SECTION 7.1

ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND CONSTRUCTION

7.1 ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND CONSTRUCTION

This section addresses the environmental effects of site preparation and construction of the proposed commercial facility. The potential effects of construction activities on the local population and the environment are presented.

The site layout for the commercial facility includes a nominal 120'x300' process building that will be used for uranium extraction, precipitation, drying and packaging, offices, laboratories and change rooms; waste ponds totaling about 30 acres; well fields that will impact approximately 25 acres per year; and access roads. The total area impacted at any one time, not including access roads which will be reclaimed during final reclamation, will be approximately 120 acres. All areas disturbed will be reclaimed either during the life of the mine or during final reclamation. Except for the wells and access roads that will be scattered throughout the permit area, the facilities will be confined to approximately 40 acres within Section 19, T31N, R51W, Dawes County, Nebraska.

Site preparation and construction activities will involve topsoil salvaging, pond excavation, building erection, road construction and completion of injection, production and monitor wells. Proposed heavy equipment for construction includes dozers, backhoes, fork lifts, a crane, scrapers, motor-graders, a water truck, compaction equipment (sheeps-foot-roller), drilling rigs and heavy trucks (e.g. concrete).

The proposed impact of these operations on the environment and mitigative procedures are as follows.

The principal land use to be impacted by site preparation and construction will be grazing. In the worst case, cattle would be excluded from the 150 acres that would be under development at any time. Assuming cattle would be excluded from the construction phase through ground water restoration there would be a loss of 3.9 Animal Unit Months (AUM)/year to 11.7 AUM/year. The 3.9 AUM/year is based on proper use as determined by field observation of present range condition while 11.7 AUM/year is based on the present stocking rates used in the area. Exclusion of livestock from this area would have a direct benefit as the present range would be rested and as a result, carrying capacity would increase.

The vegetation will be removed in the construction area. This is an unavoidable impact. There were, however, no threatened or endangered plant species documented within the Permit Area. The vegetation in the Permit Area dominated by disclimax flora with a low productivity. Considerable opportunity for floristic enhancement exists during revegetation. This vegetation removal is considered a short-term impact with potential long term benefits through reclamation.

There will be minimal short term impacts on wildlife species as a result of construction activities and no long term impacts. There were no documented threatened or endangered mammals, birds, reptiles, amphibians or fish in the Permit Area. The Permit Area provides marginal habitat for big game (mule deer, white-tailed deer, and elk) while carnivores (red foxes, coyotes, raccoons, long tailed weasels, stripped skunks) are expected to occur regularly in low numbers.

The nesting territory of raptors, including a pair of golden eagles and a pair of redtailed hawks, lies within the Permit Area. Rough-legged hawks, northern hariers, prairie falcons and kestrals also utilize the Permit Area. Impacts on these species will be in direct proportion to a reduction in suitable prey. This should be minimal as a result of a small disturbance.

In a worst case, wildlife will leave the area as a result of normal construction activity. Through proper reclamation, it is felt the wildlife habitat for both terrestrial and aquatic species can be enhanced.

Field investigations in 1982 and 1987 identified 21 new archaeological resource locations. These sites are represented by eight Native American components, twelve Euroamerican locations and a buried deposit of undetermined cultural association. Six of these sites identified as

25DW114, 25DW192, 25DW194, 25DW198, 25DW20-25,and 25DW112 are considered to be potentially eligible for the <u>National Register of Historic Places</u> and would warrant further investigation if they are to be directly impacted. These resources, however, will be avoided and not be impacted during contruction activities. Therefore, the area has been recommended to be cleared for construction of the commercial facility as long as the identified resources are avoided and continued coordination is maintained with the Nebraska State Historical Society. (See Section 2.4, Regional Historic, Archaeological, Architectural, Scenic and Natural Landmarks).

The effects of construction on the hydrologic system should be minimal. During construction there may be increased sediment from adjacent unnamed tributaries to Squaw Creek. This sediment would result from earth moving activities exposing soil to potential wind and water erosion. This condition will be temporary as the site will be stabilized.

Well completion will not adversely affect ground water during the construction phase. Completion methods previously discussed in this application are designed to prevent comingling of aquifers and provide adequate mechanical integrity for use during the operational phase. Well clean-up will result in removing a small volume of water relative to the overall recharge capacity of the zone of well completion. No water users will be impacted as a result of completion of wells.

The effects of construction on the immediate population, which are unavoidable, will result from increased traffic to and from the construction site, noise from heavy equipment, minimal fugitive dust and a slight increase in the work force.

The nearest residence is approximately one-half mile from the proposed commercial facility. Trees and topographic differences between the site and this residence will cut down the visual impact during construction. Further, traffic will normally enter the road to the Permit Area from a topographic low prior to passing this residence's drive. Since there is a one-half mile separation between the proposed construction and the residence, noise should be no problem.

Fugitive dust during construction will be controlled within the Permit Area by watering or applying dust suppresant to roads as necessary.

The social and economic effects of construction on the town of Crawford and surrounding area will be slight because of the small scale of activities. The total work force during construction will not stress existing public facilities. Income from salaries is expected to result in increased business and governmental incomes thus having a positive economic impact on the community.

SECTION 7.2

ENVIRONMENTAL EFFECTS OF OPERATIONS

7.2 ENVIRONMENTAL EFFECTS OF OPERATIONS

The major environmental concerns during the operation of the Crow Butte Commercial facility are those potential impacts of mining on the groundwater, the radiological impacts, the impacts of evaporation pond leakage (if it were to occur) and disposal of wastes.

Excursions represent a potential effect on the adjacent groundwater as a result of operating the Crow Butte facility. During operations, injection of the lixivant into the wellfield will result in a degradation of water quality compared to pre-mining conditions. Movement of this water out of the wellfield results in an excursion. Excursions of contaminated groundwater in a wellfield can result from an improper balance between injection and recovery rates, undetected high permeability strata or geologic faults, improperly abandoned exploration drill holes, discontinuity and unsuitabiity of the confining units which allow movement of the lixivant out of the ore zone, poor well integrity, and hydrofracturing of the ore zone or surrounding units. Based on information already presented in this application, none of the above are expected to occur during commercial operations. This is not to say that an excursion will never occur. Past experience from other Commercial Scale in situ leach projects has shown that when proper steps are taken in monitoring and operating the wellfield, excursions, if they do occur, can be controlled and serious impacts on the groundwater system prevented. Control of excursions at the Crow Butte Commercial facility, if they occur, will be accomplished by increasing the negative potentiometric pressure in the wellfield and effectively drawing contaminated water back into the wellfield. The monitoring and sampling program as designed will provide early detection of any lateral or vertical excursions.

