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1.0 PROPOSED ACTIVITIES

SWEETWATER URANIUM MILL

LICENSE APPLICATION

1.0 PROPOSED ACTIVITIES

Minerals Exploration Company (MINERALS), a wholly owned subsidiary of Union Oil Company of California, has been engaged in uranium exploration work in southwestern Wyoming for the past nine years and is now planning to mine and mill uranium from deposits discovered in the Great Divide Basin approximately 34 air miles northwest of Rawlins and 27 air miles south of Jeffrey City. The proposed project is located in Township 24 North, Range 93 West, in northeastern Sweetwater County.

It is currently estimated that the deposits consist of about 16 million tons of uranium ore containing approximately 15.3 million pounds of uranium oxide. The ore has an average grade of 0.048 percent uranium oxide.

Milling operations are expected to begin in mid-1980. The primary milling circuit involves grinding the sandstone ore into a sandlike material, then dissolving the uranium from the grain surfaces using a sulfuric acid solution. The uranium-rich acid solution will be recovered in a six stage countercurrent decantation process. The leached sand will be discarded as tailings in an impoundment. The uranium will be transferred from the aqueous acid phase to an organic phase by means of a solvent extraction process. The uranium will be removed from the organic phase by ammonium sulfate and will then be precipitated by the injection of ammonia gas. The final precipitate, commonly called "yellowcake" (mostly U_3O_8), will be washed, calcined and packed into 55-gallon drums. The finished product will then be shipped to a uranium hexafluoride conversion plant and eventually turned into fuel for nuclear power plants.

In a secondary operation, liquors from the piles of low-grade material will be collected and pumped along with mine sump discharge water to ion-exchange columns in the mill. The uranium will be transferred from the aqueous pregnant solution to a resin in these columns. An acid solution will be used to strip the uranium from the loaded resin. This uranium-rich solution will be added to the mill stream ahead of the solvent extraction system.

The mill will operate 24 hours per day, 365 days per year, over its expected life of 15 years. The average mill throughput rate of 3000 tons (dry weight) of ore per day is expected to yield an average of about 900,000 pounds of product annually. Recovery of uranium from low-grade material and mine water will increase production to approximately 1,000,000 pounds per year.

The mill facilities will consist of several large buildings, several small buildings, and an array of tanks of various sizes. Facilities have been designed and arranged to present a well-integrated, compact appearance. The five larger buildings will contain:

- offices and a laboratory
- warehouse, change room and maintenance shop
- mine service facilities
- grinding, leaching and countercurrent-decantation equipment
- solvent extraction equipment

A slurry pipeline will transport tailings from the mill to the tailings impoundment, about 500 feet to the southeast, for permanent disposal. The impoundment, consisting of four parts or cells, will be built sequentially as needed and will be constructed to provide for subsurface disposal of solid tailings. Each cell will be excavated to a depth of 50 feet and will be surrounded by a 50-foot high dam to contain the supernatant portion of the tailings slurry. All interior surfaces of the dam and excavation areas will be covered by a synthetic liner.

The tailings slurry will be pumped into the impoundment through a spigot-type distribution system. Tailings will be discharged into the bottom of the impoundment through open flumes or riser pipes. This system will allow for natural distribution of coarser material around the periphery of each cell and the finer fraction or slimes settling towards the center or bottom of the cell.

By the time mine and mill operations are completed, the impoundment will cover approximately 290 acres. At the termination of mill operations, the impoundment will be covered with earth fill and planted with native vegetation. This will prevent the tailings and other trapped waste materials from endangering livestock and wildlife and from contaminating the surrounding area.

In late 1979, at the peak of the construction phase, the proposed Sweetwater project is expected to provide employment for 150 people. The total operating work force is expected to reach approximately 290 people by mid 1980 when the project is onstream. Minerals Exploration Company is working closely with local government agencies and planners to ensure that these employees integrate smoothly and rapidly into local communities.

The project will make an economic contribution to the communities in the surrounding area, particularly the city of Rawlins, where most of the employees are expected to reside. The annual project payroll will be in excess of $5 million. In addition, direct (corporate) and indirect (salaries, sales, gasoline, etc.) taxes are expected to exceed $8 million annually.

MINERALS has retained consultants to conduct studies on the potential effects of the project on local communities, native vegetation and wildlife, air quality, water quality, and water availability.

2.0 SITE DESCRIPTION

2.0 SITE DESCRIPTION

MINERALS proposed mill site is described briefly in the following subsections. A more detailed description can be found in the Environmental Report (ER). Specific references to the Environmental Report have been made where appropriate.

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 Geography

The proposed mill is located in the Great Divide Basin approximately 34 air miles northwest of Rawlins, Wyoming and 27 air miles south of Jeffrey City, Wyoming in Township 24 North, Range 93 West in the County of Sweetwater. The mill is in Section 15 of T24N, R93W. The major portion of the tailings impoundment is in Section 14 overlapping slightly into Sections 15, 22 and 23. Figure 2.1-1 shows the location of the site with respect to state, county and local subdivisions. A more detailed description can be found in Figure 2.1-2. A topographic map of the area is presented in Figure 2.4-2, page 2-50 of the ER.

2.1.2 Demography

The Great Divide Basin is sparsely populated with only a scattered number of seasonal residents. There are no known residences within 10 miles of the proposed site, and the town of Bairoil (22 miles to the northeast) represents the closest group of permanent residences.

Transient uses of the Red Desert area consist primarily of recreational pursuits (hunting, sightseeing, rock-hounding, etc.), livestock grazing, minerals, and oil and gas exploration. No reliable visitor use statistics for the Red Desert or the site are available.

The counties of Sweetwater, Carbon and Fremont and the specific communities of Rawlins, Jeffrey City and Wamsutter could be expected to experience project-related socioeconomic impacts. Detailed demographic information regarding these areas and communities is provided in Section 2.2 of the Environmental Report.

2.2 METEOROLOGY

Meteorology data were obtained on site and from Casper. Casper data agreed quite well and, therefore, were utilized for determining long-term wind conditions and atmospheric stability.

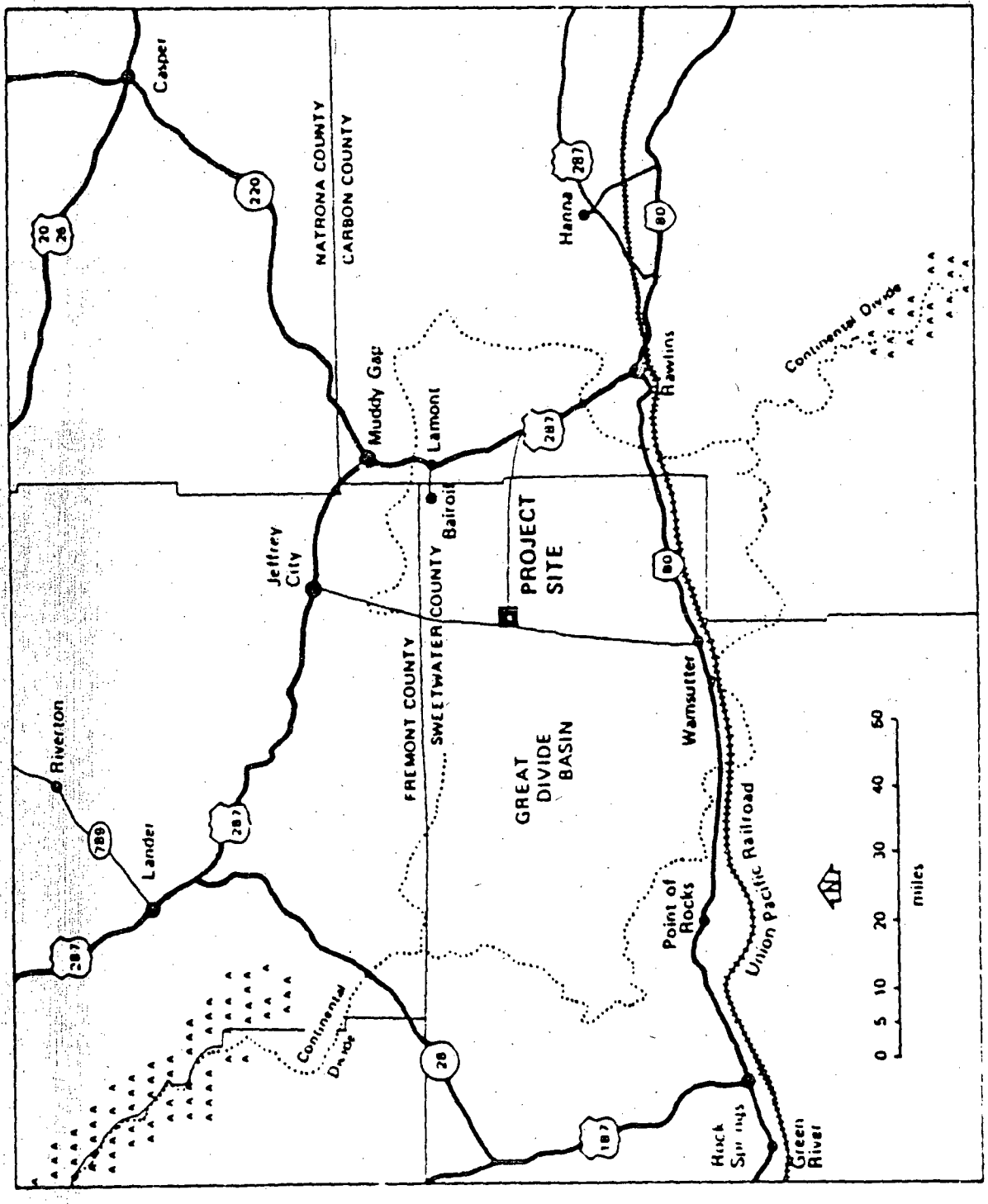


Figure 2.1-1. LOCATION OF SWEETWATER PROJECT SITE

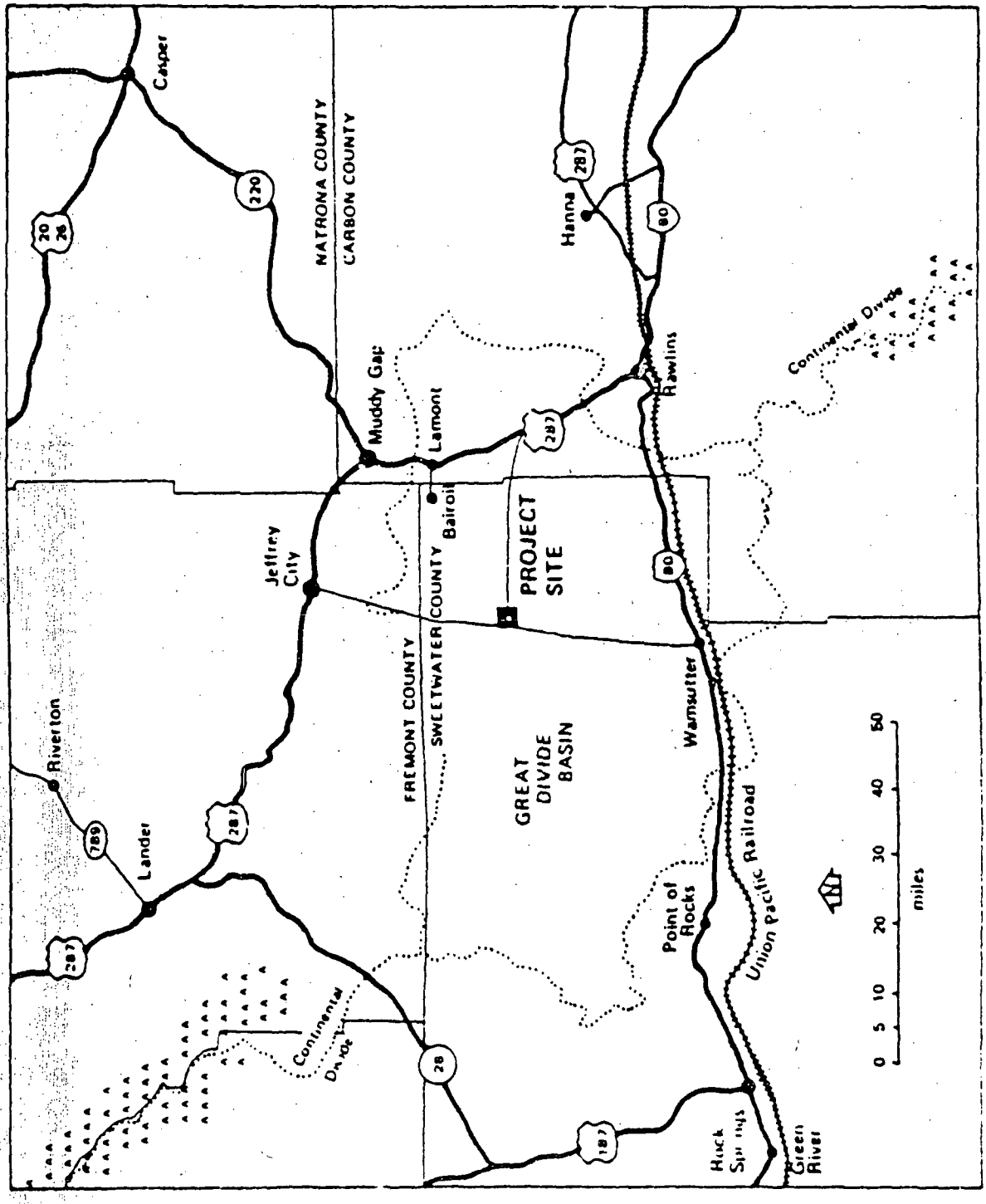
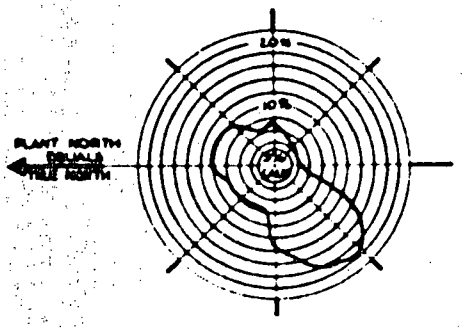


Figure 2.1-1. LOCATION OF SWEETWATER PROJECT SITE



WIND ROSE

± 115,000 GAL
H_2SO_4 STORAGE TA

250,000 GAL
PLANT PROCESS WAT
STORAGE TANK

250,000 GAL
POTABLE & FIRE PRO
WATER STORAGE TA

MAIN ELECTRICAL SUBSTATION

PROCESS, POTABLE & FIRE WATER PUMP HOUSE

ACID PUMP HOUSE

ORE BLENDING PAD (BY M.E.C.)

BOILER ROOM, COMPRESSED AIR & WATER TREATMENT EQUIPMENT

ORE RECEIVING BUILDING

MINE TRUCK PARKING

DRY TRANS PAD AND PANEL

PLANT SECURITY FENCE

DIESEL OIL PUMP STATION

TWO 200,000 GAL DIESEL OIL STORAGE TANKS

HOSE CA HOUSE

CATCHMENT BASIN (BY OTHERS)

NO	DATE	REVISION	BY	APP	APP
A		I-B-R REMOVED VOID - REDRAWN			

PLOT PLAN

REFERENCE DRAWINGS NUMBER

NOTES

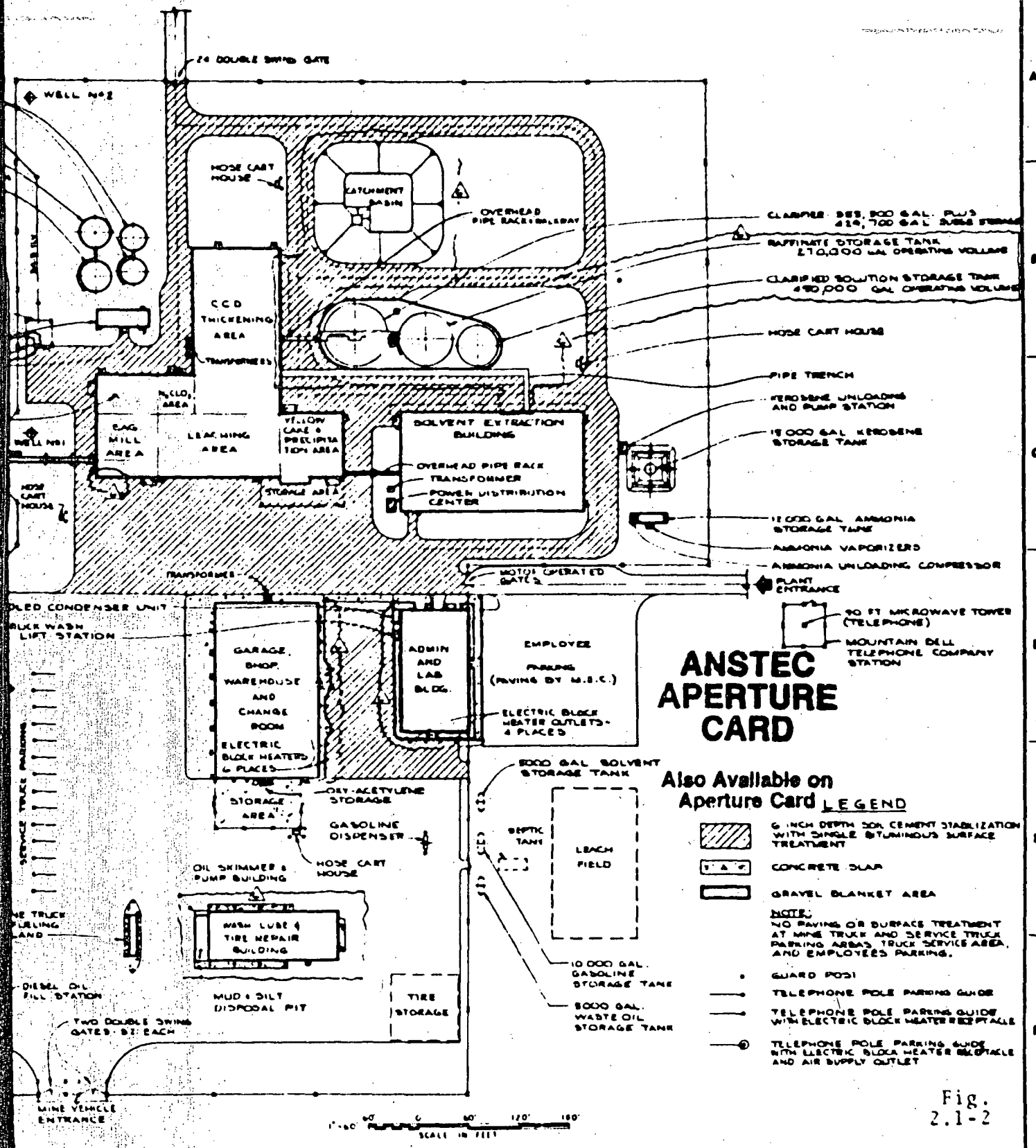


Fig. 2.1-2

KAISER ENGINEERS

PLANT GENERAL ARRANGEMENT

JOB No. 78160 DRWG. No. 10-2-C REV. B-6

The climate of the project site is semi-arid with the following general features: abundant sunshine, light rainfall (confined largely to the warmer half of the year), moderate to high wind speeds and a large diurnal change in temperature. Winters are relatively long and cold, and summers are relatively short and hot.

