium will be extracted in a process plant. The plant process will utilize the following steps:

A. Loading of uranium complexes onto an ion exchange resin
B. Reconstitution of the solution by addition of sodium bicarbonate and oxygen
C. Elution of the uranium complexes from the resin using a sodium chloride/bicarbonate eluant and the precipitation of uranium using H_2O_2.

The plant will be designed to operate at an average of 2500 gallons per minute. Estimated U_3O_8 production will be 1,000,000 lbs (453,600 kg) annually.

The operation of the facility will result in two sources of liquid waste. They are: eluant bleed and reverse osmosis brine. Five solar evaporation ponds will be utilized to handle liquid waste.

During restoration, a reverse osmosis unit will be used to filter the contaminates out of the discharge water and the purified water will be recycled through injection wells into affected zones and recovered by pumping. FEN's restoration process program is designed to return the water quality of the affected zone to a chemical quality consistent with the quality level specified by NDEC.

After groundwater restoration has been completed, all injection and recovery wells will be reclaimed using appropriate abandonment procedures. Furthermore, FEN will implement a sequential land reclamation and revegetation program on the site. This reclamation will be performed on all disturbed areas of the site, including the plant, wellfield, ponds and roads. Specifics on the reclamation plan and abandonment of wells are presented section 6.0.

FEN will maintain financial responsibility for groundwater restoration, plant decommissioning and surface reclamation. This responsibility will be in the form of a surety bond or letter of credit with USNRC and/or the State of Nebraska. This surety or letter of credit will be based on the costs of the aforementioned activities.

8.2 Mining Alternatives

Conventional surface or underground mining of the Crow Butte ore deposits are not economically feasible for several reasons including the spatial characteristics of the mineral deposit and environmental factors. The depth of the deposit and subsequent overburden ratio makes surface mining impractical. Surface mining is commonly undertaken on large, shallow (less than 300 ft) ore deposits and uranium will be recovered from depths of approximately 650 feet on the Crow Butte site.

The physical characteristics of the deposit and overlying materials also make underground mining not feasible for the Crow Butte project. In addition, costs of mine development including surface facilities, shaft, subsurface stations, ventilation system, and drifting would decrease the economic efficiency of the project.

In-situ mining is the only environmentally and economically effective way that FEN can extract the uranium from the site deposit.

8.3 Process Alternatives

8.3.1 Lixiviant Chemistry

FEN will use a sodium bicarbonate lixiviant which is an alkaline solution. Where the groundwater contains carbonate (which it does at Crow Butte), an alkaline lixiviant will mobilize fewer hazardous elements from the ore body and will require less chemical addition than an acidic lixiviant. Also, test results at other projects indicate only limited success with acidic lixiviants, while the sodium bicarbonate has proven highly successful on the Crow Butte R & D project, as well as other projects.

8.3.2 Groundwater Restoration

No feasible alternative groundwater Restoration method is available for the Crow Butte project. The R & D phase of the project exhibited the effectiveness of the proposed method. The use of groundwater sweep, permeate/ reductant injection and aquifer recirculation restored the groundwater to its pre-mining quality.

8.3.3 Waste Management

FEN is proposing to utilize solar evaporation ponds to handle liquid waste generated from the facility. An alternative to solar evaporation ponds would be deep well injection. Deep well injection may be considered at a later date.

An additional alternative is to handle the waste as a liquid without evaporation. This could involve land application of water of suitable quality for irrigation purposes.

Alternative pond design and locations have also been considered. The selected site represents the best location considering proximity to the plant, size of drainage and suitable soils. The design is such that seepage of toxic materials into the subsurface soils or hydrologic system would be prevented or minimized. The ponds have also been designed to protect the down-gradient area from surface flows and subsurface seepage in the event of dam failure.

8.4 Conclusion

In considering all available alternatives for the Crow Butte project, FEN has selected those that are the most feasible from an engineering and economic standpoint and minimize the impact to the environment.