The long term impacts on the groundwater quality should be minimal since restoration of the wellfield will be accomplished during operations. The drawdown effects on the aquifer as a result of operations will also be minimal.

Another potential impact during operations would be evaporation pond leakage or failure. If ponds were to leak uncontrolled, this could potentially contaminate the shallow aquifer (Brule) and contaminate the soil in the area. To mitigate this impact, ponds will be installed having an impermeable synthetic liner and underliner of compacted soil. This dual liner system should prevent uncontrolled seepage. Furthermore, the ponds will contain a leak detection system which will be checked daily allowing for the early detection of a leak, thereby minimizing the quantity of leakage. Pond or dam failure could also result in unacceptable contamination of surface and groundwater. Such a failure is highly unlikely since the ponds have been designed and will be constructed to prevent failure of the dikes and a large fraction of the total pond volume will be located below grade, and this fraction would not be released in the event of dam failure. To further minimize the risks, a berm will be constructed below the dam to restrict surface flow and provide secondary containment to prevent water from entering the English Creek drainage. Size and location of the berm will be determined druing the final design of the ponds.

The radiological impacts resulting from the Crow Butte Commercial facility will be maintained within the limits set by NRC. Section 7.3, Radiological Effects, of this application discusses in detail the radiological pathways as well as the potential impacts on the population and the environment.

A small volume of solid waste will be generated at the Crow Butte Commercial facility. It is anticipated that these solid wastes will be disposed of at an NRC licensed mill tailings disposal site.

Other potential environmental impacts associated with operations will be those effects of flora and fauna, grazing patterns and socioeconomic effects.

As noted in Section 7.1, Site Preparation and Construction, there should be no threatened or endangered plant or wildlife species impacted. Surface disturbance will result in loss in habitat over the life of operations. Since the disturbance will be small, no significant impacts are expected on these species.

To mitigate the potential for wildlife entering the pond area, a 7-foot wildlife proof fence will be constructed around the ponds.

Water fowl landing on ponds should not be a serious problem since the proposed commercial facility is not located in a significant water fowl migratory route.

Present grazing patterns in the Permit area will temporarily be disrupted during operations. The loss of animal units has been discussed in Section 7.1. This impact will be temporary and will be mitigated over the long term through reclamation.

The addition into the Crawford area of approximately three personnel at the commercial facility will not stress public facilities in the area. Incomes derived from the payroll of 35 anticipated employees are expected to benefit the Crawford area through purchased goods and services.

During operations traffic will increase to and from the commercial facility. This traffic, resulting from employees and routine deliveries, will increase fugitive dust. Should fugitive dust impact the nearest residences, mitigation measures will be undertaken to minimize it.

SECTION 7.3

RADIOLOGICAL EFFECTS

<u>TABLE OF CONTENTS</u>

7.3 RADIOLOGICAL EFFECTS

The proposed action is the permitting of an in-situ uranium operation with an average production flow rate of 2500 gpm and an average restoration flow rate of 400 gpm.

An assesment of the radiological effects of the Crow Butte Project must consider the types of emissions, the potential pathways present, and an evaluation of the potential radiological hazards associated with the emissions and pathways. Since the proposed project is an in-situ operation, most of the particulate emissions sources normally associated with a conventional mill will not be present. A vacuum dryer is planned for the commercial operation. The vacuum dryer works on the principle that gases or particulates released into the system are collected in a liquid condenser and there is no release of air particulates. The effluent collection efficiency for this dryer system is therefore 100 percent. The routine radioactive emission will therefore be radon-222 gas.

Radon-222 is present in the ore body and is formed from the decay of radium-226. The radon dissolves in the lixiviant as it travels through the ore body to a production well, when the solution is brought to the surface the radon is released.

In order to assess the radiological effect of radon-222 on the environment, an estimate of the quantity released during the operation must be made. Meteorological data and dispersion models are used to predict the ground level air concentration at various points in the environment. The ingrowth of radon daughters is important and their concentration in the soil, vegetation and animals must be calculated. Finally, the impact on man from these concentrations of radionuclides in the environment must be determined.

In the following sections the assumptions and methods used to arrive at an estimate of the radiological effects of the Crow Butte Project will be discussed briefly. A detailed presentation of the source terms is included as Appendix 7.3(A). The anticipated effects will be compared to naturally occurring background levels. This background radiation, arising from cosmic and terrestrial sources as well as naturally occurring radon-222, comprises the primary radiological impact to the environment in the region surrounding the proposed project.

7.3.1 Exposure Pathways

The proposed project is an in-situ facility. Particulate emissions sources normally associated with conventional mills such as crushing and grinding operations, ore storage pads, and mill tailings ponds will not be present. The only source of radioactive emissions from the facility will be the evolution of radon gas.

Radon-222 gas will be dissolved in the leaching solution and will be released as the solution is brought to the surface. The evolution of this gas at the production wells will be controlled through the use of covered wellheads. The pump discharge lines will be under pressure and will maintain the gas in solution until it reaches the production surge tank. This tank will be vented into a manifold and then outside the plant. The manifold will be exhausted by an induced draft fan. The residence time of the solution in the tank will be sufficient to allow the release of a majority of the gas through the vent at a safe level above the plant.

The solution will then be passed through ion exchange columns which will also be vented into the manifold. From these columns the solution will be pumped to an injection surge tank, where it will be refortified with chemicals before being pumped to the wellfield. This tank will be vented in a manner similar to the production surge tank and if any additional radon-222 leaves the solution it would be vented at this location.

The injection wells will be closed and pressurized. This will eliminate them as a source of radon emissions. The evaporation ponds will not contain sufficient radium-226 concentrations to produce significant radon-222 emissions, therefore the ponds are not considered as a source of radon. The primary source of radon will be the tank vent system. For the purposes of these calculations it will be assumed that the entire quantity of radon present in the leach solution will be released from the tank vent system. The height of the vent was assumed to be 12.1 m (40 ft) above the foundation of the facility.