Detailed data and information regarding meteorology pertinent to the site can be found in Section 2.7 of the Environmental Report.

2.3 HYDROLOGY

The Great Divide Basin is an internally-drained basin defined by a bifurcation of the Continental Divide. There is very little surface water in the Basin. Some perennial lakes are located a few miles south of the site in Chain Lakes Flat which is near the center of the basin. Heavy precipitation can cause some surface water flow in draws; however, these flows are infrequent. Annual precipitation is only about 6 to 8 inches. There are a few intermittent springs in the lower portions of the basin that discharge into draws, but this water seeps into the ground a short distance downstream.

2.3.1 Groundwater

A description of regional and local groundwater aquifers, groundwater movement, and present and projected regional groundwater uses is provided in Section 2.6, pages 2-73 to 2-83, of the Environmental Report. Table D-1 in Appendix D of the report (page D-1) provides a list of the wells and springs located within 12 miles of the project area. This table also presents such pertinent information as the depth of the water level and the yield of each water source. Table D-2 in Appendix D (page D-2) provides information on adjudicated groundwater rights in the area.

2.3.2 Surface Water

A description of the hydrological characteristics of surface waters in the project area is provided in Section 2.6, pages 2-93 to 2-96 of the Environmental Report. The Battle Spring Draw drainage basin, by far the largest drainage basin on the site, covers approximately 20,500 acres.

2.4 GEOLOGY AND SEISMOLOGY

Brief descriptions of the site geology and seismology are presented below. More detailed discussions are presented in the Environmental Report.

2.4.1 Geology

The Great Divide Basin is part of the Wyoming Basin physiographic province as defined by Fenneman (1931). The floor is a plateau marked by elongated ridges and isolated mountains. The altitude of the plateau surface ranges from 6500 to 7500 feet above sea level. The Great Divide Basin is an internally-drained basin bound on most sides by major structural uplifts.

The surface at the project site is covered by thin Holocene alluvium derived from the immediately underlying Battle Springs Formation. The formation consists of interbedded and interfingered mudstones, siltstones and sandstones. The beds are nearly horizontal and dip northward at an angle of less than one degree.

No major fractures, joint patterns or faults have been observed in the vicinity of the proposed structures, and no evidence of any of these features has been indicated by drilling.

A more detailed discussion of the regional and site-specific geological characteristics are discussed in Section 2.4 of the Environmental Report.

2.4.2 Seismology

Wyoming, northwestern Colorado and northeastern Utah are not considered seismically active areas, relative to the main earthquake belts of the world. Recorded evidence of seismic activity indicates that the proposed site is in a region of low seismic activity. Although earthquakes have been reported in the region, they have been characterized by low magnitude and low intensity. Between 1853 and 1973, no regionally disastrous earthquakes have been recorded within 200 miles of the site.

A more detailed discussion of seismology of the region and site is presented in Section 2.5 and Appendix C of the Environmental Report.

3.0 FACILITY DESIGN AND CONSTRUCTION

3.0 FACILITY DESIGN AND CONSTRUCTION

3.1 MILL PROCESS

Ore from the open pit mines will be hauled by truck to a probe tower where its uranium oxide content will be determined. If the ore contains more than 0.029 percent uranium oxide, it will be trucked to the mill stockpile. Material below the cut-off grade of 0.029 percent and above 0.010 percent U_3O_8 will be piled on pads for possible heap leaching. A front end loader will feed the ore grade material through a grizzly into the grinding circuit.

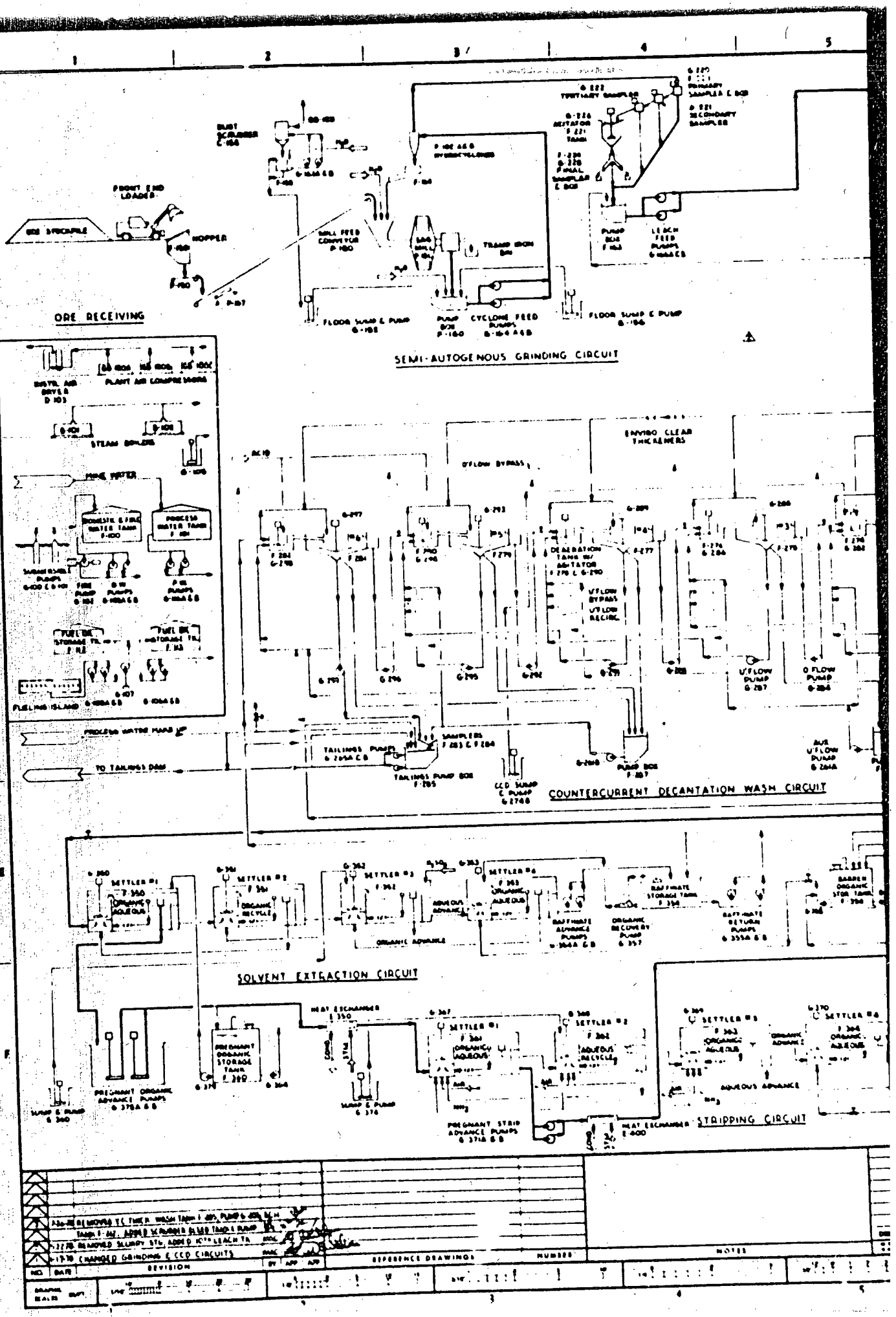
The proposed uranium mill will process an average of 3000 tons of ore per day, 365 days per year. Based on a 0.048 percent average grade of ore and a 91.7 percent recovery, the mill will produce approximately 2650 pounds of concentrate per day.

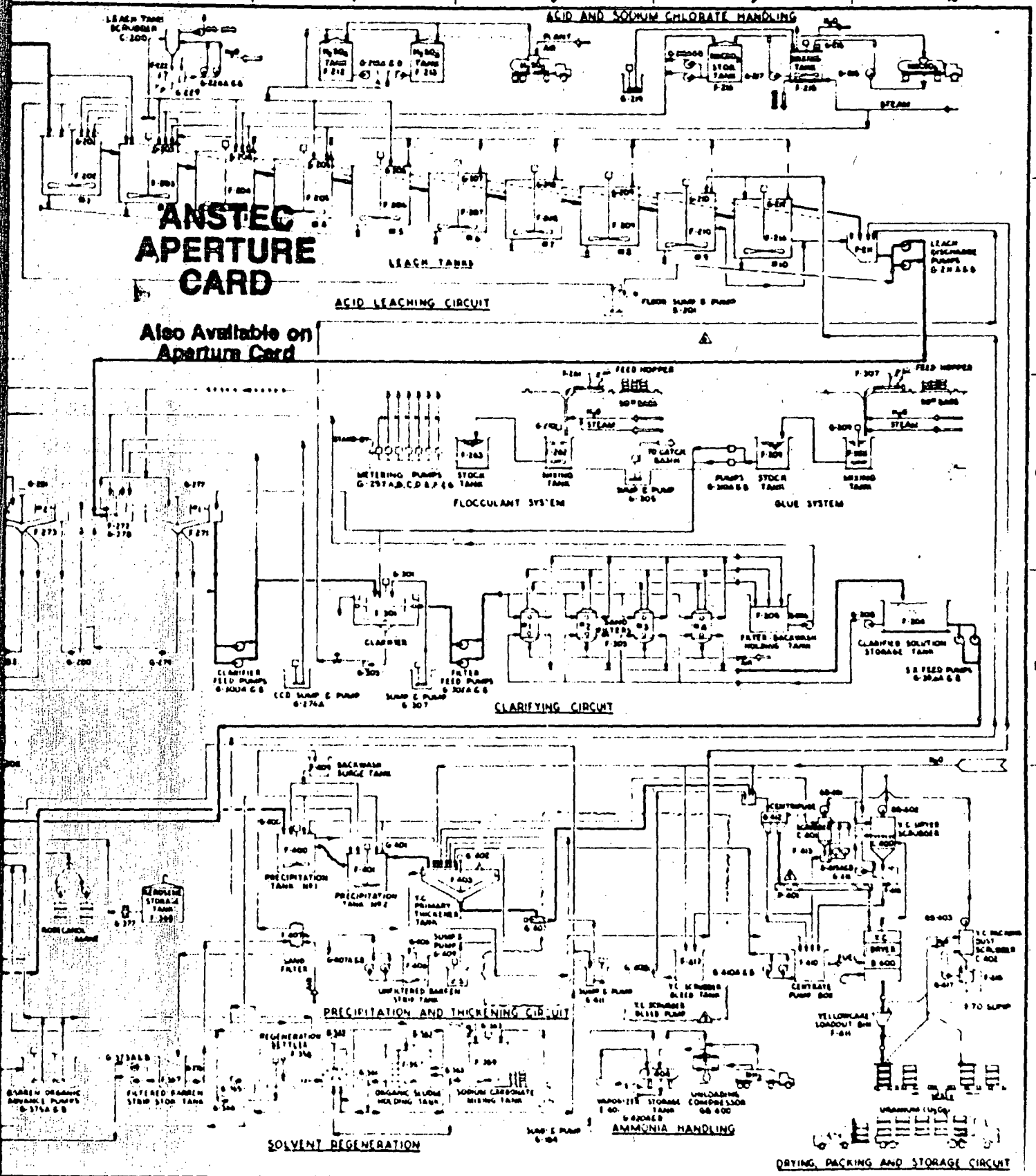
It will be necessary to employ a series of operations in the mill to extract the uranium oxide from the ore. The sandstone ore will first be processed through a semi-autogenous mill circuit to reduce its size. The fine ore will then be mixed with an acid solution in agitator tanks to dissolve the uranium minerals. The discharge from the leaching circuit will be pumped to a countercurrent decantation system where the uranium-rich (pregnant) solution will be separated from the tailings in multiple stages of thickeners and filters. The tailings will be pumped to a subsurface impoundment. The pregnant solution will be clarified and then pumped to a solvent extraction system. In this system, the pregnant liquor passes through a series of stages in which the dissolved uranium is transferred from the aqueous phase to an organic phase and then stripped, purified and concentrated. Anhydrous ammonia will be added to the uranium-rich (loaded) strip solution to precipitate the uranium. Finally, precipitates of uranium will be dryed, packaged and shipped to customers.

A simplified flow chart is presented in Figure 3.1-1.

Ore Receiving and Grinding

A front end loader will load stockpiled ore into a hopper. Oversize material is removed with a stationary grizzly with 18" square openings. An apron feeder regulates the withdrawal of ore


ORE RECEIVING
SEMI-AUTOGENOUS GRINDING CIRCUIT
COUNTERCURRENT DECANTATION WASH CIRCUIT
SOLVENT EXTRACTION CIRCUIT
STRIPPING CIRCUIT
ENVIRO CLEAR THICKENERS
TO TAILINGS DAM
REFERENCE DRAWINGS
NOTES
REVISION



		NONE	
		JERRY SUAREZ	6-6-77
		N JACOB/M C	6-13-77
		R C HOSKINS JR	8-15-77
			8-19-77
			8-19-77

KAISER ENGINEERS

GENERAL PLANT
PROCESS FLOWSHEET

F
3

JOB No. 76160 | DWG. No. 10-6-P | REV. B-3

from the hopper onto a belt conveyor which carries the material to a semi-autogenous grinding mill. The feed rate is monitored by a belt scale. The product from this mill is pumped to a set of hydro-cyclones where the pulped ore is separated by size. The cyclone underflow (coarse material) is returned to the grinding circuit and the cyclone overflow (fine material) is discharged to the pump box.

Figure 3.1-2 shows the ventilation equipment locations for the ore receiving and grinding operations.

Leaching, Washing and Clarification

The ore pulp from the hydro-cyclone overflow is pumped into the first of ten rubber-lined steel leach tanks. Agitation is accomplished mechanically, thoroughly mixing the 55 percent solids pulp. Acid and oxidant are metered into the system.

The leached pulp from the leaching circuit is pumped to the first of six countercurrent decantation washing thickeners. Each stage of washing consists of feed pumps and a 32-foot diameter thickener.

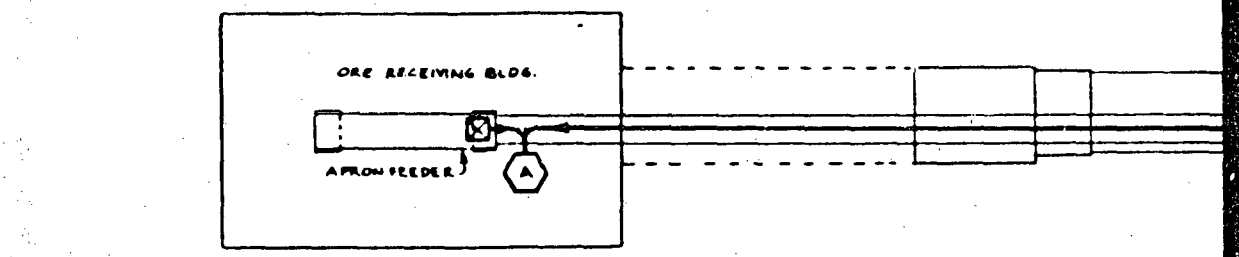
The pregnant solution overflows from the No. 1 thickener to a sump and is advanced by a pump to a clarifier. A dilute solution of animal glue is added to the clarifier to promote flocculation and settlement of the fine suspended solids. The thickened slime product is recycled to the leach circuit by a pump.

The clarified pregnant aqueous is pumped to a tank which serves as a surge reservoir. It is then pumped through sand filters for final clarification. The clarified solution is then advanced to the solvent extraction circuit feed storage tank.

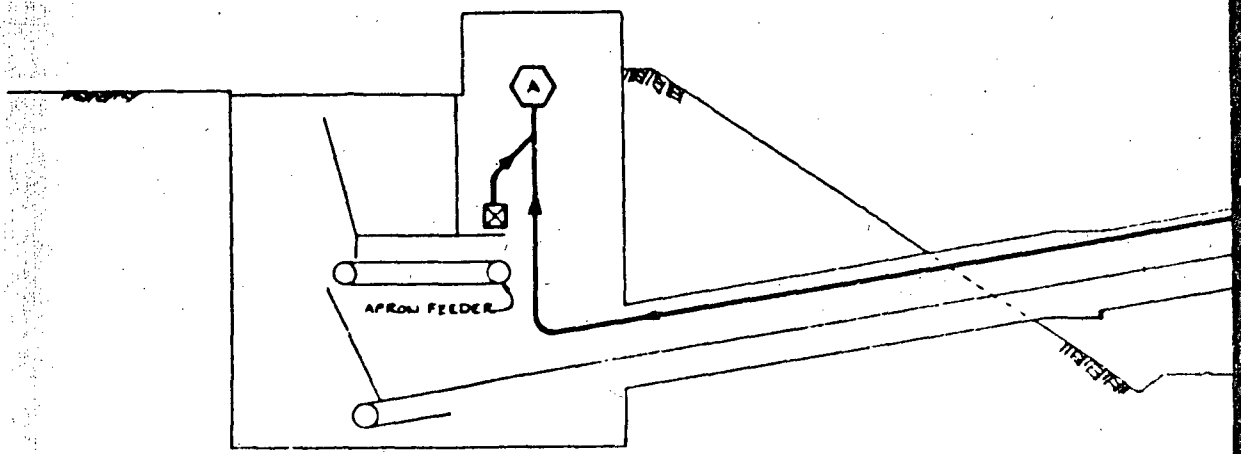
Figure 3.1-3 shows the ventilation equipment locations for the leaching, washing and clarification areas.