The atmospheric emission of radon will lead to its presence in all quadrants of the region surrounding the Crow Butte Project. Due to the relatively short half-life of radon-222, the ingrowth of radon daughters during wind blown transportation must be considered. There exists an inhalation pathway as a result of the emission of radon gas. As the radon daughters ingrow, deposition on the ground surface increases. A pathway also exists due to external radiation exposure arising from two sources. One source is radon and its daughters in the air, which is considered the cloud contribution. The other source is from radon daughters deposited on the ground, this source being termed the ground contribution.

A third pathway exists, which is the ingestion pathway. This results from direct foliar deposition and radionuclides in the soil being assimilated by the vegetation. The vegetation may represent a direct ingestion pathway to man if consumed and secondary pathway if fed to animals which are in turn consumed by man.

7.3.2 Exposures From Water Pathways

The solutions in the zone to be mined will be controlled and adequately monitored to insure that migration does not occur. The overlying aquifers will also be monitored. The action to be taken in the event of an excursion, as well as the anticipated environmental effects of such an event have been discussed in Section 7.5.

Three evaporation ponds located approximately 2000 feet from the plant building will be constructed during the first year of the in-situ commercial operation. These evaporation ponds will be lined with an impermeable synthetic liner. In addition, a secondary containment berm will be installed downstream from the ponds to collect any pond discharge in the unlikely event that discharge from the ponds occurs. The ponds, therefore, are not considered a source of liquid radioactive effluents. There will be a leak detection system installed to provide a warning if the liner develops a leak. The remedial action and environmental consequences of a liner failure are discussed in Section 5.7.

The Crow Butte Plant will be located on a curbed concrete pad to prevent any liquids from entering the environment. Solutions used to washdown equipment will drain to a sump and be pumped to the ponds. The pad is of sufficient size to contain the contents of the largest tank in the event of its rupture.

Since there will be no routine liquid discharges of process water from the Crow Butte Plant there are no definable water related pathways.

7.3.3 <u>Exposures From Air Pathways</u>

The only source of radioactive emissions is radon-222 released into the atmosphere through a vent system. This release results in radiation exposure via three pathways; inhalation, ingestion, and external exposure. The atmospheric concentration of radon gas at various locations in the region around the Crow Butte Project were estimated by using the computer simulation, MILDOS (USNRC, 1981). The joint frequency data compiled from a site specific meteorological station were used to define the atmospheric conditions in the project area.

Based on the site specific data and method of estimation of the source term presented in Appendix 7.3(A), the emission rate of radon-222 from the Crow Butte Project is conservatively assumed to be 3619 Ci/yr (3590 Ci/yr was used in MILDOS). Based on this release rate and average meteorological conditions, the concentrations of radon at ten locations were calculated. Table 7.3-1 lists the locations of receptors. The direction and distance from the source of emissions is given in the table. The first four receptors are located at 100 m from the plant building. The wind pattern in the region shows prevailing wind directions from the south-southwest. Receptor 5 is at the air monitoring station AM-1, located at the residence closest to the proposed facility. Receptor 7 is at the air

TABLE 7.3-1

INDIVIDUAL RECEPTOR LOCATION DATA
CROW BUTTE PROJECT

Receptor No.	Distance from Source (Meters)	Direction	Rn-222 Concentration (Ci/m³)	%MPC
1	100	N	1.60E-09	53.0
2	100	E	5.04E-10	16.8
3	100	W	2.89E-10	9.6
4	100	S	1.03E-09	34.2
5 (AM-1)	792	E	1.08E-10	3.6
6 (AM-8)	1036	NE	3.25E-10	10.8
7 (AM-2)	1280	NNW	1.50E-10	5.0
8	3292	NW	2.49E-11	0.83
9	1890	NW	3.02E-11	1.0
10	10,000	W	1.76E-12	0.06
Maximum Permissible Concentration			3.00E-09	

monitoring station AM-2, located at another residence. Receptor 6 is at air monitoring station AM-8, located at the nearest residence in the direction of the prevailing winds. In addition to the points from the plants and residences, a point 10 km (6 mi) to the west of the facility at receptor 10 was identified.

This receptor was identified to evaluate the dose from the ingestion pathway due to Pb-210 since this radon daughter requires sufficient time to ingrow.

Table 7.3-1 contains the estimated radon-222 concentrations at each of the receptors. Also included in this table is the limit for radon-222 concentrations in unrestricted areas which is listed in 10 CFR Part 20, Appendix B, Table II and the percent of the maximum permissible concentration at each location. The residence with the highest predicted concentration, Receptor 6, is approximately eleven percent of the limit. The radon-222 concentrations have been adjusted to correct for radioactive decay during transit.

The unit of exposure to radon and its daughters is called a "working level". One working level is defined as any combination of radon daughters in one liter of air that will result in the ultimate emission of $1.3x10^5$ MEV. Tables 7.3-2 and 7.3-3 list the predicted working level exposures for the 100 m points and the residences respectively. In addition, the predicted airborne concentrations of Pb-210, Bi-210 and Po-210 are also given with a comparison to the maximum permissible concentration (MPC) for each radionuclide. As is given in Table 7.3-3, the predicted WL exposure and the radon daughter concentrations at Receptor 6 (AM-8) appears to be the greatest with the fraction of MPC for WL, Pb-210, Bi-210, and Po-210 being 2.0%, 0.0005%, 0.000005%, and 0.00014% respectively.

The primary dose received from radon daughters is through inhalation. The primary organ dose from radon daughters is to the bronchial epithelium of the tracheobronchial region. Table 7.3-4 lists the total inhalation doses to the bronchial epithelium at each of the receptors as a result of a one

TABLE 7.3-2

RESULTS OF MPC CHECK
CROW BUTTE PROJECT
POINTS 100 METERS FROM PLANT

Receptor Description		Rn-222(WL)	Pb-210	Bi-210	Po-210
N 100 meters	Conc., pCi/m³	3.04E-04	1.03E-05	1.03E-05	1.03E-05
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	9.13E-03	2.58E-06	5.16E-08	1.47E-06
E 100 meters	Conc., pCi/m³	1.05E-04	6.08E-06	6.09E-06	6.09E-06
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	3.15E-03	1.52E-06	3.04E-08	8.69E-07
W 100 meters	Conc., pCi/m³	8.07E-05	5.72E-06	5.72E-06	5.72E-06
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	2.42E-03	1.43E-06	2.86E-08	8.17E-07
S 100 meters	Conc., pCi/m³	2.43E-04	1.51E-05	1.51E-05	1.51E-05
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	7.31E-03	3.79E-06	7.57E-08	2.16E-06

TABLE 7.3-3

RESULTS OF MPC CHECK
CROW BUTTE PROJECT
RESIDENCES

Receptor[1] Description		Rn-222(WL)	Pb-210	Bi-210	Po-210
5 (AM-1)	Conc., pCi/m³	1.91E-04	4.91E-06	2.92E-06	2.92E-06
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	5.73E-03	1.05E-06	1.46E-08	4.17E-07
6 (AM-8)	Conc., pCi/m³	7.12E-04	1.98E-05	1.00E-05	4.99E-06
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	2.13E-02	4.94E-06	5.00E-08	7.17E-07
7 (AM-2)	Conc., pCi/m³	4.15E-04	1.46E-05	4.99E-06	9.99E-06
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	1.25E-02	3.64E-06	2.49E-08	1.43E-06
8	Conc., pCi/m³	1.35E-04	1.93E-05	8.45E-07	8.07E-07
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	4.07E-03	4.83E-06	4.22E-09	1.15E-07
9	Conc., pCi/m³	1.21E-04	7.66E-06	1.03E-06	1.03E-06
	MPC pCi/m³	3.33E-02	4.00E+00	2.00E+02	7.00E+00
	Fraction of MPC	3.63E-03	1.92E-06	5.16E-09	1.47E-07
10 (Garden & Pasture)	Conc., pCi/m³	1.53E-05	2.85E-08		
	MPC pCi/m³	3.33E-02	4.00E+00	NO DATA	NO DATA
	Fraction of MPC	4.59E-04	7.12E-09		

(1) See Table 7.3-1

TABLE 7.3-4

PREDICTED INHALATION DOSE
CROW BUTTE PROJECT

Receptor Number	Total Annual Committed Dose to Bronchial Epithelium (mrem/yr)
1 (N 100 meters)	1.00E+03
2 (E 100 meters)	3.15E+02
3 (W 100 meters)	1.80E+02
4 (S 100 meters)	6.42E+02
5 (AM-1)	6.73E+01
7 (AM-2)	9.43E+01
6 (AM-8)	2.04E+02
8 (3292 meters N)	1.57E+01
9 (1890 meters NW)	1.90E+01
10 Garden & Pasture (10,000 meters)	1.10E-03
Natural Background (USNRC, 1979a)	5.60E+02

Note: Locations of air monitoring stations (AM) are found in Figure 2.10-1.

year exposure to the airborne radionuclide concentrations including radon and its daughters predicted at each of the receptors. The dose to the bronchi is a result of inhalation of radon and its decay products. The dose resulting from exposure to naturally occurring radon levels in the Western Great Plains has been estimated at 560 mrem/year (USNRC, 1979a). The increase above this background level predicted for the nearest residence at AM-1 (Receptor 5) is slightly more than 12 percent. The predicted increase in dose above background to the bronchi at Receptor 6 (AM-8) is 36.4 percent.

Radon emitted from the facility will also result in an annual total committed dose to the lungs, whole body, bone, liver and kidneys via the pathways of inhalation, cloud and ground concentrations and ingestion. These doses were evaluated at the receptor locations and are negligible.

7.3.4 Population Dose

The annual population dose commitment to the population in the region within 80 km of the Crow Butte Project is also predicted by the MILDOS code. The results are contained in Table 7.3-5 where the dose to the bronchial epithelium is expressed in terms of person-rems. For comparison the dose to the population within 80 km of the facility due to natural background radiation has been included in the table. These figures are based on the 1980 population and average radiation doses reported for the Western Great Plains (USNRC, 1979a).

The atmospheric release of radon also results in a dose to the population on the North American continent. This continental dose is calculated by comparison with a previous calculation based on a 1 kilocurie release near Casper Wyoming, during the year 1978. The results of these calculations are included in Table 7.3-5 and also combined with dose to the region within 80 km (50 mi) of the facility to arrive at the total radiological effects of one year of operation at the Crow Butte Project.

TABLE 7.3-5

DOSE TO THE POPULATION FROM ONE YEAR'S OPERATION CROW BUTTE PROJECT

	Dose (person rem/yr)
	Bronchial Epithelium
Dose received by population within 80 km of the facility	1.82
Natural background for population within 80 km of the facility	24025.
Dose received by population beyond 80 km of the facility	201.6
Total continental dose	203.4
Natural background for the continental population	1.73E+08
Fraction increase in continental dose	1.17E-06

For comparison of the values listed in Table 7.3-5, the dose to the continental population as a result of natural background radiation has been estimated. This estimate is based on a North American population of 346 million and a dose to each person of 500 mrem/yr to the bronchial epithelium. The maximum radiological effect of the Crow Butte Project would be to increase the dose to the bronchial epithelium of the continental population by 0.00012 percent.

7.3.5 <u>Exposure to Flora and Fauna</u>

It is presumed that the flora and fauna in the area will receive no greater exposure than that calculated for humans. The predicted doses from inhalation, meat ingestion and vegetation ingestion for humans would also be similar for the omniverous mammals and as noted earlier, these doses are negligible.

The major concentration of radionuclides associated with flora will be from deposition onto the plants. Table 7.3-6 gives the ground surface concentrations for Pb-210.

The flora in the area will also receive exposure from uptake of radionuclides in the soil. The uptake fraction of radionuclides however, is only a small fraction of that found in the soil. Dressen and Marple (1979), evaluating plant uptake of radionuclides, estimated an uptake factor for lead to be 0.19.

There are no applicable limits for radiation exposure of species other than man, although it is accepted that most species are less radiosensitive than man. Therefore the radiation protection limits applicable to man are conservative for other species. Further, given that the calculated doses for humans as a result of this proposed facility, are only fractions of the natural background exposures, the magnitude of the effects on other species are expected to be even less than those for humans.