Solvent Extraction

The solvent extraction section consists of two unit operations. First, the uranium values are extracted from the clarified

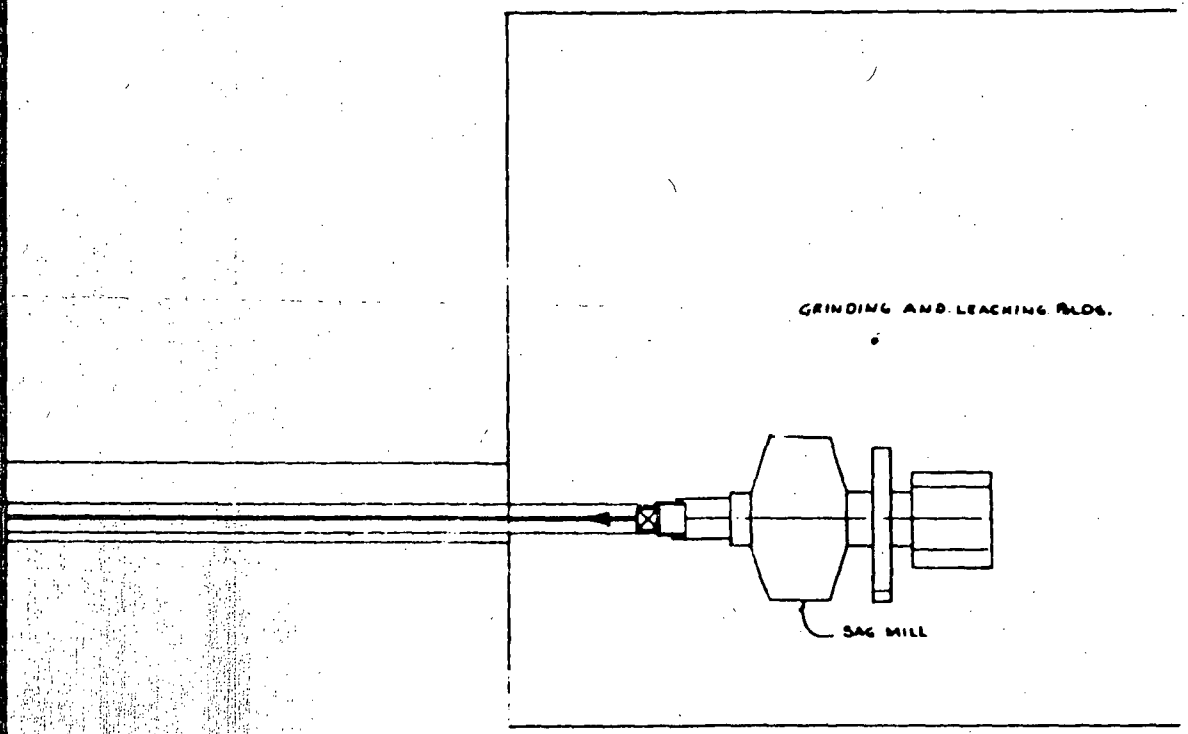


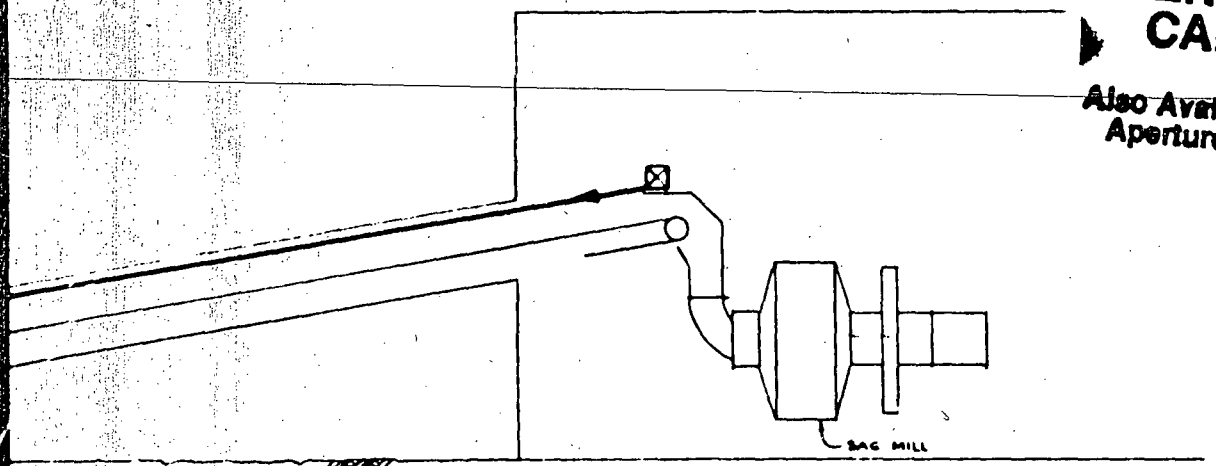
PLAN



ELEVATION

NO.	DATE	REVISION	BY	APP.	APP.	REFERENCE DRAWINGS	NUMBER	NOTES





SOURCE/PICK UP PT.

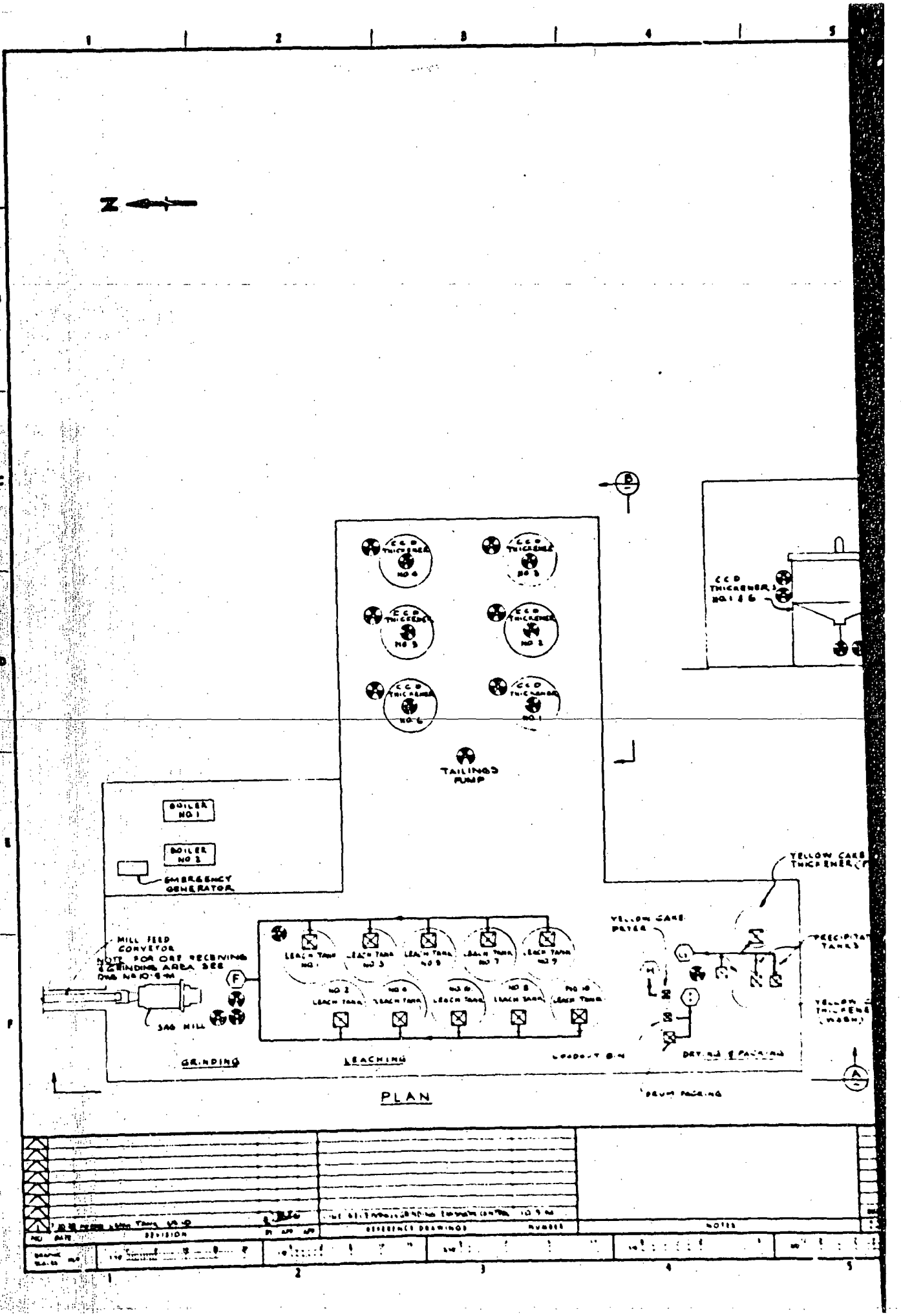
WET SCRUBBER

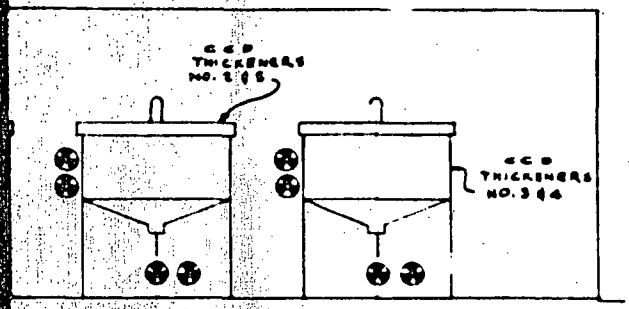
LEGEND

Fig. 3.1-2

9707140120-03

		KAISER ENGINEERS	
		ORE RECEIVING AND GRINDING EMISSION CONTROL	
		JOB NO. 76180	DWG. NO. 10-5-M


N
C C D THICKENER NO 6
C C D THICKENER NO 5
C C D THICKENER NO 4
C C D THICKENER NO 3
C C D THICKENER NO 2
C C D THICKENER NO 1
C C D THICKENER NO 1 & 6
TAILINGS PUMP
BOILER NO 1
BOILER NO 2
EMERGENCY GENERATOR
MILL FEED CONVEYOR
NOTE FOR ORE RECEIVING & GRINDING AREA SEE DWG NO 10-9-M
SAG MILL
LEACH TANK NO 1
LEACH TANK NO 3
LEACH TANK NO 5
LEACH TANK NO 7
LEACH TANK NO 9
NO 2 LEACH TANK
NO 4 LEACH TANK
NO 6 LEACH TANK
NO 8 LEACH TANK
NO 10 LEACH TANK
YELLOW CAKE DRYER
YELLOW CAKE THICKENER
PRECIPITATE TANKS
GRINDING
LEACHING
LOADOUT BIN
DRY'G & PACKING
DRUM PACKING
PLAN



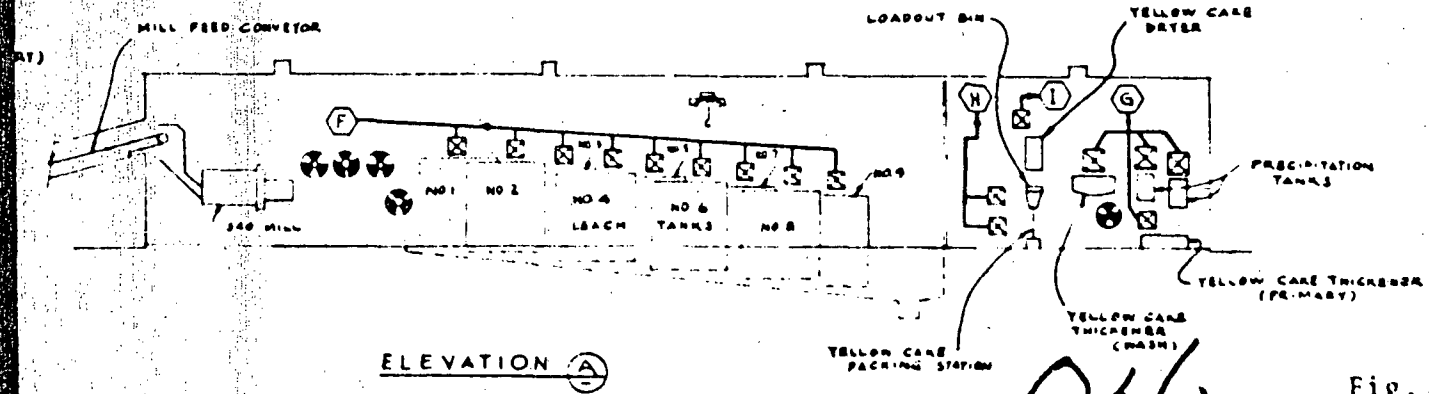
ELEVATION (B)

WET SCRUBBER

SOURCE/PICK-UP POINT

NUCLEAR INSTRUMENT

LEGEND



ELEVATION (A)

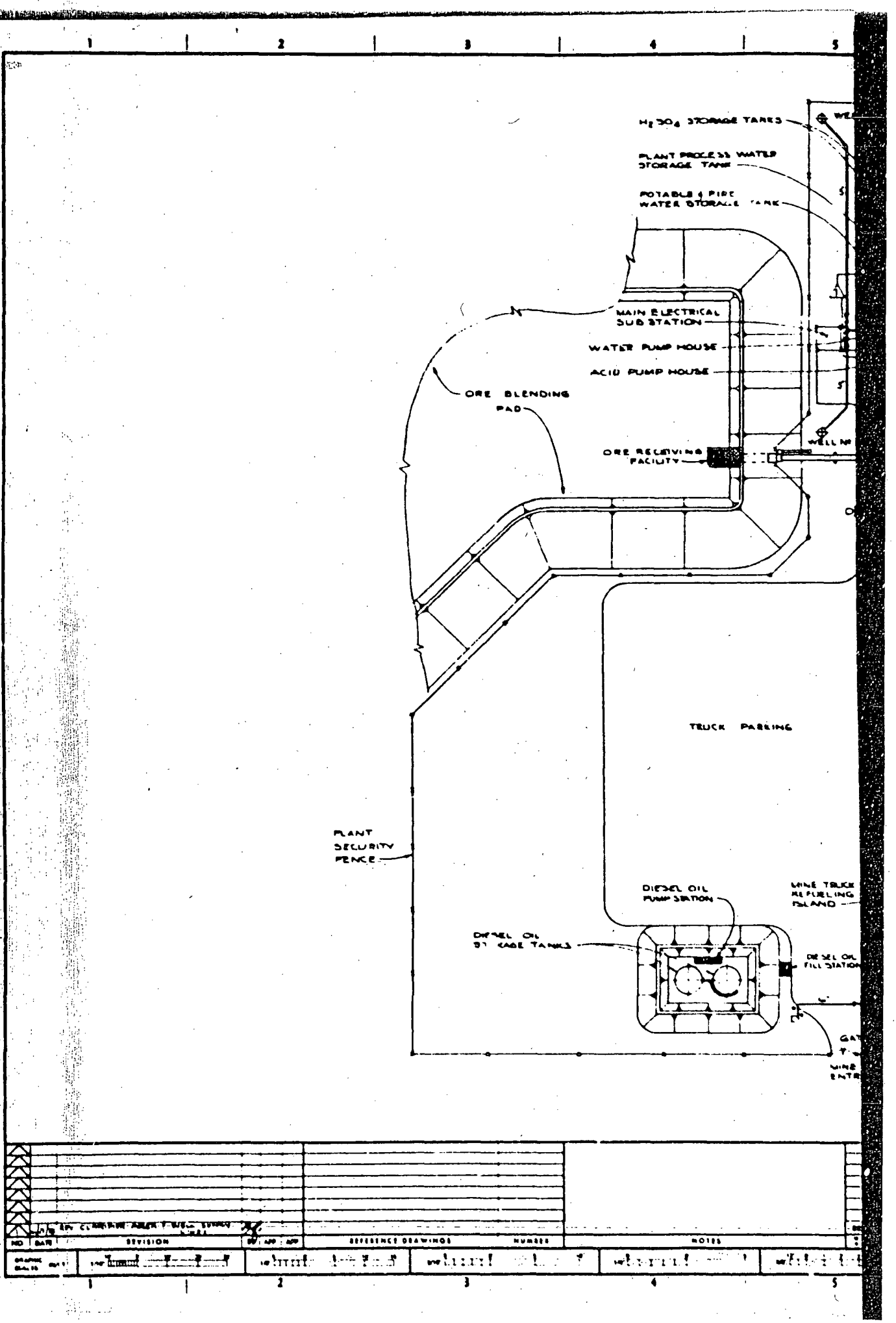
9707140120-04

Fig.
3.1-3

KAISER ENGINEERS

LEACHING, WASHING DRYING & PACKING
EMISSION CONTROL

JOB No. 78160 | DWG. No. 10-6-M | B-1


H_2SO_4 STORAGE TANKS
PLANT PROCESS WATER STORAGE TANK
POTABLE & FIRE WATER STORAGE TANK
MAIN ELECTRICAL SUB STATION
WATER PUMP HOUSE
ACID PUMP HOUSE
ORE BLENDING PAD
ORE RECEIVING FACILITY
TRUCK PARKING
PLANT SECURITY FENCE
DIESEL OIL PUMP STATION
DIESEL OIL ST CASE TANKS
MINE TRUCK REFUELING ISLAND
DIESEL OIL FILL STATION

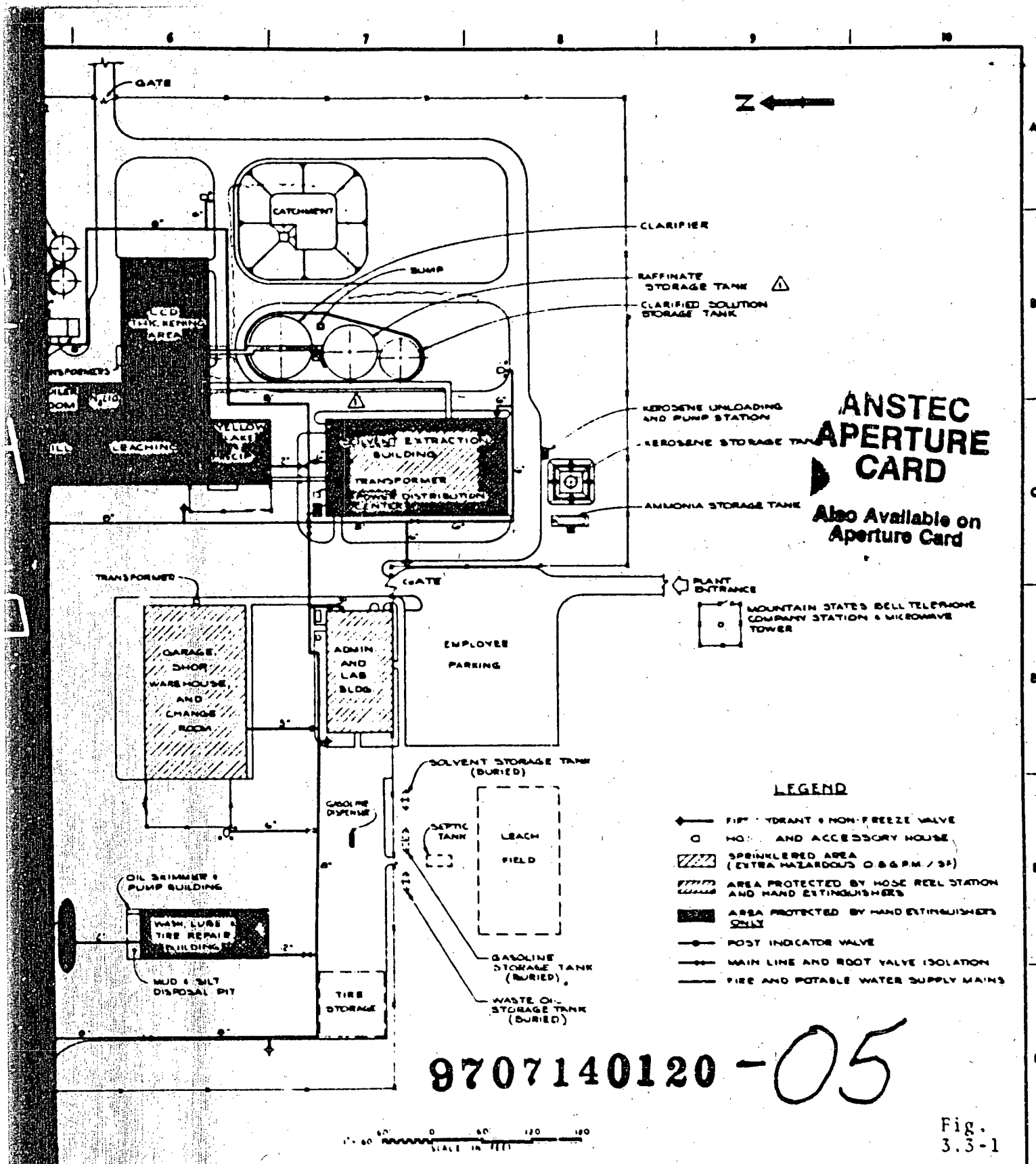


Fig. 3.3-1

pregnant aqueous solution by solvent ion-exchange and concentrated into an organic liquid. Recovery and additional concentration is achieved by stripping before being advanced to the precipitation operation.