TABLE 7.3-6

GROUND SURFACE CONCENTRATIONS, pCi/m²

Receptor Description		Pb-210
1	(N 100 meters)	3.97E+00
2	(E 100 meters)	2.34E+00
3	(W 100 meters)	2.20E+00
4	(S 100 meters)	5.82E+00
5	(AM-1)	1.35E+00
6	(AM-8)	5.61E+00
7	(AM-2)	3.66E+00
8	(3292 meters N)	3.66E-01
9	(1890 meters NW)	5.15E+00
10	Garden & Pasture (10,000 meters)	2.16E+00

APPENDIX 7.3 (A)

TABLE 7.3(A)-1

SITE SPECIFIC INFORMATION
PROPOSED CROW BUTTE PROJECT

Parameter	Value
Average ore quality, U_3O_8, in ore body	0.31 %
Ore Radon-222 activity, assuming equilibrium with U-238	839 pCi/g
Operating days per year (plant factor)	365 days
Dimensions of ore body	
Area per year to be mined	22.5 acres
Average thickness of body	4.9 feet
Average screened interval	15.1 feet
Average production flow rate	2500 gpm
Formation porosity	29 %
Process recovery	95 %
Leaching efficiency	60 %
Rock density	1.92 g/cm³
Restoration flow rate	400 gpm
Production cell parameters	
Residence time	assume 7 days
Type of cell pattern	variable
Radius	20, 28, 40 m
Average cell flow rate	189 lpm
Annual Rn-222 emission from production	2989 Ci/yr
Annual Rn-222 emission from restoration	630 Ci/yr
Source stack description (Radon)	surge tank vent
Stack height	12.1 m
Stack diameter	0.18 m
Stack exit velocity	2.0 m/sec (Est)

TABLE 7.3(A)-2

SOURCE AND RECEPTOR COORDINATES
PROPOSED CROW BUTTE PROJECT

	East (km)	North (km)	Elevation m
Sources			
1. Surge Tank Vents	0	0	12.1
Receptors			
1. North 100 meters	0	0.10	1
2. East 100 meters	+0.10	0	1
3. West 100 meters	-0.10	0	1
4. South 100 meters	0	-0.10	1
5. AM-1	0.792	-0.152	1
6. AM-8	0.823	0.610	1
7. AM-2	-0.305	1.219	1
8. 3292 meters N	-1.829	2.774	1
9. 1890 meters NW	-1.280	1.402	1
10. Pasture & Vegetation Garden	-10.0	0	1

TABLE 7.3(A)-3

CALCULATION OF ANNUAL RADON EMISSIONS
PROPOSED CROW BUTTE PROJECT

1) To calculate radon release from leaching assuming that U-238 is in equilibrium with all its decay products:

$$Ci/m^3 = 869 \text{ pCi/g Ra-226} \times 1.92 \text{ g/cm}^3 \times 0.2 \times 0.71/0.29 \times 10^{-6} = 8.17 \times 10^{-4} \text{ Ci/m}^3$$

The yearly release is then:

$$8.17 \times 10^{-4} \text{ Ci/m}^3 \times 9462 \text{ lpm} \times (0.72) \times 365 \text{ d/yr} \times 1.44 = 2925 \text{ Ci/yr}$$

2) The radon release from soaking and start-up is given by:

$$8.17 \times 10^{-4} \text{ Ci/m}^3 \times 22.5 \text{ acres} \times 4074 \text{ m}^2\text{/acres} \times 1.49 \text{ m} \times 0.29 = 32 \text{ Ci/yr}$$

The total release of radon from the start-up solution, production lixiviant, and soaking solution is:

Start-up solution	32 Ci/yr
Production	2925 Ci/yr
Soaking solution	32 Ci/yr
	2989 Ci/yr

TABLE 7.3(A)-4

3) The radon release from restoration is given by:

$$8.17 \times 10^{-4} \text{ Ci/m}^3 \times 1514 \text{ lpm} \times 365 \text{ d/yr} \times (0.92) \times 1.44 = 598 \text{ Ci/yr} + 32 \text{ (start-up)} = 630$$

The total release from this 22.5 acre in-situ mining operation is then:

$$2989 + 630 \text{ Ci/yr} = 3619 \text{ Ci/yr}$$

TABLE 7.3(A)-5

MISCELLANEOUS DATA

Fraction of year during which cattle graze locally	Est. 33%
Fraction of cattle feed obtained by grazing	Est. 90%
Fraction of stored cattle feed grown locally	Est. 90%
Acreage required to graze 1 animal unit (450 kg) for one month (AUM)	3.5 ha
Length of growing season	4 mo/yr
Fraction of locally produced vegetables consumed locally	Est. 100%
Fraction of locally produced meat consumed locally	Est. 50%
Fraction of locally produced milk consumed locally	Est. 100%

REFERENCES

United States Nuclear Regulatory Commission, *Draft Environmental Statement Related to the Operation of the Teton Project,* NUREG-0925, Washington, D.C., June, 1982.

United States Nuclear Regulatory Commission, *MILDOS A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations,* NUREG/CR-2011, Washington, D.C., April, 1981.

United States Nuclear Regulatory Commission, *Resource Areas, a Supplement to the Generic Environmental Impact Statement on Uranium Milling,* NUREG/CR-0597, Washington, D.C., June 19, 1979a.

Dresser, D. and M. Lynn Marple. 1979. *Uptake of Trace Elements and Radionuclides from Uranium Mill Tailings for Four-Wing Salt Bush and Alkali Sacaton,* Proceedings Uranium Mill Tailings Management, Fort Collins, Colorado, November 19-20, 1979.

SECTION 7.4

NONRADIOLOGICAL EFFECTS

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7.4 NONRADIOLOGICAL EFFECTS

In this section the anticipated environmental effects of routine discharges of nonradioactive wastes are presented. The commercial scale in-situ uranium mining process proposed by Ferret Nebraska will produce minimal nonradiological effects. The effects of plant construction and operation as well as radioactive emissions have been discussed in previous sections.

Hydrochloric acid will constitute the main gaseous nonradiological effluent that is anticipated at the Crow Butte Commercial Project. Hydrochloric acid will be stored on site. The storage tank will be vented into a process tank to remove hydrogen chloride gas from the air passing from the vent. The only other possible gaseous effluent is carbon dioxide. Carbon dioxide for use in the process will be located at the site. Very minor amounts of CO_2 could escape into the atmosphere when the tanks are charged.

To predict the concentration of hydrogen chloride in the region around the mill, its rate of release must be estimated. The following assumptions were used in the estimate.

1. Hydrogen chloride gas is emitted from the scrubber only during the process of filling the tank.

2. The acid concentration is 32% with a temperature of 10°C (50°F) and a partial pressure of 11.8 mm Hg.

3. One tank truck delivery is 1,497 kg (3,300 lb) of acid and it requires one hour to fill the tank.

4. The scrubber efficiency is 99%.

5. Emissions occur from a scrubber vent 3.0 m (9.8 ft) above the facilities foundation. The vent has a diameter of 0.20 m (8.0 in) and a flow velocity of 0.2 m/s (.66 f/s).

The estimate of hydrogen chloride gas released during the tank filling process is 3.2 g. Using this source term, atmospheric dispersion calculations, and the average meteorological condition, the highest concentration of hydrogen chloride is anticipated to be 2.5×10^{-2} ug/m³ in the vicinity of the facility. The threshold limit value for hydrogen chloride is 7000 ug/m³. This predicted concentration is very low and only occurs during the one hour required to fill the tank. This tank will only need to be filled about 43 times per year. The effect of this emission on the region surrounding the Crow Butte Project will be insignificant.

There will be an increase in the total suspended particulates (TSP) in the region as a result of the Crow Butte Commercial Project. This increase in TSP will be greatest during the short time required for site preparation. Revegetation will be performed quickly to mitigate the problems associated with the resuspension of dust and dirt from disturbed areas. All areas disturbed during construction will be revegetated during the operation of the facility with the exception of the plant area pad, the roads, and areas covered by the pond liner. Of these the most significant source will be dust emissions from unpaved roads. The amount of dust can be estimated from the following equation which is taken from *Supplement No. 8 for Compilation of Air Pollutant Emission Factors* (USEPA, 1978).

$$E = (0.81s)\ \frac{S}{30}\ \ \frac{365 - w}{w}$$

Where:

E = emission factor, lb/vehicle-mile
s = silt content of road surface material, 40%
S = average vehicle speed, 30 mph
w = mean number of days with 0.01 inches or more of rainfall, 85

Using the values stated above, the emission factor is equal to 0.25 lb/vehicle-mile. The distance from the facility to Highway 71 is 3 miles away traveling due west and 4.5 miles through Crawford. Assuming 35 employees, a five workday week and a 33% increase to allow for additional traffic (deliveries, etc.), the total mileage on dirt roads is 1000 miles/week. This corresponds to a dust emission of 6.5 ton/yr as a result of the increased traffic on dirt roads. Traffic counts make by the Nebraska Department of Roads in 1987 indicated that there are currently 119 daily trips on the County Road that employees would take to Crawford (4.5 miles) from the plant. This results in over 2000 miles per week at the present time. If the increased dust presents a problem, the emissions can be reduced by appropriate control procedures such as the use of dust control chemicals on the road surface. The duration of increased suspended particulates will be short, on the order of two years, and would stabilize after construction.

All of the airborne emissions presented above will have minimal impact on the environment. At no time during the life of the project is it anticipated that the ambient air quality standard of the State of Nebraska will be exceeded. These standards are included in Table 7.4-1.

During construction, there is a possibility that sediment load may increase in Squaw Creek. If rain, producing runoff, occurs during construction a small amount of the fill may be carried into the creek. Significant precipitation during construction of the ponds and plant might also produce the same effect. Plant cover for erosion control will be established as soon as possible on exposed areas. Little additional suspendable material should be produced during operation and ground water restoration. Site reclamation with backfilling of the ponds, grading the plant site, and replacing topsoil will also expose unsecured soil for suspension in runoff waters. The increased sediment load as a result of precipitation during construction or reclamation should not significantly effect the quality of Squaw Creek since the more sensitive areas of the stream are located upstream from the point of entry of the tributary.

The effects of the production and restoration phases of the project on water levels in the Chadron aquifers were evaluated. During these phases of the project the water level in wells located in Crawford that are completed in the Chadron Formation are expected to decrease by 12 to 13 feet in the first ten years of mining due to a reduction in the aquifer's hydrostatic pressure. The hydrostatic head in the Chadron Aquifer is approximately 490 feet above the top of the aquifer and the decrease caused by mining would only be 2 to 3%. This decrease should not have any significant effect on the water use in the area. The majority of the population in the area that uses ground water as a source of water, complete their wells in the Brule Formation and this aquifer will not be impacted by the mining operation. The water supply for the town of Crawford is Dead Man's Creek and not the Chadron aquifer. As a result the proposed mining activities will alter the water use patterns in the area very little, if any. The drawdown in the water level experienced in the Chadron aquifer at the town of Crawford will return to normal levels after restoration is completed at the Crow Butte Project.

Domestic liquid wastes from the restrooms and lunchrooms will be disposed of in an approved septic system. The septic system will meet the requirements of the state of Nebraska. These systems are in common use throughout the United States and the effect of the system on the environment is known to be minimal.

From the above discussion can be seen that the effects of the planned discharges of nonradioactive effluents from the Crow Butte Commercial Project will be insignificant. This is due to the small volumes of effluents and their generally benign environmental effects.

TABLE 7.4-1

AMBIENT AIR QUALITY STANDARDS OF THE STATE OF NEBRASKA*

Particulate Matter

Primary standards

75 micrograms per cubic meter annual geometric mean

260 micrograms per cubic meter maximum 24-hour concentration not to be exceeded more than once a year

Secondary standards

60 micrograms per cubic meter annual geometric mean

150 micrograms per cubic meter as a maximum 24-hour concentration not to be exceeded more than once a year

Sulfur Dioxide

Primary standards

80 micrograms per cubic meter (0.03 ppm) annual arithmetic mean

365 micrograms per cubic meter (0.14 ppm) as a maximum 24-hour concentration not to be exceeded more than once a year

Secondary standard

1300 micrograms per cubic meter (0.5 ppm) as a 3-hour concentration not to be exceeded more than once per year

Nitrogen dioxide

Primary and Secondary standards

100 micrograms per cubic meter (005 ppm) annual arithmetic mean

TABLE 7.4-1 cont.

Carbon monoxide

Primary and Secondary standards

10 milligrams per cubic meter (9.0 ppm) as a maximum 8 hour concentration not to be exceeded more than once a year

40 milligrams per cubic meter (35 ppm) as a maximum 1-hour concentration not to be exceeded more than once a year

Ozone

Primary and Secondary standards

235 micrograms per cubic meter (.12 ppm) as a maximum 1-hour concentration not to be exceeded more than one day a year

Hydrocarbons

Primary and Secondary standards

160 micrograms per cubic meter (0.24 ppm) as a maximum 3-hour concentration (6 a.m. to 9 a.m.) not to be exceeded more than once a year

* Source: NAPC, 1975

REFERENCES

Nebraska Air Pollution Control, *Rules and Regulations,* State of Nebraska, Department of Environmental Control, June 1975.