The pregnant aqueous solution enters the first stage of an extraction mixer tank where it is joined with the advancing organic. An agitator provides both the mixing and pumping function required for the stage's operation.

The mixture of aqueous and organic solution overflows into a settler for phase disengagement. A portion of the organic is recycled for phase ratio control in the mixer with the balance flowing to the loaded organic storage tank.

The aqueous solution continues on to the next extraction stage. After four such countercurrent extraction stage with the organic, the aqueous solution becomes a barren raffinate, which is recycled back to the countercurrent decantation wash circuit as makeup or is discharged as tailings. The loaded organic advances to a storage tank.

The loaded organic is pumped through a heat exchanger and on to the first stage of four countercurrent strip/mixer tanks where it is joined by the advancing ammonium sulfate stripping solution.

Gaseous anhydrous ammonia is added to the mixer to control the pH during the stripping. An agitator provides the required pumping and mixing requirements for this operation. The mixture of organic and stripping solution overflows into a settler compartment for phase separation.

The organic solvent continues on to the next stripping stage. After four such countercurrent contacts with the advancing stripping solution, the now barren organic discharges to a storage tank ready for return to the extraction circuit. The pregnant aqueous solution is then pumped through a heat exchanger and on to the precipitation circuit.

Precipitation, Drying and Drumming

In the precipitation tanks, gaseous anhydrous ammonia is injected into the final pregnant solution, causing the uranium to precipitate as a basic ammonium diuranate, more commonly referred to as "yellowcake".

The pulp from precipitation enters the yellowcake thickener. Effluent from wet scrubbing makes up the bulk of the wash water. The thickener overflow is collected in the barren liquor surge tank and is further processed in a sand filter prior to recycling to the barren stripping solution tank in the solvent extraction circuit. The washed and thickened yellowcake slurry is withdrawn by pump and advanced to a centrifuge for a final wash and mechanical dewatering.

A pump takes the thick mud-like centrifuge cake and feeds it to the multi-hearth drying furnace. The furnace discharge product passes through a crusher for reduction to minus 1/4". The final product is then packaged into steel drums. After sampling, the barrels are stacked for storage until a lot or shipment quota has been reached.

Figure 3.1-3 shows the ventilation equipment locations for the drying and packaging areas.

3.2 MAJOR EQUIPMENT

A list of the major equipment is shown in Table 3.2-1. The number, description and approximate specifications are also included. Minor modifications may be necessary due to design changes.

Table 3.2-1

MAJOR EQUIPMENT

Equipment	Qty.	Description	Approximate Specification
Grizzly Ore Receiving	(1)	16" Stationary Grizzly and Steel Hopper	55 ton capacity
Conveyor	(1)	Rubber covered conveyor belt to transport the ore to the semi-autogenous mill	48 inches wide x 180 feet long
Semi-autogenous Mill	(1)	Cylindrical steel grinding mill	18 ft. dia. x 7 ft. long
Leach Tanks	(10)	Cylindrical, rubber-lined steel c/w mechanical agitators	22.5' dia. x 22' hi. and 75 HP agitators
Countercurrent Decantation Tanks	(6)	Open, rubber-lined steel tanks with a mechanical raking mechanism	32' dia. 7.5 HP motor

Table 3.2-1 (cont.)

Equipment	Qty.	Description	Approximate Specification
Clarifier	(1)	Open, lined steel with concrete bottom fitted with a mechanical raking mechanism	75' dia. x 25' hi. 3HP motor
Clarifying Filters	(4)	Cylindrical steel pressure filters containing garnet and sand filter beds	9' dia.
Clarified Solution Storage Tank	(1)	Closed, lined steel	75' dia. x 16'
Barren Organic Storage Tank	(1)	Closed, lined steel	16' dia. x 16'
Solvent Extraction Mixer-Settlers	(4)	Two compartment open concrete tanks, one compartment fitted with agitator	36' wide x 82' long 30HP agitator
Raffinate Storage Tank	(1)	Closed, lined steel tank	70' dia. x 12'
Pregnant Storage Tank	(1)	Closed, lined steel	16' dia x 16' hi.
Solvent Stripping Mixer-Settlers	(4)	Two compartment open concrete tanks, one compartment fitted with agitator	7' wide x 82' long 5 x 15HP
Filtered Barren Strip Storage Tank	(1)	Open, lined steel	8' dia. x 8' high
Organic Sludge Holding Tank	(1)	Open, lined steel with agitator	12' dia. x 12' high 5HP agitator
Precipitation Tanks	(2)	Open, lined steel with agitators	6' dia. x 6' hi. 5HP agitators

Table 3.2-1 (cont.)

Equipment	Qty.	Description	Approximate Specification
Yellowcake Primary Thickener	(1)	Open, lined steel conical tank with raking mechanism	17' dia. 2 HP drive
Unfiltered Barren Strip Storage Tank	(1)	Open, lined steel with agitator	8' dia. x 8' hi. 5 HP agitator
Centrifuge	(1)	Rotating, solid bowl with scroll	9" dia. 25HP
Yellowcake Dryer	(1)	Oil-fired, four hearth with raking arms	6' dia.
Dryer Wet Scrubber and Exhaust Cooler	(1)	Water scrubbed dryer exhaust	760 ACFM @ 800°F in; 580 ACFM @ 161°F out; 99.5% efficiency
Yellowcake drumming bin and Feeder	(1)	Closed, steel bin and rolls crusher	5000 lbs. U_3O_8 capacity
Drumming Scrubber	(1)	Water scrubbed dryer exhaust	500 CFM 99.5% efficiency
Sulfuric Acid Storage Tanks	(2)	Closed, steel	31' dia. x 24'
Kerosene Storage Tank	(1)	Closed, steel	14,000 gals.
Sodium Chlorate Storage Tank	(1)	Closed, steel	20' dia. x 18'
Flocculant Stock Tank	(1)	Closed, steel	14' dia. x 14'

Table 3.2-1 (cont.)

Equipment	Qty.	Description	Approximate Specification
Glue Stock Tank	(1)	Closed, steel	9' dia. x 9'
Filter Backwash Holding Tank	(1)	Closed, lined steel	16' dia. x 14'
Ammonia Storage Tank	(1)	Pressurized, cylindrical steel	12,000 gals.
Wet Scrubber SAG Mill Feed	(1)	Water scrubbed	6,000 CFM 99.5% efficiency
Leach Tank	(1)	Water scrubbed	5,000 CFM 99.5% efficiency
Wet Scrubber Laboratory Hoods	(1)	Water scrubbed	8,000 CFM 99.5% efficiency
Wet Scrubber Y-C Precip., Y-C Thickener, Y-C Centrifuge	(1)	Water scrubbed	1,800 CFM 99.5% efficiency

3.3 INSTRUMENTATION

Process plant instrumentation will serve two main functions:

1. To control the process at the optimum operating condition;

2. To alert plant operators to an abnormal condition and initiate corrective action as required.

The process plant is designed to be fail safe in the event of power failure. Emergency power will be made available to equipment and instrumentation needed to maintain operator safety.

All process plant instrumentation will be conventional devices, well proven and accepted in current industrial applications. The components are constructed to applicable industrial specifications and contain no potentially hazardous components with the exception of the nuclear sources in the nuclear density gauges.

3.3.1 Nuclear Instruments

The instrumentation will include a total of nineteen commercially available nuclear density gauges in three broad groups of application. The first group of twelve gauges will measure and control the pulp density of slurries containing uraniferous solids in aqueous suspension at strategic locations in the process plant. The second group of six gauges will measure and control the slime levels in the six CCD thickeners. Figure 3.1-3 shows the locations of Group 1 and Group 2 nuclear instruments.

The third group of gauges will be used by the mine department for uranium analysis. One will be located in the grade control tower and will be used to analyze ore hauled from the mine. Two will be used in the pit to analyze and locate ore pods.

All source heads will be doubly encapsulated in stainless steel and be sealed and mounted in rugged, shielded housings. The source heads will be provided with key securable, manually operated three-position source shutters for measurement, calibration and complete closure. The housings will be clearly marked with radiation warning notices as required by the NRC and all gauges will be installed away from frequently used operator walkways. All gauges will be leak tested initially and once every three years thereafter, providing the beta gamma surveys do not show an unusual radiation increase.

1. Slurry Density Measurement

The 12 gauges will have a 5-inch source head of 200 mCi Cs^{137} maximum to measure a range of pulp densities between 35 and 60% solids by weight. They will be Texas Nuclear Model No. SGH202 or equivalent by other manufacturers and will be located as follows:

Gauge No.	Location
1 & 2	On the pipeline feeding the cyclones in the grinding area.
3	On the pipeline from the leach tank feed pumps.
4	CCD feed from leach tanks.

Gauge No.	Location
5 through 10	On each of six thickener underflow pipelines.
11	On the pipeline to the tailings pond.
12	On the pipeline from the yellowcake thickener underflow pump.

2. Slime Level Detection

The six gauges will have an 18 inch source head of 400 mCi C_s137 maximum to detect and control the slime level in the thickeners over a normal range of 4 feet to 8 feet from the liquid surface of the thickener. They will be Texas Nuclear Model No. CNH or equivalent by other manufacturers and will be located on the side of each of six thickener tanks. Gauge numbers will be 13 through 18.

3. Uranium Analysis

The three gauges will contain 3mCi of Cadmium 109 hermetically sealed in the source head. They will be Texas Nuclear Model No. 9200 or equivalent by other manufacturers. Gauge number will be 19 through 21.

3.3.2 Dust Collection, Ventilation and Scrubbing

The failure of all dust collector, ventilator and scrubber fans will be alarmed in the appropriate control rooms as follows:

a. Receiving area.

b. Leach tank scrubber exhaust fan. Failure of the water supply to the scrubber will also be alarmed.

c. Solvent extraction building ventilator fans.

d. Yellowcake thickener and precipitation tank scrubber exhaust fan. Failure of the water supply to the scrubber will also be alarmed.

e. Yellowcake scrubber exhaust fan. Failure will be detected by a temperature sensor on the discharge duct of the scrubber. A flow switch will detect failure of the scrubber water supply and automatically switch to an alternative water source. This transfer will be alarmed in the control room.

f. Yellowcake loading wet collector fan.

Failure indication time in all cases is less than five seconds.

3.3.3 Reagent Control in Power Failure

The following automatic valves controlling reagents and utility supplies to the circuit will fail shut in the event of a power failure.

a. Sulfuric acid to the leach circuit.

b. Sodium chlorate to the leach circuit.

c. Ammonia to the stripping circuit mixer settler.

d. Sulfuric acid to the extraction settler.

e. Steam to the organic heat exchanger.

f. Steam to the pregnant strip heat exchanger.

g. Ammonia to the precipitation tanks.

Response time in all cases is less than five seconds.

3.3.4 Fire Protection

The mill is designed to minimize the occurrence of fires. Heat sensors will be strategically located to detect fires and approved fire extinguishers will be available in all areas. Selected employees will be trained in fire control techniques. A fire protection arrangement is found on Figure 3.3-1.

An A.T.C. (Alcohol Type Concentrate) system will be installed in the solvent extraction building settling tanks. It consists of a pumping tank and individual foam makers on each tank. A.T.C. activation will be via heat sensors strategically located.

The response time of the heat sensors will depend on the intensity of the fire. The response time of the water valves will be immediate.

In the event of a power failure, all drives associated with the roaster-dryer, including the scrubber fan, will restart automatically to cool the furnace. Response time will be 45-90 seconds.

Fire water pressure will be maintained during power failure by an emergency diesel pump.

Fire pump can operate approximately 4 hours with no replenishment of source water, and approximately 4.5 hours with replenishment.

3.3.5 Conveyor

The conveyor is equipped with safety shut down cable switches. Response time is immediate.

3.3.6 Radiation Protection Instrumentation and Specifications

Beta-gamma and alpha survey meters will be used to monitor the mill, the workers and the environment. Radiation surveys will be made on a routine basis and exposure kept "ALARA".* Laboratory instruments will also be available to measure radiation.

1. Beta-gamma survey meters shall have the following minimum specifications:

Range: The lowest range not to exceed 0.2 mR/hr full scale. The highest range to measure 200 mR/hr.

Response time: Adjustable.

Battery operated and portable.

Calibration potentiometers for each range (scale).

Adaptable to use either thin walled GM tubes or "pancake" GM tubes.

Environmental capabilities: Must operate satisfactorily in the temperature range -40 F to 120 F.

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* "ALARA" - As Low As Reasonably Achievable

Examples of satisfactory beta-gamma survey meters include:

Eberline Instrument Corporation
E-520, E-530, Probes: HP-240, HP-177C

Ludlum Measurements, Inc.
Model 3, Model 5 Geiger Counter;
Probes: Model 44-6, 44-9

2. Alpha survey meters shall have, as a minimum, the following specifications:

Range: The lowest range not to exceed 500 dpm full scale. The highest range to measure 50,000 dpm. Readings should be in dpm.

Battery operated and portable.

Calibration potentiometers for each range (scale).

Adaptable to use of scintillation and gas-proportional types of alpha probes.

Environmental capabilities: Must operate properly in the range -40 F to 120 F.

Examples of satisfactory alpha survey meters include:

Eberline Instrument Corporation
PAC-4G, PS-2, Probes: AC-21, AC-21B, TP-1

Ludlum Measurements, Inc.
Model 12 (CRM); Probes: 43-2, 43-5

3. Laboratory counters for contamination smear samples and air sample filters shall have the following minimum requirements:

Scaler: Counting capacity of at least 999,999.

Timer: Presettable count times.

Threshold and window: Adjustable.

Regulated, adjustable power supply.

Adaptable to GM, proportional and scintillation detectors, for detection of alpha, beta and gamma.

Shielded detector and counting stage.

Examples of satisfactory laboratory counters are:

Eberline Instrument Corporation
Scaler, Model MS-2
Gas flow counter, Model FC-2, alpha, beta and gamma
Shielded and window counter, Model RD-15, HP-190
GM probe; beta, gamma
Alpha scintillation counter, Model SAC-4
Ludlum Measurements, Inc.
Scaler Model 2000, Model 2200

3.3.7 Spillage

Spillage of solids, slurry and solutions within the process plant will be minimized by level controllers and high level alarms on all major tanks and sumps. In the event of spillage, the material will be contained by curbs and will drain or be washed to sump pumps controlled by automatic level switches.

The floor sump pumps are located in all sections of the process plant and will discharge back to the circuit.

All floor sumps are six foot cubes except for a double length sump in the CCD pumphouse. The sump pump starts at a liquid level of 12" from the top and stops at a liquid level of 6" from the bottom.

The following pump boxes and tanks are fitted with level controllers (LIC) or high level alarms (LAH).

	LAH	LIC
Leach Feed Pump Box	X	
Leach Discharge Pump Box	X	
Sodium Chlorate Mixing Tank	X	
Sulfuric Acid Storage Tanks	X	
Tailings Pump Box	X	X

	LAH	LIC
Clarifier Tank	X	
Filter Backwash Holding Tank	X	
Clarified Solution Storage Tank	X	X
Pregnant Organic Feed Well	X	
Pregnant Organic Storage Tank	X	
Raffinate Storage Tank	X	X
Barren Organic Storage Tank	X	
Barren Organic Pump Well	X	
Filtered Barren Strip Storage Tank	X	
Unfiltered Barren Strip Holding Tank	X	
Wash Thickener Bleed Holding Tank	X	

High level alarms will generally be set to operate at 90% of tank or sump volume. The high point of level controllers will be set at a slightly lower level.

4.0 WASTE MANAGEMENT SYSTEM

4.0 WASTE MANAGEMENT SYSTEM

Mill effluents and waste will be minimized to the extent reasonably achievable. Pollution control equipment will be "state of the art" and will be routinely checked for efficiency and will be properly maintained.

Particulate concentrations will be maintained below permissible standards and "as low as reasonably achievable" through prevention, entrapment and collection.

4.1 GASEOUS

4.1.1 Stacks

The location of each exhaust stack, a description of emission control equipment, as well as stack diameter, is shown in Appendix 5C.

4.1.2 Other

There will be small amounts of radon generated inside the piles of ore on the stockpiles. If ore piles were left undisturbed, only a negligible amount of radon generated inside the piles would reach the atmosphere because the gas would not have time to diffuse through the ore before decaying to a solid radionuclide. However, disturbance of the ore by transporting it from the stockpiles to the mill hopper will release a small portion of the entrapped radon gas to the atmosphere.

The leach tanks will contain low concentrations of radon-222 and sulfuric acid mist. This air will be vented through a wet scrubber. The acid removed by the scrubber will be returned to the circuit.

Some water vapor, acid mist and minor amounts of radon-222 will escape into the atmosphere from the open thickeners. Air currents will provide sufficient dispersion and dilution to prevent any hazardous concentrations even at the surface of the tanks.

Some kerosene losses from the solvent extraction circuit will result from evaporation. These are expected to be minimal and will impose no environmental impacts to the environment.

Air from the yellowcake precipitators, thickener and dryer will pass through a wet scrubber and vent to the atmosphere from a stack. The exhaust gases will contain 100 ppm ammonia and traces of radon-222.

The fume hoods of the metallurgical and analytical laboratories will collect air and an undefined mixture of chemical fumes and mists. They will pass through a wet scrubber to the atmosphere. The effluent will not contain sufficient quantities of potential contaminants (radioactive or non-radioactive) to constitute a significant impact.

The electrical power requirements of the Sweetwater Project will be supplied by the Pacific Power and Light Company (PP&L). To ensure that the mill receives continuous power in the event of a utility outage, an emergency generating unit rated at 650 kilowatts (kw) will be installed in the mill complex. Emissions from the diesel engine will be vented to the atmosphere through a stack.

The Heap Leach piles may generate some Rn-222 and acid mists; however, these will be minimal.

4.1.3 General Criteria

The dust collecting, venting and fume control systems in the plant are designed to control all possible emissions when the plant is operating at a design rate of 3300 TPD.

The ore is normally fed to the plant at a moisture content of 10-14% which should not cause any dust problems. To assure protection of the environment, the dust collecting system for this plant is designed to collect dust from the dry ore which may be introduced into the system infrequently. The belt conveyor is sized to handle the maximum expected loadings. This belt will transfer the ore from the pan feeder to the semi-autogenous grinding mill.