United States Environmental Protection Agency, *Supplement No. 8 for Compilation of Air Pollutant Emission Factors,* 3rd, PB-288-905, Research Triangle Park, NC, May 1978.

SECTION 7.5

EFFECTS OF ACCIDENTS

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7.5 EFFECTS OF ACCIDENTS

Two major types of accidents may be associated with an in-situ uranium mining facility: 1) those involving radioactive materials and 2) nonradiological accidents of a chemical or physical nature. For each, varying degrees of impact may be experienced. The probability of occurrence and effects of accidents at the Crow Butte Commercial site are discussed in this section. This information is provided in accordance with USNRC Regulatory Guide 3.46.

7.5.1 Accidents Involving Radioactivity

Three classes of potential radiological accidents may be associated with a commercial scale project. The severity of their effects is judged by the amount of radioactivity which could be released and the likelihood of retrieval.

Large Releases. Large releases to the environment are those accidents which could involve surface or subsurface contamination by leaching of waste solutions in sizable quantities. Such potential accidents involve undetected leachate migration and loss of pond integrity.

Mining fluids are normally maintained in the production aquifer within the immediate vicinity of the wellfield. The function of the encircling monitor well ring is to detect any lixiviant which may migrate away from the production area due to fluid pressure imbalance. This system has been proven to function satisfactorily over many years of operating experience with in-situ mining. Although it is highly unlikely, it can be hypothesized that an excursion of leachate might pass the monitor well ring undetected.

A radioactive release due to an undetected excursion is unlikely at this project, however. All wellfields will be surrounded by a ring of monitor wells. These wells will be located no further than 61 m (400 feet) from the wellfields and screened in the ore-bearing Chadron aquifer.

Additionally, monitor wells will be placed in the first overlaying aquifer above each wellfield segment. Sampling of these wells will be on a biweekly basis as described in Section 5.7.8. Past experience at commercial operations has proven this monitoring system to be effective in detecting leachate migration. The total effect of close proximity of the monitor wells, low flow rate from the well-patterns, and over-production of leach fluids (production bleed) makes the likelihood of an undetected excursion remote.

Migration of fluids to overlaying aquifers is also considered. Several controls are used to prevent this. First, FEN has plugged all exploration holes to prevent co-mingling of Brule and Chadron aquifers and to isolate the mineralized zone. Successful plugging was tested by conducting two hydrologic tests. Results indicated that no leakage or communication exists between the mineralized zone and overlaying aquifers. In addition, prior to start of production a well integrity test will be performed on all injection/recovery wells. This requirement of the Nebraska Underground Injection Control Regulations will insure that all wells are constructed properly and capable of maintaining pressure without leakage. Lastly, monitor wells completed in the overlaying aquifer will be sampled routinely and analyzed for presence of leach solution. It is unlikely that an excursion would escape detection.

Seepage of contaminant containing solutions from the evaporation ponds into ground or surface water is a potential release of radioactivity. However, this should not be a problem at the Crow Butte site. Construction and operational safeguards as described in Section 4.2 will be implemented to insure maximum competency of the synthetic liner and earthen embankments. The graded compacted underdrain leak detection system will allow daily observation for liner leakage. Should the unlikely event occur of pond fluids seeping into the compacted subsoil, the liquid would quickly be absorbed. According to the NRC conclusion stated in the Generic Environmental Impact Statement (USNRC, 1979) "the most effective way to reduce potential ground water contamination and associated health effects is to reduce the amount of moisture available to carry toxic contaminants away from impoundments." The pond soil foundation will have a low ambient moisture due to its elevation, soil type and preparation.

Failure of the embankments from washout resulting in loss of disposed fluids is also very unlikely. The inclusion of a freeboard allowance will preclude over-washing of the walls during high winds. Choice of location for the ponds was made in consideration of several factors: availability of land, minimizing headwaters, location of ore body, and best engineering technology.

During the production phase of the project, one or more of the five ponds will contain contaminated fluids. These will originate primarily from the production bleed and the restoration brine. If a leak is detected in a pond liner, pond contents may be transferred to the adjacent pond and the liner repaired.

Small Releases. Failure of the pumping circuit, otherwise described as loss of fluids from surface piping, is the most common form of release from commercial in-situ uranium mines. This results when breaks, leaks or separations occur in pipes which transfer mining fluids from the process plant to the wellfield and back.

All piping from the plant, to and within the wellfield will be buried for frost protection. It will be constructed of high density polyethylene pipe with butt-welded joints or equivalent. To insure competency of the pipe and joints, the pipelines will be pressure tested at operating pressures prior to final burial. It is unlikely that a break will occur in a buried section of line because no additional stress is placed on the pipes. Trunkline flows and wellhead pressures will be monitored each shift for process control. Underground pipelines are protected from the major cause of failure, that of vehicles accidentally driving over the lines causing breaks. The only exposed pipes will be at the plant, the wellheads and in the control house in the wellfield.

Small occasional leaks at pipe joints and fittings at the wellheads may occur from time to time. Until remedied, these leaks will drip fluid which will be absorbed by the underlying soil. After pipe repair the soil will be surveyed for contamination and removed to a pond or storage area if necessary.

Preventative maintenance will be used to preclude this type of spill to the maximum extent possible. As part of normal operating procedures, operators are instructed to be alert for leaks and weakened areas.

Impact of such a spill would be to increase primarily Na, Cl and several trace metals in the soil. Radium would precipitate as radium carbonate or exchange onto clays. This soil would have to be removed, if contaminated, and disposed of.

The steps to be followed subsequent to a spill will be those necessary to effectively clean-up the material.

In the event of a failure of an evaporation pond or pipeline which results in an uncontrolled release of solutions, FEN will notify the USNRC within forty-eight hours. FEN will also submit a written report within seven days detailing the conditions leading to the failure, the corrective actions taken and the results achieved.

<u>Trivial Releases</u>. Releases which result in no environmental radiological impact are considered trivial. An example is the leakage or rupture of a plant process vessel. All such vessels will be stored inside the plant building on a reinforced concrete floor which contains curbs and sumps for liquid control. Any such vessel will be immediately repaired and the area cleaned to prevent contamination of employees and other equipment.

7.5.2 Transportation Accidents

Three types of materials transportation will be associated with the Crow Butte Commercial Facility.

1. Delivery of process chemicals,
2. Transport of radioactive contaminated waste to an approved disposal site, and
3. Transfer of yellowcake slurry or dried powder.