The conveyor is hooded at the discharge end and skirted at the feed end. These areas, as well as areas around the pick up points from equipment discharging onto the conveyor, are sealed as closely as practical. All entrained air from these areas, together with any dust which may be present, are vented through a dust collector properly sized for the installation. The collecting of dust at the source areas in the plant assures a clean, dust-free operation.

The specifications for the dust collectors and fans have not been developed. A dust collector is normally sized to the nearest standard size that will handle all of the material, and the fan is sized to handle 115% of the capacity of the dust collector at the required pressure drop.

The emissions from the stacks of well-run uranium operation could be expected to be as follows:

Yellowcake Dryer	μ	% of Pass-through
	0-1	18
	0-3	27
	3-5	16
	5-10	13
	+10	27

*Yellowcake Packing and Ore Handling	μ	% of Pass-through
	0-5	60
	+5	40

All dust collecting and fume control systems are based on formulas and data from "Industrial Ventilation" 13th Edition as published by the "American Conference of Governmental Hygienists".

The formulas used are as follows:

- All conveyor pickup points - 350 CFM x Belt Width (Ft.) for conveyor speeds under 250 ft/min.
- All conveyor pickup points - 500 CFM x Belt Width (Ft.) for conveyor speeds over 250 ft/min.
- Apron Feeder - 350 CFM x Width (Ft.)

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* Note: Data is not available for wet scrubbers in these areas from existing operations. The above figures are expected performance. Manufacturers data is based on percent of efficiency at different micron sizes as follows:

μ	% Efficiency
0-1	91
0-3	96
3-5	98
5-8	99
+8	99+

- Venting of the following:

Leach tanks	-- Equivalent foot method, balanced design
Yellowcake Precipitators, Thickeners and Centrifuge	-- Equivalent foot method, blast gate design
Yellowcake Dryer/Roaster	-- The total exhaust as calculated by manufacturer is sent to the scrubber.

Capture velocities of all pickup points are designed to be 300-400 ft/min. All dust collectors are sized to maintain velocities of 3,000 to 4,500 ft/min.

1. Ore Receiving Area

A. Pick up Points:

a. Coarse ore conveyor skirtboard	1400 CFM
b. Apron feeder head chute	1400 CFM
c. Mill feed conveyor head chute	875 CFM
TOTAL	3675 CFM

B. Dust Collector:

Wet scrubber 99.5% efficient

C. Fan:

Centrifugal air handling type located on the "clean" side of the dust collector and sized for 115% of collector CFM.

2. Venting of Leach Tanks

The purpose of this venting system is to clean and exhaust the fumes generated in the circuit through the scrubber to atmosphere.

A. Pick up Points:

A total of ten pick up points; one at the top of each leach tank 5,000 CFM

B. Dust collector (vapors):

Wet scrubber, efficiency 99.5 + %

C. Fan:

Same as above

3. Yellowcake Area

A. Pick up Points:

a. Yellowcake precipitation	600 CFM
b. Yellowcake thickeners	600 CFM
Total	1200 CFM

B. Dust collector:

Wet scrubber, efficiency 99.5 + %

C. Fan:

Same as above

4.2 LIQUIDS AND SOLIDS

4.2.1 Tailings

Solid and liquid wastes from the milling process, along with confined spills, will be gathered into a tailings pump box. The combined tailings effluent will be sampled, then pumped through a 10" line to the tailings pond. The tailings will consist of water, waste solids from the ore, minor unrecovered uranium particles and small amounts of chemicals used in the milling process.

1. Tailings Slurry-Physical Characteristics

The tailings slurry consistency will range from 35-40% solids. The solid particles will generally be 100% passing #28 standard sieve size.

2. Slurry Transportation & Distribution

a. The tailings will be transported from the plant area to the pond via a pressurized 10 inch line placed

upon a prepared, controlled bed surface. The prepared surface will be such that any leakage of flow from pipe line breaks will be directed to natural drainages leading to the tailings pond or other drainages that lead to an enclosed basin.

b. The tailings line will loop the pond and be equipped with multiple discharge points (manifolding) in order to deposit the tailings slurry below the liquid surface and direct it to the center of the excavated pond.

3. Airborne Particulates

Because the upper portion of the tailing impoundment will be used as an evaporation pond for the supernatant liquid portion, the tails will be completely submerged and not subject to drying and blowing. A responsible supervisor will inspect the impoundment area daily to ensure operations are being carried out as proposed.

4. Other Information

A more detailed description of the tailings system is presented in the Final Report of Design of Tailings Retention Basin, Sweetwater Uranium Project, Dames & Moore Job No. 9141-002-06, March 16, 1977, and in the supplemental report entitled, "Proposed Subsurface Tailing Disposal" dated June 1978.

4.2.2 Others

The active areas of the mine will be wetted down via water trucks or sprays to reduce fugitive dust. Reworked areas will be promptly seeded and windrowed until permanent seeding can be accomplished.

Haul roads and the ore stockpiles will be subject to treatment with water sprays or palliatives to control dust.

Ore will be trucked from the mine pits and temporarily stored in stockpiles. The fresh ore will be wet, with a

moisture content as high as 14 percent. Consequently, fugitive dust from the stockpiles is not expected to be significant. Additional wetting may be necessary and provided as needed.

The exterior plant areas will be subject to rigorous housekeeping with all accumulations of dirt, spillages, dust piles, and debris promptly removed. Water wash down and/or sprays will be used where applicable.

In addition to the measures noted above, a system of dust collectors will be provided in all areas where fugitive dust and/or fumes are generated.

4.3 CONTAMINATED EQUIPMENT

Contaminated equipment is any equipment that has removable radionuclides in excess of 1000 alpha disintegrations per minute per 100 square centimeters of surface area.

4.3.1 Decontamination

Any contaminated equipment such as pumps, fans, hammer mills, etc., will be decontaminated using an acidic solution prior to being removed and transported for repair or, if unsalvageable, prior to being disposed of in a designated area.

1. The equipment will be cleaned in the mill area using water and acid. The wash solutions will be kept in the mill circuit. The equipment will be kept wet to avoid generating any unnecessary dust.

2. Surveys and air samples will be taken as necessary for exposure control. The equipment will be re-surveyed to ensure that the radionuclides are reduced to a level consistent with the ALARA philosophy.

3. A reasonable effort to eliminate residual contamination will be made.

4.3.2 Disposal

1. Any unsalvageable equipment that is not contaminated will be disposed of in the sanitary landfill.

2. Any equipment or material that fails to meet this requirement will be disposed of in accordance with 10 CFR 20.301 and 20.304.

5.0 OPERATIONS

5.0 OPERATIONS

All operations connected with the project will be conducted in conformance with all applicable laws, rules and regulations of the various governmental agencies involved. In order to ensure compliance and further implement MINERALS' policy of providing a safe work environment with the lowest radiation exposures as reasonably achievable, the following programs will be initiated and maintained.

5.1 PROJECT ORGANIZATION

An organization chart of the personnel for the Sweetwater Project is presented in Figure 5.1-1.

5.1.1 Management Responsibility

1. General Manager: The General Manager of the Sweetwater Uranium Project will have overall responsibility for coordinating and directing the activities of all project personnel. The General Manager reports to the Corporate Manager of Operations.

2. Mill Superintendent: The Mill Superintendent will report to the General Manager and will be responsible for mill production, cost and quality control of mill operations, and for meeting production schedules and delivery dates. He will also be responsible for product control, mill safety and metallurgy. The Mill Superintendent will carry out his duties either by direct supervision or by delegation of authority to the Mill General Foreman, the Mill Foreman and Chief Metallurgist.

3. Safety and Environmental Administrator: The Safety and Environmental Administrator is responsible to the General Manager for the Environmental Protection, Radiation, and Industrial Safety programs for the project. He is responsible for all reports and records necessary to comply with regulations and requirements of the NRC, EPA, MSHA, and other government agencies that regulate these aspects of mining and milling. He will serve as management surveillance and as an advisor to the Maintenance, Mill and Mine Superintendents and direct project security programs.

The Safety and Environmental Administrator or his designate has the authority to cancel, postpone or modify any process, or operation which proves an immediate radiological

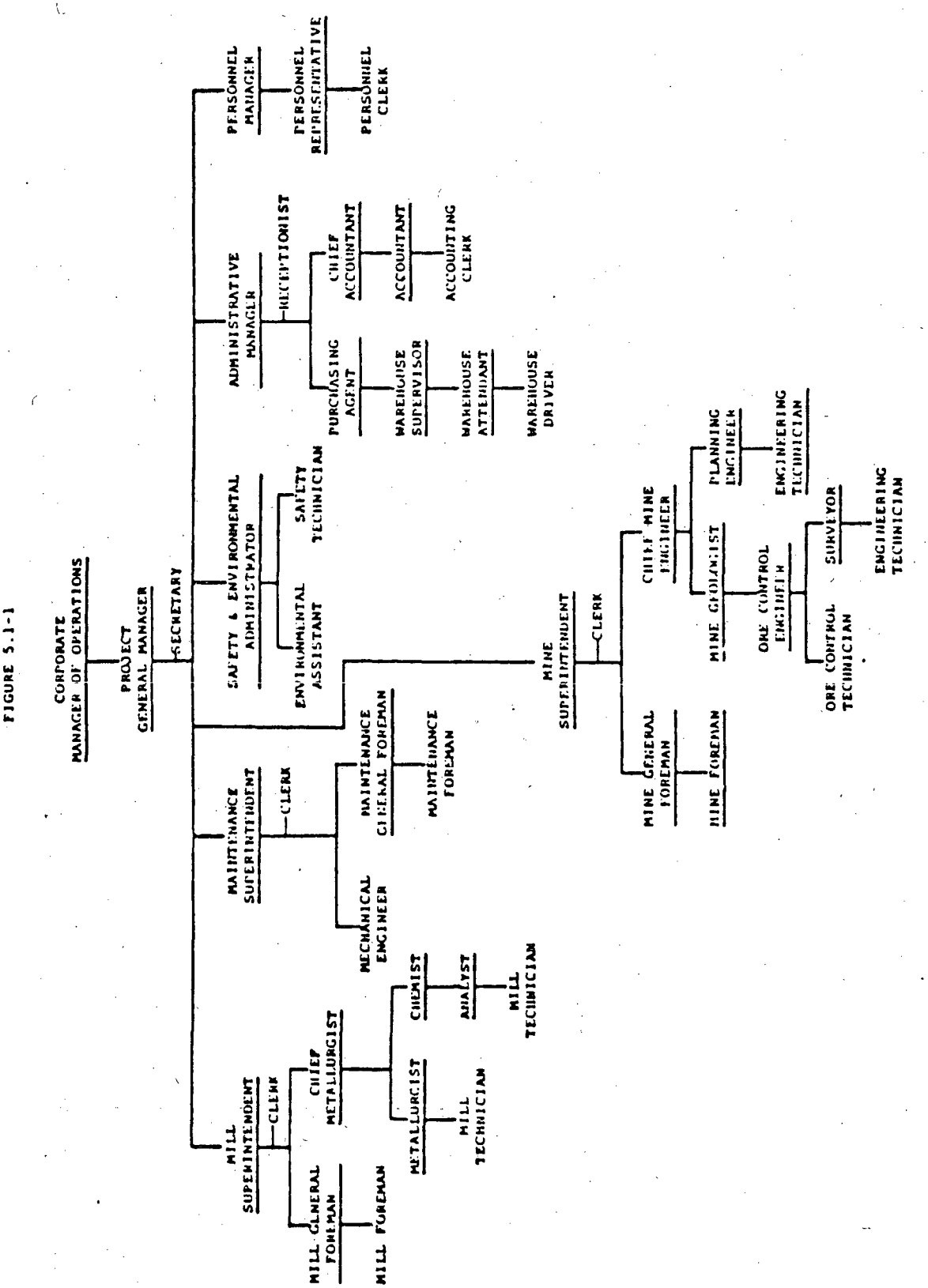

CORPORATE MANAGER OF OPERATIONS
PROJECT GENERAL MANAGER
SECRETARY
PERSONNEL MANAGER
PERSONNEL REPRESENTATIVE
PERSONNEL CLERK
ADMINISTRATIVE MANAGER
RECEPTIONIST
CHIEF ACCOUNTANT
ACCOUNTANT
ACCOUNTING CLERK
PURCHASING AGENT
WAREHOUSE SUPERVISOR
WAREHOUSE ATTENDANT
WAREHOUSE DRIVER
SAFETY & ENVIRONMENTAL ADMINISTRATOR
SAFETY TECHNICIAN
ENVIRONMENTAL ASSISTANT
MAINTENANCE SUPERINTENDENT
CLERK
MAINTENANCE GENERAL FOREMAN
MAINTENANCE FOREMAN
MECHANICAL ENGINEER
MILL SUPERINTENDENT
CLERK
CHIEF METALLURGIST
CHEMIST
ANALYST
MILL TECHNICIAN
METALLURGIST
MILL TECHNICIAN
MILL GENERAL FOREMAN
MILL FOREMAN
MINE SUPERINTENDENT
CLERK
CHIEF MINE ENGINEER
PLANNING ENGINEER
ENGINEERING TECHNICIAN
MINE GEOLOGIST
ORE CONTROL ENGINEER
SURVEYOR
ENGINEERING TECHNICIAN
ORE CONTROL TECHNICIAN
MINE GENERAL FOREMAN
MINE FOREMAN

FIGURE 5.1-1

hazard to employees. His decision is subject to revocation only by the General Manager or his designate after consultation.

5.1.2 Required Approvals

Any training requirements, process changes, unusual maintenance work or equipment modification, requires the approval of the Safety and Environmental Administrator prior to implementation. An operating manual covering each phase of the operation will be written and made available to each mill and maintenance employee. The Safety and Environmental Administrator will approve the health and safety aspects of the operating procedures. The manual will be updated as necessary to reflect any process or operational changes.

5.1.3 Safety Administrative Procedures

In addition to the routine safety inspections, the Safety and Environmental Administrator will make monthly inspections of work areas and practices with respect to radiation safety. All monitoring and exposure data will be reviewed monthly to ensure compliance. Any trends or deviations from the "as low as reasonably achievable" (ALARA) philosophy will be addressed. A formal report will be prepared and reviewed by the General Manager and all department heads. The report will address any upward trends, unusual discharges, problem areas and monitoring data.

A semi-annual audit will be conducted by the Corporate Medical Department staff. Operating procedures, exposure records, monthly inspection reports, training programs, safety meeting reports, and the ALARA philosophy will be reviewed. All phases will be evaluated to determine the total programs' effectiveness.

5.1.4 Corporate Review and Assistance

1. Inspections: Corporate management will inspect and review the project, its programs and records on at least an annual basis.

2. Approval: The Corporate Medical Department will inspect, review and approve the project health physics safety programs and records on at least an annual basis.

3. Guidance: Professional guidance and assistance from the Union Oil Company Medical Department, Union Research Center and Corporate Environmental Sciences Department will be provided as needed.

5.2 QUALIFICATIONS

The qualification of management and radiation protection personnel are enumerated below. The qualifications listed are the desired minimums; however, experience may be substituted for a formal degree.

5.2.1 General Manager

a. Advanced technical training or BS degree or higher, and/or
b. Extensive experience in mining or milling (5-10 years).
c. Basic knowledge of radiation and industrial safety.
d. Proven skills in supervisory and management functions.

5.2.2 Mill Superintendent

a. Advanced technical training or a BS degree from a recognized college or university, and/or
b. Experience in mining or process operations, preferably within the uranium industry (3-5 years).
c. Training in radiation protection, industrial safety, accident prevention and medical first aid.
d. Training in supervisory and management functions.

5.2.3 Safety and Environmental Administrator

a. Advanced technical training or BS degree or higher in a technical or scientific field, and/or
b. Training and experience in industrial safety (2-3 years).
c. Training and experience in medical first aid (2-3 years).
d. Specialized training in radiation protection, with at least bi-annual refresher course.
e. Training and experience in management.
f. Have a working knowledge of radiation detection instruments, biological effects of radiation and mathematics of radiation.

5.2.4 Environmental Assistant

a. An associate degree in science or equivalent work experience (1-2 years).
b. Able to effectively communicate with all levels of management.
c. Training and/or experience in radiation protection.

d. Demonstrated concern for the safety of personnel.
e. Demonstrated ability to perform assigned duties promptly and accurately and ability to use good judgment in emergency situations.

5.3. TRAINING

MINERALS considers training an important part of any employee's work schedule. All new employees will receive a minimum initial training in Radiation Safety, Industrial Safety and Process Operations. Further specific and periodic refresher training courses will be given for areas of work responsibility. The Safety and Environmental Administrator will administer the safety and radiological training programs.

5.3.1 Employee Radiation Safety Training

Basic indoctrination in radiation protection will be given to all employees assigned to work in the mill area. The training will be given during the first month of employment. Indoctrination training will include a written examination. These individuals and their respective supervisors will sign a statement that the employee received radiation protection training, successfully completed testing of that training, and the date the training was received. The signed statement and the examination will be kept in the employee's personnel folder. Retraining, covering the basic indoctrination material, will be given to employees at least every 2 years. Retraining will be documented. The basic employee indoctrination training will include:

1. Principles of radiation protection

    a. Definition and explanation of radiation and radioactive contamination, including physical forms and sources within the mill.
    b. Biological effect of radiation.
    c. ALARA Philosophy.

2. Radiation Measurement

    a. Units of measurement.
    b. Detection methods and instruments.
    c. Applicable limits.

3. Methods of radiation control

   a. Distance, time and shielding principles.
   b. Radiation area work rules, including good housekeeping, proper handling of contaminated materials and external and internal contamination control.
   c. Protective clothing - proper use, (demonstrations) and experience wearing a respirator.

4. Radiation sources

   a. When and where to expect radiation and radioactive contamination.
   b. Potential hazards.

5. Limits and guides

   a. Allowable exposure based on 10 CFR 20 and internal control (administrative) guides.
   b. Guides for maintaining exposure ALARA.
   c. Required notification and posting.

6. Radiation control and job performance

   a. Consequences of rule violation.
   b. Exposure reduction through job planning.

7. Waste disposal

8. Decontamination methods

5.3.2 Supervisory Safety Training

Additional training will be given to supervisors so they will be able to provide specific job-related training and evaluate their subordinates' performance. Supervisory training will include:

1. Radiation levels expected, normal and abnormal values.

2. Applicable standards and plant control limits, ALARA philosophy implementation.

3. Importance of training workers in radiation protection.

4. Planning and procedure review.

5. Methods for controlling contamination.

   a. Protective clothing and respiratory equipment.
   b. Radiation control and posting requirements.
   c. Personnel monitoring.
   d. Work practices and housekeeping.

6. Methods for controlling radiation dose.

   a. Personnel dosimetry.
   b. Time, distance and shielding.

7. Personnel and area decontamination methods.

8. Control and use of sources - calibration source, density, gauges, x-ray sources, etc.

Supervisor training will be documented in the same manner as indoctrination training, with retraining required every 2 years.

Mill employees will receive on-the-job training from supervisors. Maintenance employee's job performance with respect to radiation protection will be appraised annually by his supervisor to determine if retraining is necessary. The supervisor is responsible for continual evaluation and on-the-job training as necessary to ensure the employee's exposure is maintained "as low as reasonably achievable".

5.3.3 Environmental Assistant/Technician Training

Technician(s) performing radiation protection duties will receive additional training beyond the normal indoctrination training. Training will consist of lectures and/or on-the-job training. Documentation will include written examinations kept in the employee's personnel folder. Training will include:

1. Introduction to nuclear physics

   a. Atomic structure
   b. Radiation theory
   c. Interaction of radiation with matter
   d. Radiation measurement units

2. Biological effects of radiation

3. Radiation measurement

   a. Detector types and operation
   b. Personnel monitoring methods
   c. Survey techniques and methods
   d. Quantitative and qualitative measurements

4. Control of radiation sources

   a. Source geometry and shielding, distance and time methods
   b. Contamination control
   c. Protective clothing and respiratory protection
   d. First-aid relative to radiation protection

5. ALARA philosophy

6. Audit techniques with respect to conformance with radiation practices and procedures by plant employees.

7. Decontamination

   a. Contamination limits
   b. Preparation prior to work to minimize decontamination
   c. Decontamination methods for personnel, tools and areas

8. Regulations

   a. 10 CFR 19
   b. 10 CFR 20
   c. 10 CFR 21
   d. 10 CFR 49, radioactive shipments
   e. 10 CFR 50, Appendix I
   f. Regulatory Guides
   g. Internal (administrative control) guides
   h. License conditions

Technician on-the-job training and demonstration will be conducted by the Safety and Environmental Administrator, and other qualified persons. Oral and demonstration tests will be given to evaluate the technician's job performance. Documentation of training will be placed in the employee's personnel file.

5.3.4 Industrial Training

A safety technician will participate in new employee orientation to assure that new employees are instructed in safety rules and work procedures. All employees will be given a tour of the entire complex by a safety technician and advised of potential hazardous or dangerous areas. A safety awareness program will be administered continuously throughout the facility.

Employees who will come into contact with chemicals and solvents will be kept abreast of new chemicals as they are introduced and advised of any known hazards and of safety precautions necessary for safe handling.

Employees who are to work on any unfamiliar machinery will be instructed and trained as to its safe operation.

The Company will provide first aid equipment and facilities and will train persons at selected locations to become qualified in first aid methods.

5.3.5 Process Operations Training

All employees will be given thorough job training before they begin work in their assigned classification, to include but not limited to analytical and subjective training in all phases of their particular job assignment, and:

1. In the case of mill and maintenance personnel, will include training in the use and handling of all hazardous materials they may come in contact with during the course of operation including machinery necessary to be operated or maintained as part of their job.

2. In the case of mine and maintenance personnel, a continuous training program will be administered to ascertain proper procedures are followed in all phases of this operation to ensure safe practices and procedures are followed during both the operation and maintenance of equipment.

5.4 SECURITY

Security personnel will be on the property at all times. The mill, heap-leach pads, and tailings impoundment will be fenced and posted with "RESTRICTED AREA" signs in accordance

with 10 CFR 20.203. Parking facilities for employee and visitor vehicles will be outside this fenced area. A gate adjacent to the office will provide access for personnel reporting on and off shifts.

The mill will operate 24 hours per day, 365 days per year and all personnel will be instructed to report immediately any unauthorized persons observed on the premises to their supervisors.

All visitors will be required to register at the office and will not be permitted inside the plant area without proper authorization from appropriate supervisory personnel. Each visitor will be escorted while within the secured area.

Contractors having work assignments, such as equipment repair personnel, will be given security, safety and radiation protection orientation and subsequently allowed to perform their duties without escort.

5.5 RADIATION SAFETY

In order to comply with limits established in 10 CFR 20 and to keep exposures as low as reasonably achievable, MINERALS has established an employee radiation monitoring and protection program described in this Section 5.5.

5.5.1 Occupational Exposure, External

External exposure to ionizing radiation will be determined from known dose rates and exposure times or from dosimeter results.

1. Personnel Monitors: All mill and maintenance employees will be issued thermoluminescence dosimeters (TLD'S) or film badges and will wear them while working in the mill complex. The TLD'S or film badges will be exchanged on a monthly basis and will be furnished and analyzed by a reliable laboratory such as Eberline Personnel Dosimetry Section, P. O. Box 2108, Santa Fe, New Mexico. In addition, stationary badges or dosimeters will be placed in selected locations and read quarterly. Locations will be determined under actual operating conditions.

2. Exposure Control Limits-Action Levels: If an employee receives a dose in excess of 25 percent of the limits

specified in the table in paragraph (a) of 10 CFR 20.101 in any calendar quarter, the following action will be implemented:

a. The laboratory will be contacted to check on any possible analytical or calculation error(s). If no mistakes are found --

b. The Safety and Environmental Department will initiate an investigation to determine where and how the exposure(s) occurred. If there is an indication that a work area has unusual external radiation, a survey will be made of the area to determine the cause.

c. If a source of unusual external radiation is noted, appropriate action will be taken to lower the level of radiation as far below the limits specified in 10 CFR 20 as is reasonably achievable and to ensure that no unnecessary exposure occurs in the future.

3. Exposure Records: All exposure records will be kept in accordance with the regulations set forth in 10 CFR 20.102. All exposure investigations will be documented on form Exp-1 or its equivalent. An example of form Exp-1 is found in Appendix A.

4. Employee Age Limits: No individual within a restricted area who is under 18 years of age will be allowed to receive in any calendar quarter a dose in excess of 10 percent of the limits specified in paragraph (a) 10 CFR 20.101.

5. Measurement Precision:

Exposure, MR	5	10	50	300	3,000	30,000
Standard deviation	20%	10%	4%	4%	4%	4%

6. Quality Assurance Program: Eberline has developed a quality assurance program that meets the requirements of the American National Standards Institute (ANSI-N45.2), the Nuclear Regulatory Commission (10 CFR 50, Appendix B), and other agencies of the

U.S. government (MIL-Q-9859). Additional assurance is gained through audits conducted internally. Laboratories used will meet or exceed these requirements.

5.5.2 External Radiation Control (Beta Gamma Surveys)

1. Surveys: Direct Beta-Gamma radiation surveys will be performed quarterly at locations established. After mill operations commences, these locations will be evaluated for effectiveness and changed or added to as necessary. Special emphasis will be given to potential high radiation areas such as around sealed sources, the x-ray unit, or in the concentrate areas. Additional surveys will be conducted whenever an area is suspect and during non-routine maintenance or spills.

2. Instruments: A list of instrumentation is found in Section 3.3.6. The survey instruments will be checked with a standard prior to each survey. The instruments will be sent to a reputable vendor for calibration semi-annually.

   Additional equipment to be utilized in external radiation control monitoring will include:

   a. Thermoluminescence dosimeters or film badges.

   b. Geiger-Mueller counter or scintillometer with sensitivities of 0-10 MR/Hr with multiples up to 100X. This equipment will be calibrated in accordance with manufacturer specifications, or quarterly.

3. Radiation Control Limits - Action Levels: If an area has radiation in excess of 100 millirems/hr, the following action will be taken:

   a. A sign or signs bearing the radiation symbol and the words: "CAUTION HIGH RADIATION AREA" will be conspicuously posted.

   b. Each entrance or access point will be:

      1. Equipped with a control device which shall cause the level of radiation to be reduced

below that at which an individual might receive a dose of 100 millirems in one hour upon entry into the area; or

2. Equipped with a control device which shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering the high radiation area and a supervisor are made aware of the entry; or

3. Secured except during periods when access to the area is required with positive control over each individual entry.

5.5.3 Occupational Exposure Internal

Exposure to internal radiation will be determined from known exposure times and concentrations of airborne radionuclides.

1. Time-Exposure Records

A time study of all mill and maintenance employees will be conducted to determine the amount of time spent in each area. This information, along with the area airborne concentration, will be used to calculate exposure. The proposed sampling methods and schedule is outlined in Appendix C. Time cards, work logs, process reports and maintenance work orders will be used to verify the employee work locations.

A computer program or equivalent method will be used to determine weekly and quarterly exposure. The hours worked and airborne concentrations will be used to determine exposure. Any abnormal exposures will be included in the exposure calculation and records.

2. Air sampling

On a periodic basis, portable sampling pumps will be attached to employees during the shift in order to determine time-weighted averages. High volume pumps will also be used to sample work locations. Portable air samples will be conducted on:

a. Representative employees of the yellowcake area.

b. Employees during maintenance of yellowcake equipment or special air samples taken during work period.

c. Additional representative employees in selected work locations in the process area where airborne uranium dust is suspected.

Fixed location sampling will be performed in work areas such as yellowcake and selected process areas.

Filters will be analyzed by a reliable laboratory for total uranium. Semi-annually, filters samples collected in representative areas will also be analyzed for Ra-226 and Th-230.

Radon daughter monitoring will be performed monthly in selected process areas. Sampling and analysis will be performed with a standard procedure such as the Kusnetz method.

3. Extraordinary Procedures

Permanent time records will be monitored during a non-routine maintenance or spill in accordance with the procedures outlined in this Section.

4. Exposure Control Limits - Action Levels

If an employee reaches an action level of 25 percent of MPC, the Safety and Environmental Administrator will institute an investigation of their work record and exposure history to identify any problem areas. If any problem areas are noted, they will be studied and necessary corrective measures taken to ensure that the exposures are as low as reasonably achievable.

5.5.4 Bio-Assay

1. Routine Testing

A urine specimen will be routinely collected from all regular yellowcake workers, all personnel directly

involved in maintenance tasks in which yellowcake dust is produced and all workers who exceed 25% MPC for airborne uranium. The samples will be collected every two weeks. All other mill employees and other mill maintenance employees will be routinely sampled once per month.

An in vivo lung count will be performed annually on all regular yellowcake workers, all personnel directly involved in maintenance tasks in which yellowcake dust is produced and all workers who exceed 25% of MPC for airborne uranium.

2. Special Tests

Any special urinalysis or lung count will be scheduled by the Safety and Environmental Administrator.

3. Exposure Control - Action Levels

A. Urine

If 15 to 30 µg/l of uranium is found in the urine, the following actions will be taken:

1. Re-analyze the sample.
2. Talk with the employee about eating habits and personal hygiene.
3. Review exposure history for possible causes.

If over 30 µg/l of uranium is detected in the urine, the following actions will be taken:

1. Repeat the requirements stated above.
2. Obtain and analyze new sample.

If levels are still above 30 µg/l --

3. Determine why air samples were not representative and did not warn of excessive concentrations of airborne uranium. Make corrections.
4. Identify the cause of airborne uranium and initiate additional control measures.

5. Determine whether other workers could have been exposed and perform bioassay measurements for them.

6. Consider work assignment limitations to assure the worker does not exceed a urinary uranium concentration of 30 µg/l.

B. In Vivo

If 9 to 16 nCi of uranium is detected in the lungs, the following actions will be taken:

1. Confirm result (repeat measurement).

2. Determine why air samples were not representative and did not warn of excessive airborne uranium. Make corrections.

3. Identify the cause of airborne uranium and initiate additional control measurements.

4. Determine whether other workers could have been exposed and perform bioassay measurements for them.

5. Consider work assignment limitations that will permit the lung burden to be reduced through natural elimination to a level less than 16 nCi.

If over 16 nCi of uranium is detected in the lungs, the following actions will be taken:

1. Take the actions listed above for 9 to 16 nCi.

2. Establish work restrictions for affected workers.

3. Perform individual case studies (bioassays) for affected workers.

4. Management Review

All bioassay results will be evaluated by the Safety and Environmental Administrator and Corporate Medical Department. Results will be sent to the General Manager

and Department Superintendent and, upon request, given to employee. MINERALS will evaluate an employee's radiation exposure history by reviewing records of previous exposure.

5.5.5 Respiratory Protection

The respiratory protection program is based on Regulatory Guide 8.15 "Acceptable Procedures for Respiratory Protection" and NUREG-0041 "Manual of Respiratory Protection Against Airborne Radioactive Materials". The program will be directed by the Safety and Environmental Administrator with professional guidance and assistance from the Union Oil Company Medical Department, Union Research Center and Corporate Environmental Sciences Department.

1. Routine and Non-Routine Operations

   Respirators are required on routine operations at the discretion of the Safety & Environmental Administrator or Mill Superintendent.

   Any employee who enters the yellowcake areas (drying and packaging) will be required to wear respiratory protection.

   Non-Routine Operations will be administrated as outlined in Appendix D.

2. Training and Restrictions

   Pre-employment physical examinations will be evaluated to determine if the employee has any medical limitations that preclude assigning the individual to this type of work.

   All supervisors and employees who work in the yellowcake areas and those involved in upset or yellowcake area maintenance will receive the following instructions:

   a. All mill and maintenance employees will be trained in the proper use and be shown how to wear the respirator. The shift supervisor, Safety and Environmental Administrator, or his delegate, will ensure that all protective equipment is worn properly.

b. Each employee will be advised that they may leave the area for relief from respiratory use in case of equipment malfunction, physical or psychological discomfort, or any other condition that might cause reduction in the protection afforded the wearer.

c. Employees working in the yellowcake concentrate area shall be instructed not to smoke, eat, and/or remove their respiratory protective equipment while working in a situation that requires the respiratory protective equipment. The work will be monitored to ensure that all necessary safeguards are taken.

d. The following topics will also be discussed:

1. Type of airborne contaminants, their physical and chemical properties and toxicity.

2. Type, operation and limitation of respiratory equipment.

3. Need for respiratory equipment.

4. Ensuring that respiratory equipment is working properly and it has been properly fitted.

5. Proper use and maintenance of respiratory equipment.

6. Action to be taken in the event of a malfunction on defective equipment.

e. Each employee shall be fitted with different types of respiratory equipment until one is found suitable. Those employees who cannot wear a particular make of respiratory may not use that device for any work. Correct facial fit will be verified with the irritant smoke test or an equivalent method.

f. Employees working in areas which require respiratory protection will be clean-shaven (no interfering facial hair) so proper fit can be achieved.

g. Each employee working in the yellowcake concentrate area under upset or non-routine situations shall shower and change into clean coveralls/clothes after each work period and/or prior to eating.

3. Cleaning, Storage, Inspection

Respirators shall be cleaned and disinfected as often as necessary to ensure that proper protection is provided to the user.

After cleaning and after each use, the respirator is inspected to be sure it is functioning properly. Worn or deteriorated parts are replaced as soon as detected, using only approved parts for that particular device. The cleaned respirator will be stored in plastic bags to avoid contamination.

Instructions on the proper care and use of respirators will be posted in the yellowcake area and/or other potential use areas.

A partial list of approved respirators are:

MSA Custom Comfo II
Welsh 7580
Welsh 7580M
MSA Ultravine
MSA Ultravine (Air powered)

4. Exposure Records

In computing employee exposure, credit for respirators will be taken as outlined in Appendix D.

5.5.6 Decontamination Procedures

1. Employee cleanup

All employees who work in the yellowcake area (dryer and package room) and those involved in upset or yellowcake maintenance activities will be issued coveralls and will shower and change clothes before leaving the property.

2. Contaminated clothing

All contaminated clothing will be laundered on the property. No contaminated clothing or personnel will be allowed to leave the property.

3. Contaminant Surveys

a. Employees receiving direct body contamination will be surveyed for contaminants after showering. They will not be allowed to leave the restricted area without authorization of the Safety and Environmental Department (see Appendix 5-B).

b. Quarterly surveys of selected employees will be made to ensure other mill employees are not contaminated. This will be accomplished using a portable alpha survey instrument as the employees are leaving at the end of the shift. This instrument will be available always.

4. Changeroom Facilities

All mill personnel will be provided with change facilities so that they may leave their work clothes at the mill. The change facilities will include showers and will be designed to encourage their use, thus enabling supervisors to control decontamination of personnel. A washer and dryer will be provided and all coveralls contaminated with yellowcake will be washed on the property.

5. Responsibility

a. Each employee is responsible for safety and quality in his work and for adherence to safety and radiation protection rules as a condition of employment.

b. The shift supervisor or Safety and Environmental Department will ensure that the above rules are enforced.

APPENDIX A

FORM # EXP-1

DATE: _____

EMPLOYEE NAME: _____

EXPOSURE _____ PERIOD OF EXPOSURE _____

JOB CLASSIFICATION/TYPE _____

ACTION TAKEN _____

_____

_____

_____

SIGNED: _____

Safety & Environmental Department

APPENDIX B

PERSONNEL DECONTAMINATION PROCEDURE

NOTE: Decontamination work will be done in the showers and sinks provided

a. Wash contaminated portion of body thoroughly and completely with mild soap for two or three minutes. Pay particular attention to finger nails and between fingers, similarly pay attention to all body folds, hair and ears.

b. Rinse completely,dry and monitor. Repeat three times, if necessary.

c. If contamination remains after three washings, wash as before but use a soft bristle brush (surgeon's brush) provided. Wash for five minutes and rinse. Take care not to abrade the skin. Do not use brush on face.

d. If contamination still exists, apply 3% citric acid solution with cotton swabs, then soap and water. Wipe always in a direction away from the eyes, ears, nose, mouth, and other body openings.

e. The following are the permissible limits for remaining fixed contamination on body surfaces.

Beta-Gamma = 0.05 m Rem/hr at 1 inch (G-M probe)

Alpha = 50 d/m/100 cm^2

NOTE: If contamination cannot be removed to these levels, or if initial contamination is extensive or received as a result of an accident, contact the Safety & Environmental Department.

f. Wound decontamination must receive immediate attention. The wound should be allowed to bleed freely for a brief period to remove contamination from the wound itself and the area around the wound should be wiped with sterile swabs. Wipe away from wound, discard swab, and use another, etc. Radiation protection personnel will monitor the wound.

NOTE: In case of severe injury, decontamination shall NOT interfere with or take precedence over proper medical or surgical care. First aid treatment shall be given priority and safety and environmental personnel shall accompany injured person to the doctor or hospital, taking precautions to prevent spread of contamination.

APPENDIX C

MONITORING PROGRAMS

The following Tables and Figures show monitoring type, frequency and location for all in-plant and environmental monitoring. The number of samples, locations of monitoring points, type of sampling, etc., have been derived based on experience and metallurgical activity of the area. All areas where radiation, dust or other hazards may exist have been covered in the in-plant monitoring program. If any problem areas develop, the monitoring program will be intensified in those areas and modifications made as necessary to adhere to the ALARA philosophy.

Environmental monitoring locations, types and sample frequencies have been designed so as to determine incremental changes in ambient background concentrations. Meteorological conditions, groundwater movement, site boundaries, etc., were factors considered in establishing the sites. Further, where possible, sites were located so as to coincide with sites utilized for baseline monitoring. Stack monitoring programs were designed to comply with State and Federal regulations and where potential radionuclide emissions may occur.