All transport will be made with contracted vehicles and licensed drivers. Major public highways will be traveled except for final access to the site.

Based on the production schedule and material balance, it is estimated that approximately 272 bulk chemical deliveries per year will be made to the site. This averages about one truck per working day for delivery of chemicals throughout the life of the project. Types of deliveries will be carbon dioxide, caustic soda, hydrochloric acid, sodium chloride, hydrogen peroxide, sodium hydroxide, and oxygen (See Table 7.5-1). Since no unusual or hazardous driving conditions are known to exist in this part of Nebraska, the accident rate for these vehicles should be that of the overall chemical trucking industry. Based on published accident statistics the probability of a truck accident is in the range of 1.0 to 1.6 x 10^{-6}/km (1.6 to 2.6 x 10^{-6}/mile). Truck accident statistics include three categories of events: collisions, noncollisions, and other events. "Collisions" are between the transport vehicle and other objects, whether moving vehicles or fixed objects. "Noncollisions" are accidents involving only the one vehicle, such as when it leaves the road and rolls over. Accidents classified as "other events" include personal injuries suffered on the vehicle, persons falling from or being thrown against a standing vehicle, cases of stolen vehicles, and fires occurring on a standing vehicle. The likelihood of a truck shipment of chemicals or product from the commercial facility being involved in an accident of any type in the Crawford area during a one-year period is approximately 1%. This probability was obtained by multiplying the probability of accident per vehicle-km (1.3 x 10^{-6}/km) by the number of shipments per year (322 = 272 chemical + 50 yellowcake) and the distance per shipment (25 = 4.5 miles to Crawford + 10 miles outside Crawford). If road safety conditions demand, FEN will consult with the County to alleviate any problem.

TABLE 7.5-1

BULK CHEMICAL DELIVERIES
(Trucks/Year)

Type of Chemical	Estimated Deliveries
Carbon dioxide	42
Oxygen	60
Hydrochloric acid	43
Hydrogen Peroxide	14
Soda ash	64
Sodium chloride	36
Sodium hydroxide	11
Sodium sulfide	2
TOTAL	272

A finite amount of radioactive (by-product) waste materials will be generated during operation of the commercial facility, restoration and reclamation. Used equipment and pipes may have surface contamination of uranium and radium-226. Soils which have absorbed a spill may contain uranium, radium-226 and small amounts of trace metals. Sludge from the evaporation ponds will contain varying concentrations of salts, radionuclides and trace metals.

Transport of by-product waste materials will likely be to one of the existing uranium mill tailings ponds. Prior to any disposal, FEN will obtain NRC approval for the proposed location. The environmental effects of a by-product material accident, in the very unlikely event one were to occur, would be highly localized due to the low radioactive content of the waste material. For example, the specific activity of uranium ore is usually estimated to be $1x10^{-9}$ Ci/g while $6x10^{-7}$ Ci/g is used for yellowcake. This by-product material waste would generally have a lower specific activity than that of ore.

In the accident analysis of the Sand Rock Mill Project, a transportation accident involving yellowcake was assumed for which was calculated an environmental release fraction of $9x10^{-3}$ of fractional probability of occurrence. This represents the initial airborne material released at an accident site carried by a 5 m/s (10 mph) wind for a 24-hour period. Assuming a population density of 62 people per square kilometer, a fifty year dose commitment to the lungs of the general population was estimated at between 0.9 and 13 man-rem, depending on the severity of the spill. This value was considered small when compared with the estimated 50-year integrated lung dose of 1427 man-rem from natural background (USNRC, 1982). The lower activity of the wastes and low population density in northwest Nebraska and Wyoming would produce even lower dose commitments than the above estimates in the event of an accident.

If an accident should occur resulting in spillage of the waste materials, clean-up of the location would begin as soon as possible. Spilled material would be scraped up and placed in the same or similar truck. Any soil beneath the materials would also be removed until contamination levels were acceptable.

After year three, when the commercial facility reaches full capacity, a maximum of 50 truckloads per year will be required to ship the product if it is yellowcake slurry. The slurry will be transported either in a trailer-mounted tank vessel or in lined drums. Twenty-five 40,000 lb. truckloads will be required to ship the final product if the slurry has been dried.

All travel to and from the commercial facility will be on major highways except at the site. The probability that a collision, non-collision, or "other event accident" will occur is remote. FEN has developed a spill contingency plan and emergency response program for use with Crow Butte Commercial Facility shipments. According to this plan, specified equipment will be kept on-site or in shipment vehicles for containment and clean-up use. Site and supervisory personnel will be trained in emergency response. The plan of action and notification procedures for appropriate local, state and federal officials is included as Appendix 7.5(A).

7.5.3 Other Accidents

Site accidents not involving radioactivity should not be a major factor at the Crow Butte Commercial Facility. The operation will be of small size with fewer than 35 operating personnel involved. The facility will consist of a process building, an office building, five evaporation ponds (about 6 acres each), and wellfields. The wellfields will disturb approximately 75 acres at any one time composed of approximately 23 acres of wellfields in each of the three phases (development, operation and reclamation).

Personnel will be trained in safety and emergency procedures in accordance with Mine Safety and Health Administration regulations. Initial and refresher training will include occupational safety, first aid, radiation safety and fire procedures.

Another possible type of accident is leakage or rupture of process or chemical holding vessels. Precautionary measures have been taken to contain any such event. The chemical storage tanks will be located on curbed concrete pads to contain a spill. The oxygen and carbon dioxide which are stored as liquified gases, do not require a curbed concrete pad for containment since these chemicals will convert to gaseous form and vent to the atmosphere if a leak occurred.

All process tanks will be located inside the plant building. The cement floor will be curbed with collection sumps central to the tankage. This area has sufficient capacity to contain the entire contents of one or more tanks should rupture occur. The material would be collected in the sump, then pumped to either a process tank or the evaporation ponds. Tanks of oxygen and carbon dioxide will be stored away from the processing building and yellowcake storage area. No accidents are anticipated which would adversely affect the environment or surrounding population.

REFERENCES

U.S. Nuclear Regulatory Commission, *Draft Generic Environmental Impact Statement on Uranium Milling,* NUREG-0511, April 1979.

U.S. Nuclear Regulatory Commission, *Draft Environmental Statement Related to the Operation of Sand Rock Mill Project,* NUREG-0889, March 1982.