The following are some of the specific areas given consideration in determining the monitoring program:

1. Areas which may produce dust, vapors, mists, gases or radiation.
2. Available water sources.
3. Area of most likely migration.
4. Average meteorological conditions.
5. Prevailing wind direction.
6. Site boundaries.
7. Baseline data.
8. Nearest residence.
9. Areas of maximum radioactivity.
10. High traffic areas.

TABLE C-1

IN PLANT AMBIENT AIR MONITORING PROGRAM

SAMPLE LOCATION	SAMPLE DESCRIPTION	FREQUENCY	SAMPLE TYPE	TOTAL-U	Rn-222 (B)
Ore Pad	Traversing Pad	Monthly	(1)	X	X
Sag Mill	Traversing Area Around Sag Mill	Monthly	(1)	X	X
Leach Area	Traversing Area Around Leach Tanks	Monthly	(1)	X	X
Leach Operator	Personnel Sampler	Quarterly	(2)	X	
C.C.D.	Traversing Upper Level	Monthly	(1)	X	X
C.C.D. Operator	Personnel Sampler	Quarterly	(2)	X	
Solvent Extraction	Traversing SX Area	Monthly	(1)	X	X
Solvent Extraction	Personnel Sample	Quarterly	(2)	X	

TABLE C-1 (cont'd)

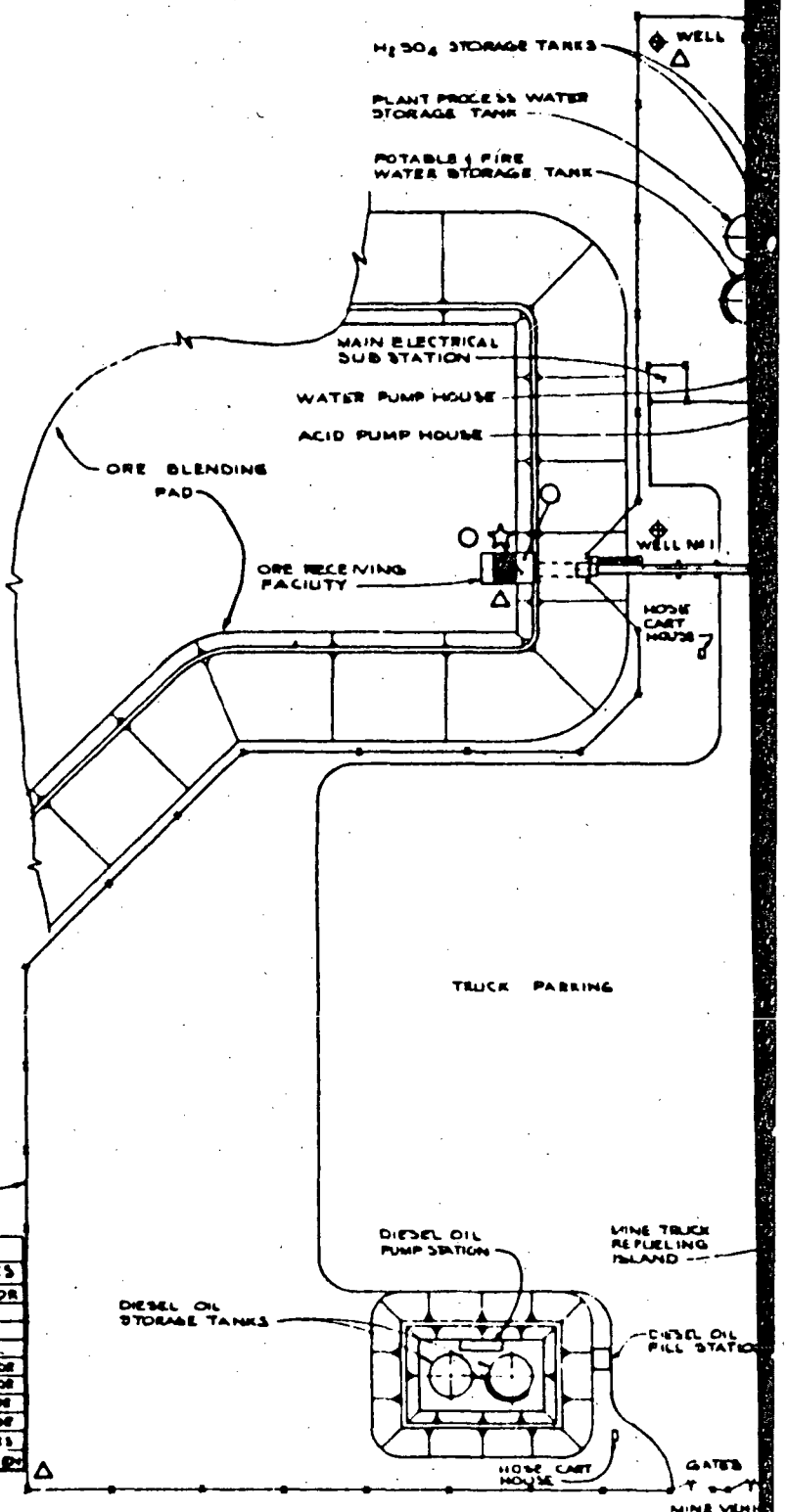
IN PLANT AMBIENT AIR MONITORING PROGRAM

SAMPLE LOCATION (A)	SAMPLE DESCRIPTION	FREQUENCY	SAMPLE TYPE	TOTAL-U	Rn-222 (B)
Precipitation	Traversing Precipitation Area	Monthly	(1)	X	X
Yellowcake Dryer	Traversing Upper Level	Monthly	(1)	X	X
Yellowcake Dryer	Traversing Middle Level	Monthly	(1)	X	X
Yellowcake Packaging	Traversing Lower Level	Monthly	(1)	X	X
Yellowcake Operator	Personnel Sample	Quarterly	(2)	X	
Maintenance Operator	Personnel Sample	Quarterly	(2)	X	
Laboratory	Traversing Laboratory	Monthly	(1)	X	X
Lube & Tire Shop	Traversing Area	Quarterly	(1)	X	X
Administration Building	Traversing Area	Quarterly (C)	(1)	X	X
Garage & Shop	Traversing Area	Quarterly (C)	(1)	X	X
Warehouse	Traversing Area	Quarterly (C)	(1)	X	X
Change Room	Traversing Area	Quarterly (C)	(1)	X	X

SAMPLE TYPES

(1) HIGH VOLUME (1-5 minutes)
(2) PERSONNEL BREATHING ZONE SAMPLES (2-8 hours)

(A) See Figure C-1 for locations.
(B) Radon will be sampled using the standard Kusnetz method. Ref. U.S. Bureau of Mines.
(C) Annually after 1st year's quarterly data.



VENT TALLEY

LOCATION	CFM	TEMP °F	VENT DIA.	REMARKS
ORE RECEIVING AREA	8000	AMBIENT	18"	DUST COLLECTOR
BAG MILL PRIMARY				
LEACH TANK	9000	60°-70°	18	FUME COLLECTOR
V.C. PRECIPITATION & THICKENING	11000	60°-100°	8	FUME COLLECTOR
V.C. DRYER	600	160°	6	DUST COLLECTOR
V.C. PACKING	800	60°-100°	6	DUST COLLECTOR
LABORATORY HOODS	2000	60°-70°		EXHAUSTERS
	TOTAL			INTEGRITY

NO	DATE	REVISION	BY	APP	APP.	REFERENCE DRAWINGS	NUMBER	NOTES

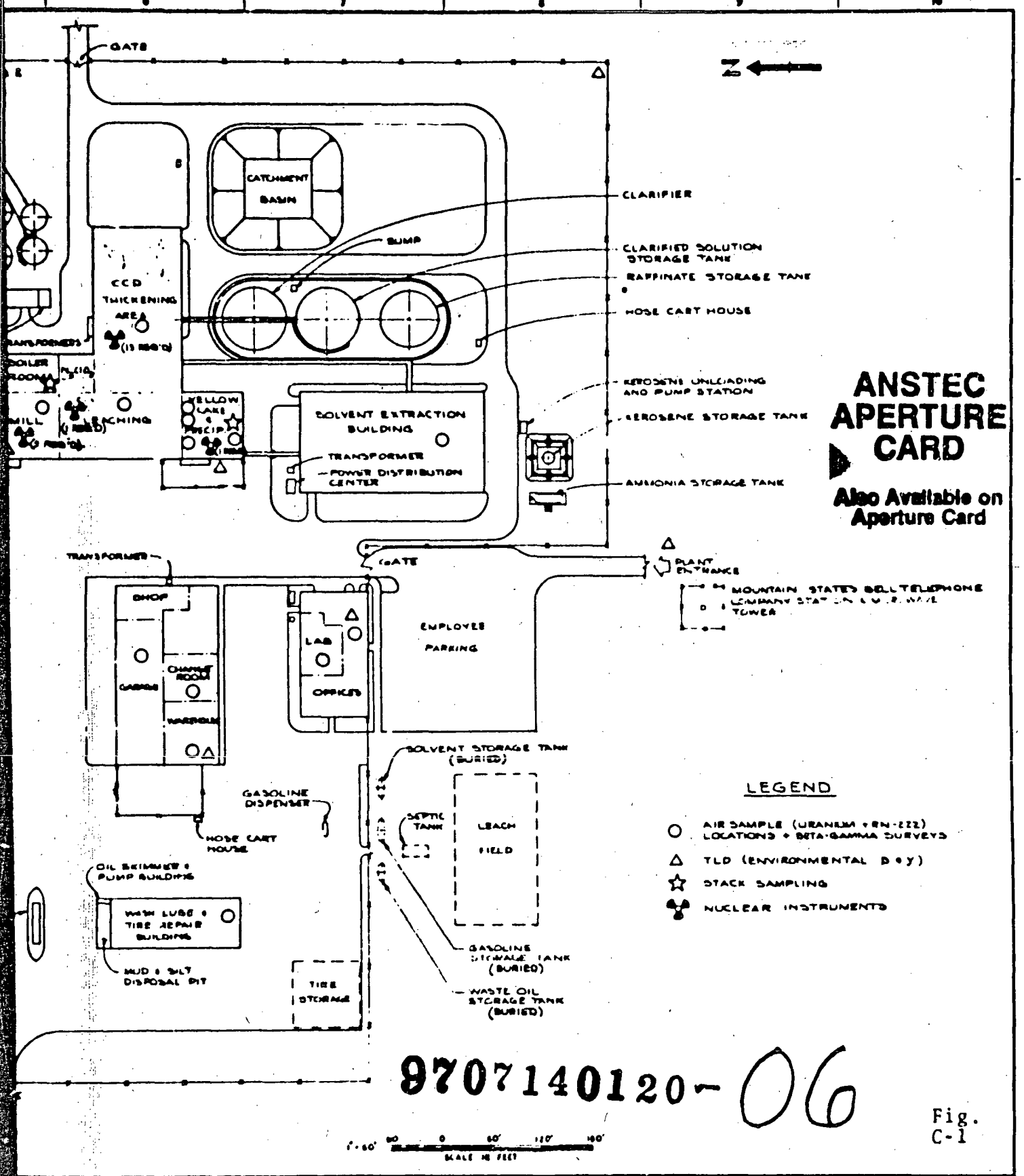


Fig. C-1

KAISER ENGINEERS

ENVIRONMENTAL MONITORING

Job No. 76160 | Drawing No. 10-57-C | Revision B-0

TABLE C-2

OTHER INPLANT MONITORING

SAMPLE LOCATION	ENVIRONMENTAL PARAMETER	SAMPLE FREQUENCY	MEASUREMENT
Mill & Maintenance Employees	Beta Gamma (TLD)	Monthly	Beta Gamma
20 Air Sample Locations (See Table C-1)	Beta Gamma (Survey Meter)	Semi-annually after 1st year's quarterly data	Beta Gamma
Mill & Maintenance Yellowcake Employees and all Employees who exceed 25% MPC for airborne U	Urinalysis	Every two weeks	Uranium
	In-Vivo	Annually	Uranium
All other Mill & Mill Maintenance Employees	Urinalysis	Monthly	Uranium
Ore area composite Leach and CCD composite Yellowcake area composite	Air	Semi-annually	Uranium Ra-226 Th-230

TABLE C-3

ENVIRONMENTAL MONITORING PROGRAM

ENVIRONMENTAL PARAMETER	SAMPLE LOCATION	SAMPLE FREQUENCY	MEASUREMENT
Surface water	5 Locations (Fig. C-2)	Semi-annually	Ra-226, Th-230 U, Chemical, * Water level
Tailings Impoundment (Water)	Location ig. C-3)	Yearly	Ra-226, Th-230 U, Chemical, * Water level
Unusual water discharge (Spill)		As necessary	NPDES parameters, Th-230
Groundwater	4-6 Locations (Fig. C-3)	Semi-annually following 1st year's quarterly data	Ra-226, U, pH
		Annually	Th-230, Chemical*
Groundwater (Tailings Impoundment)	4-6 Locations (Fig. C-3)	Quarterly following 1st year's monthly data	Ra-226, U, pH
		Annually following 1st year's quarterly date	Th-230 Chemical*
Mine water	Discharge point	In accordance w/ NPDES Permit	In accordance w/ NPDES Permit
Air	6 Locations (Fig. C-2)	(3) 24-hr/6 days Quarterly composite	Particulates, Ra-226, U, Th-230
		(2) Quarterly	Particulates, Ra-226, Th-230 U
		(1) Continuous	Particulates, U, Ra-226, Th-230
Air	4 Locations (Fig. C-2)	48-hour integrated sample. Semi-monthly	Rn-222

Table C-3. Environmental Monitoring Program (cont.)

ENVIRONMENTAL PARAMETER	SAMPLE LOCATION	SAMPLE FREQUENCY	MEASUREMENT
Meteorological (Met data reduced to atmospheric stability)	(Fig. C-3)	Continuous	Wind Speed, Wind direction, Temperature, Precipitation
Beta Gamma	10 Air Monitor Locations (Fig. C-3)	Continuous (Read quarterly)	Beta Gamma
Soils	7 Locations (Fig. C-2)	Annually	U, Ra-226, Th-230, Pb-210
Sediment	3 Locations	"	"
Vegetation	7 Soil Sample Locations (Fig. C-2)	Annually	U, Ra-226, Th-230
Mammals	Composite Restricted Area, Composite Unrestricted Area	Annually	U, Ra-226, Th-230

*Parameters included in Chemical Analysis are listed below.

pH	Silica	Nitrate (as N)	Mercury
Temperature	Zinc	Arsenic	Selenium
Total Dissolved Solids	Manganese	Boron	Potassium
Total Suspended Solids	Nickel	Phosphorus	Copper
Alkalinity	Chromium	Fluoride	Cadmium
Hardness	Chloride	Aluminum	Vanadium
Sulfate	Iron (Dissolved)	Molybdenum	Sodium
Iron (Total)	Calcium	Redox Potential	Dissolved Oxygen
Lead	COD		

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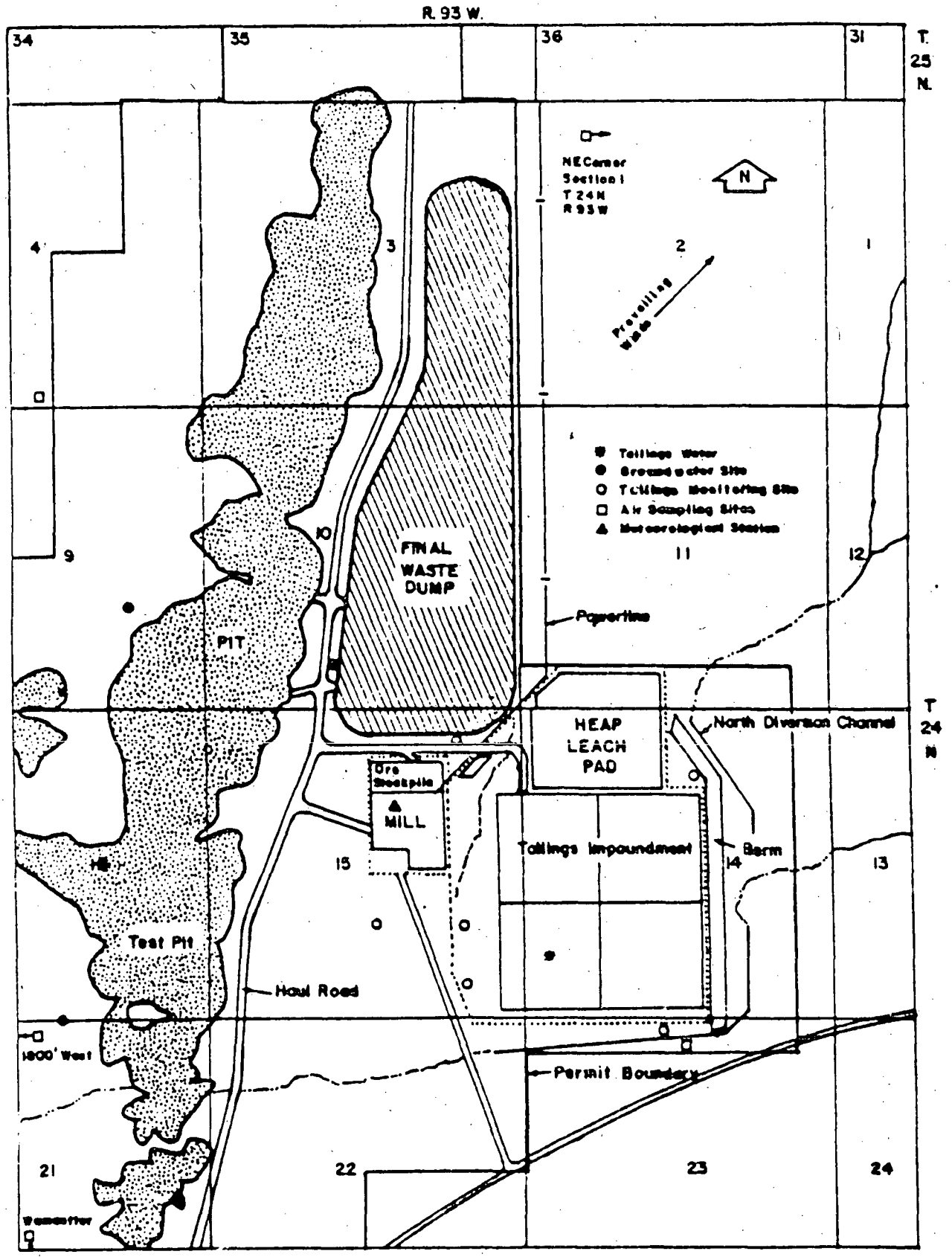

Figure C-3 LOCAL MONITOR SITES

TABLE C-4

STACK MONITORING PROGRAM

STACK DESCRIPTION	FREQUENCY	PARAMETERS							
		PARTICULATES	U	Ra-226	Rn-222	Th-230	H_2SO_4 MIST	NH_3	HYDROCARBONS (TOTAL)
1. YELLOWCAKE PRECIPITATOR, CENTRIFUGE, DRYER, PACKAGING ROOM	1	X	X	X	X	X		X	
2. ORE RECEIVING	1	X	X	X	X	X			
3. LEACH TANK	1	X	X	X	X	X	X		
4. SOLVENT EXTRACTION	2							X	X

FREQUENCIES

1. Periodically after first year's semi-annual sampling
2. Bi-annually

TABLE C-5

ANALYTICAL SENSITIVITY

OF

RADIOLOGICAL PARAMETERS

MEDIUM	PARAMETER	SENSITIVITY	APPROXIMATE SAMPLE SIZE	
			Inplant	Environmental
Water	Ra-226	.05 p Ci/l	4 liters	4 liters
	Th-230	.01 p Ci/l	4 liters	4 liters
	U	5 µg/l	4 liters	4 liters
Air	Ra-226	9×10^{-5} p Ci/M^3	300 m^3	300 m^3
	Th-230	5×10^{-5} p Ci/M^3	300 m^3	300 m^3
	U	6×10^{-5} p Ci/M^3	> 1 m^3	300 m^3
	Rn-222	.02 p Ci/l*	10 liters	50 liters
Soils	Ra-226	.05 p Ci/g (dry)	--	2000 g
Vegetation and Mammals**	Th-230	.01 p Ci/g (dry)	--	2000 g
	U	.05 µg/g (dry)	--	2000 g

* Kusnetz Method .5 p Ci/l

** Mammals sample size = 200 g

SAMPLING METHODS

WATER - The samples will be taken at a site which is representative of the water being sampled. Care will be taken to avoid sample contamination. The samples will be stored in a manner that insures that the characteristics to be analyzed are not altered. In some instances refrigeration will be necessary. Each sample will be labeled with the following information:

a. Designation or location
b. Date and time of collection
c. Sample type (grab etc.)

In addition to this information, a sample data sheet will be filled out. The sample data sheet will contain the following information:

a. Sample designation or location
b. Sample date and time of collection
c. Sampled by
d. Analysis required
e. Date sent to laboratory
f. Weather data (wind speed, direction, temp., etc.)
g. Comments

AIR - A high volume air samples will be used to collect airborne particulates on a filter paper at a high sampling rate (500 - 2200 liters per minute). The sampling time will be 2 or 3 minutes for in-plant samples for exposure analysis and 2 to 6 hours for environmental samples. The filter paper will be pre-weighed and then weighed again after sampling is complete. The particulate concentration will be calculated from the weight gain (after 24 to 48 hours in a desiccator) divided by the sample volume. The filter will be dissolved and analyzed using an approved method.

The low volume sampler will be a light weight, battery-operated unit that will be attached to an employee's clothing and operated for 4 to 8 hours. The filter head is attached to the employee's lapel or collar and closely approximates the breathing zone. The sampling rate will be 1-20 liters per minute. The filter will be dissolved and analyzed using an approved method. Good industrial hygiene methodology will be employed throughout the sampling period.

For environmental samples, the same type of sample data sheet that is used for water will be used.

Radon samples taken in the mill will be collected and analyzed using the standard Kusnetz method. This method is described in Volume 2,

Appendix 3, page 137 of the book "Controlling Employee Exposure to Alpha Radiation in Underground Uranium Mines" by Robert L. Rock. Environmental radon samples will be collected in a plastic or nylon bag with a pump using a sampling rate of 0.5 to 2 liters per minute. The sample duration will be approximately 48 hours. Radon will be analyzed using a scintillation cell. This method is described in "Standard Methods" 14th Edition, 1975.

SOIL - A composite soil sample will be collected on 10 foot centers from an area of approximately 900 square feet. The surface sample will be cleaned of roots and rocks, dried, pulverized, blended and analyzed using an accepted method.

VEGETATION - Vegetation samples will be collected in the same areas sampled for soil. The vegetation which is in abundance and the vegetation that plays an important role in the food chain will be sampled. A larger sampling area may be necessary to insure adequate sample size.

ANIMALS - Approximately 200 grams of small mammals will be collected within the restricted area and a similar amount in the unrestricted area. A number of small traps will be used. The mammals will be washed, frozen and stored until a sufficient number have been collected. They will then be dissolved and analyzed using an accepted method. Sample data sheets will be maintained for soil, vegetation and animal samples.

APPENDIX D

NON-ROUTINE MAINTENANCE OR SPILL

1. Management Direction

In the event of an upset or non-routine maintenance or operating condition involving radioactive material or process chemicals, the supervisor on duty will advise the General Manager, Safety and Environmental Department and the appropriate Department Superintendent before any work is started. The Safety and Environmental Department will then evaluate the conditions and issue the proper safety procedures and instructions and authorize the work. A non-routine operation is defined as an upset, spill or non-routine maintenance that involved radioactive material classes or exposure that are of short duration and adequate limitation of exposure by engineering controls is not practicable.

The Department Superintendent or his designate and the Safety and Environmental Department shall be responsible for the supervision of and verification that the work was completed in accordance with the safety procedures established.

2. Employee Restrictions

a. Yellowcake Areas: No employee shall be permitted to work in a yellowcake area during an upset or non-routine maintenance condition without permission of the Safety and Environmental Administrator or his delegate. Respiratory protection is required in the drying and packaging areas. The Safety and Environmental Administrator, or his delegate, will evaluate the condition(s) and ensure that proper procedures are followed in accordance with the operating guide for upset or non-routine maintenance conditions.

b. Employees involved in upset or yellowcake maintenance activities will be issued coveralls and will shower and change clothes

before leaving the property. (It should be noted that all employees working in the yellowcake area will be subject to these restrictions.)

c. All employees who work in the yellowcake area involved in upset or yellowcake area maintenance activities will be required to utilize respiratory protection equipment. Two types of respirators, air-purifying and air supplying, will be used. All respirators used will have approval under U.S. Bureau of Mines requirements or as recommended in ANSI Standard 286.1.

In addition, when circumstances warrant, each person will wear rubber suits complete with rubber boots and gloves, or an anti-contamination coverall and hood similar to Mine Safety Appliance Coverall (Catalog No. 6905064). Respiratory protection equipment will be required of all employees working in the yellowcake area, including routine operations.

3. Radiation Protection Assurance (Operating guide)

a. The Safety and Environmental Administrator or his delegate will take an air sampler equipped with a pre-weighed (to the nearest 0.01 milligram) filter (either membrane-type or TFA-type) and sample at least 20 cubic feet of air from the breathing zone where an individual will work. The loaded filter will be weighed immediately and the net weight of dust collected will be determined to the nearest 0.01 milligram by substracting the weight of the loaded filter. It will be assumed that all of the dust collected consists of uranium compounds containing the uranium equivalent of U_3O_8. The approximate concentration of uranium in the sampled air will then be calculated as follows:

$$\frac{\text{uCi U}}{\text{ml air}} = \frac{\text{mg dust collected}}{\text{ft}^3 \text{ air sampled}} \times \frac{0.848 \text{ mg U}}{\text{mg dust}} \times \frac{3.53 \times 10^{-5} \text{ft}^3}{\text{ml}} \times \frac{6.77 \times 10^{-4} \text{CiU}}{\text{mg U}}$$

$$\frac{\text{uCi U}}{\text{ml air}} = \frac{\text{mg dust collected}}{\text{ft}^3 \text{ air sampled}} \times 2.03 \times 10^{-8}$$

b. If the airborne uranium concentration calculated in (a) above is between 1.0×10^{-10} uCi/ml and 5.0×10^{-10} uCi/ml, the air purifying Respirator shall be worn by individuals while working within this airborne concentration range.

c. If the calculated airborne uranium concentration exceeds 5×10^{-10} uCi/ml, individuals shall use air supplying Respirators.

d. The work period for any individual in the high airborne concentration will not exceed four hours per shift. The allowable work period will be further reduced if required to prevent over-exposure of any individual.

e. The Safety and Environmental Department will monitor the work program to ensure that these safety procedures are followed.

f. Sampling of airborne particulates using a lapel type sampler complete with cyclone or high volume method, followed by chemical analysis of the collected dust will be used to determine actual rather than approximate airborne concentrations present during the work periods. Inhaled concentrations will be calculated from the actual airborne concentrations as follows:

1. For individuals wearing the air-purifying Respirator, Inhaled concentration = $\frac{\text{airborne concentration}}{100}$

2. For individuals wearing the air-supplying Respirator, Inhaled concentration = $\frac{\text{airborne concentration}}{2000}$

Inhaled concentrations will be used to compute actual individual exposures.

4. Documentation and Records

a. Documentation by Supervisors

An authorization and Yellowcake Maintenance Form for radiation work permitted will be completed by a mill and/or maintenance supervisor for each upset or maintenance job. These documents are permanent records. An example of a Yellowcake Maintenance Form is found on page 5-40.

b. Inhaled concentrations, as determined in 3 above, will be entered in the exposure records maintained for each individual.

YELLOWCAKE MAINTENANCE FORM

Date _____ Authorized by _____

Description of work: _____

_____

_____

Protective measures required: _____

_____

_____

Respirator required:

Air purifying _____

Air supplying _____

Employee	Exposure Time	Employee	Exposure Time

Sample #	Sample Time	Sample Results uCi/ml x 10^{-9}

_____ Supervisor

_____ Safety & Environmental Department

APPENDIX E

RADIATION PROTECTION PROGRAM

Introduction

1. The NRC periodically inspects operations for compliance with established safety standards.

2. A radiation protection officer has been appointed by MEC with overall responsibility for radiological safety.

3. All personnel who work with the sealed sources are trained in basic radiation protection and must be familiar with "Procedures and Regulations for Handling Radioactive Material".

4. All employees who regularly enter areas where sealed sources are used are issued T.L.D. badges to measure their exposure.

5. At all times, the method of operations is such that radiation exposures are maintained at a minimum, consistent with the operating philosophy of keeping all radiation exposures as low as practicable.

Nuclear Gauges

By Product Material	Chemical and/or Physical Form	Maximum amount of Radioactivity in license possession at any one time
A. Cesium 137	A. Sealed Source (Texas Nuclear Model No. SGH202 or equivalent)	A. 12 Sources 200mCi
B. Cesium 137	A. Sealed Source (Texas Nuclear Model No. CNH or equivalent)	B. 6 Sources 400mCi each
C. Cadmium 109	A. Sealed Source (Texas Nuclear Model No. 9200 or equivalent)	C. 3 Sources 3mCi

Exposure Limits

The lifetime occupational whole body dose shall not exceed 5 (N-18) rem when N is the age of the employee, for any employee whose accumulated occupational dose has been determined on Form NRC-4. The whole body dose during any calendar quarter shall not exceed 3 rem. Unnecessary exposure to ionizing radiation will be eliminated and necessary exposure will be reduced to the minimum (not to exceed the above limits) consistent with the required operations. If the previous exposure history of an individual has not been recorded on Form NRC-4, the dose limits specified in the following table shall not be exceeded.

REM PER CALENDAR QUARTER

1. Whole body; head and trunk; active blood forming organs; lens of eyes; or gonads ..... 1 - 1/4

2. Hands and forearms; feet and ankles ..... 18 - 3/4

3. Skin of whole body ..... 7 - 1/2

No individual who is less than 18 years of age shall be permitted to receive a dose in excess of 10% of the limits specified in the above table.

All female employees will be instructed concerning health protection problems associated with pre-natal radiation exposure as outlined in Regulatory Guide 8.13. Signed acknowledgments of the instruction and understanding from each female employee will be on file.

Emergency Notification

In case of radioactive incident such as personnel overdose, source accident, fire or theft, action shall be taken immediately, upon discovery, to notify the proper authorities. An appropriate officer of MINERALS, Los Angeles Office, will also be notified of all such incidents.

An investigation shall be made of the incident and a written report shall be prepared, where appropriate. A report shall be made to the Nuclear Regulatory Commission in accordance with Section 20.402 and 20.403 of 10 CFR 20 and any requirement of CFR 21.

Radiation Surveys

Semi-annual radiation surveys will be made in areas where sealed sources are used. In the event there is evidence of a contaminated area or unusual radiation area during interim periods, radiation surveys will be made on the advice of the Safety & Environmental Administrator. A record shall be maintained of the radiation surveys and results of the surveys. All sources will be wipe-tested after installation and once every three years thereafter.

Caution Signs

Each room or area where a major portion of the body could receive a dose in excess of 5 millirems in one hour or 100 millirems in five consecutive days shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words - CAUTION RADIATION AREA. Each room or area where a major portion of the body could receive a dose in excess of 100 millirems in one hour shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words - CAUTION HIGH RADIATION AREA.

Each room or area in which licensed material is used or stored and which contains licensed material in an amount exceeding 10 times the quantity specified in Appendix C of 10 CFR 20 shall be posted with a sign or signs bearing the radiation caution symbol and the words - CAUTION RADIOACTIVE MATERIALS.

Control Measures

Radioactive source holders will be shipped and installed in the CLOSED position. The source holder will be placed in the OPEN position after installation. If the source holder is to be removed from its installed position, it will be placed in the CLOSED position before removal. Under no circumstances will the source be removed from the holder.

Initial radiation surveys and wipe tests will be made by the manufacturer and periodic surveys, in accordance with license conditions, will be conducted by MEC.

If maintenance or repair of the source holder is required, it will be returned to the manufacturer in the CLOSED position and will be properly labeled and packaged as described in Title 49, Parts 171 through 173.350. If a source holder is not needed, it will be returned to the manufacturer to be disposed of in accordance with 10 CFR Part 20, Section 20.301.

6.0 ACCIDENTS

6.0 ACCIDENTS

Potential accidents and the associated consequences of such accidents are discussed in this section and in Section 7.0 of the Environmental Report. Environmental consequences are lessened due to the remoteness of this facility.

The type of accidents considered include fires, spills, failure of air pollution control equipment, loss of utilities, boiler explosion, and natural disasters. A probability and severity have been assigned to each and have been subjectively derived through an objective review of available industry data and information, and experience. These are summarized and presented in Table 6.0.1.

6.1 MILL

6.1.1 Fires

1. Solvent Extraction Circuit

Approximately 125,000 gallons of kerosene are contained in the solvent extraction circuit. This kerosene represents the greatest potential for a serious fire at the project site.

a. It is possible for the kerosene to catch fire and release a heavy black smoke containing carbon soot and some natural uranium. The solvent extraction building will be equipped with an automatic sprinkler system. With this safety precaution, a fire in one of the process tanks would be contained before other tanks were compromised. The smoke generated by the fire would be released to the atmosphere through the air vents in the top of the building.

b. Since the project is located in a remote area, such a fire is not expected to cause significant environmental impacts. The short-term release of smoke, soot, and unburned hydrocarbons would decrease air quality within the immediate vicinity of the plant, but these effects would be short-term. The uranium carried in the soot could be dispersed over the same area as the smoke but the uranium would have very low levels of radioactivity.

In a documented case of an actual fire in a uranium solvent extraction unit, the area around the burned building was sampled at distances of 100 feet and 1/4 mile. No detectable uranium was found.*

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*Mill Superintendent, Petrotonics, personal communication to Humble Oil and Refining Co., 1971.

TABLE 6.0-1

ACCIDENT ANALYSIS

Type	Probability	Severity
FIRES		
Solvent Extraction Circuit	2	4-5
Storage Areas - other	3	4
PROCESS LEAKS		
Piping	5	1
Tanks	3	3
Impoundments	2	5
TAILINGS RELEASE		
Dam Failure	1	5
Line Failure	3	5
UTILITY LOSS		
Equipment Shutdown	5	2
Process Overflows	5	1-2
SCRUBBER FAILURE		
Partial	4	2
Complete	3	3
BOILER EXPLOSION	1	5
NATURAL DISASTERS		
Winds	3	3-4
Floods	1	4-5
Seismologic	1	4-5
OTHER ACCIDENTS		
Chemical Releases	4	2
Ammonia Releases	4	3
Operator Error	5	2-3
Industrial Accidents	5	1-5

Probability Scale

1. Improbable - recognized, but not reasonably expected to occur.
2. Possible - not expected to occur, but planned for.
3. Rare - may occur once or more during the operating life of the facility, but under extreme or unusual conditions.
4. Infrequent - expected to occur more than once during the operating life of the facility.
5. Frequent - expected to occur during normal operations.

Severity Scale

1. Trivial - requires operator/supervisory review and/or minor adjustment - no impact.
2. Minor - requires supervisory review and instructions to correct - no impact.
3. Significant - requires management notice and reporting, supervisory instructions to correct - may have plant area impact.
4. Serious - requires management notice and instructions to correct - potential limited impact to local environment.
5. Major - requires management and regulatory agency notice. Explicit instructions to correct impacts, if any.

c. As far as can be determined, any fire in the solvent extraction system would most likely be caused by human carelessness rather than by spontaneous or process-related incidents. To avoid these kinds of accidental fires, the following precautions will be taken:

1. Smoking by personnel will not be permitted.
2. Welding will be allowed only by special authorization.
3. No open fires will be permitted.
4. Hazard warnings will be posted.
5. Maintenance will be performed only after the responsible supervisor certifies that it can be done safely.

d. The estimated maximum probability of such an occurrence is one fire per 200 years of operation. The probability that a fire would produce a significant environmental impact is negligible. There have been two fires of this type in other mills, both of which were caused by maintenance errors and could have been prevented with proper planning.

2. Storage Areas

Fires originating in these areas are unlikely to cause significant radiological hazards unless allowed to propagate and spread.

a. Mill storage areas for reagents are segregated and are enclosed in diked areas where spillage and subsequent flame propagation are predictable and contained.

b. Outside storage of flammable materials are segregated and pose no abnormal hazards. Fires here would have negligible environmental impact.

6.1.2 Process Leaks

1. Piping

Minor leaks may occur in the mill circuit as part of daily operations. The mill circuit is completely self-contained and the possibility of liquid loss from the plant confines is highly unlikely. An entrapment basin is provided to preclude loss of liquid spills from restricted areas. A leak in exposed piping would be quickly detected and corrected. Any spilled process liquids would be promptly cleaned up to minimize the environmental impact of the spill.

2. Tanks

a. All tanks, sump wells, pump boxes, tanks and thickeners in the plant are contained within diked or enclosed areas to preclude discharge to unrestricted areas. Leakage from

these facilities would be detected in the normal process and repairs made as needed.

b. Massive rupture of any tankage would cause local plant damage and/or contamination which would have to be cleaned up and decontaminated in accordance with procedures established in Section 5.

c. Outside storage facilities are also enclosed in diked areas which minimized the impact of accidental discharge of fluids.

6.1.3 Tailings Release

1. Dam Failure

The probable accidents relating to a tailings dam failure are discussed in detail in the "Final Report on Design of Tailings Retention Basin-Sweetwater Uranium Project" Dames & Moore, March 10, 1977, and the supplemental report regarding the sub-surface disposal plan dated July 1978.

2. Pipe Line Failure

As discussed in Section 4, the tailings discharge line is pressurized and located upon a prepared bed designed to direct any leakage or loss from the line to drainages that lead to the tailings impoundment. Further, the tailings dam and pipe line will be periodically checked each shift during operations.

6.1.4 Utility Loss

1. Equipment Shutdown

a. Temporary loss of water or power to the mill could cause a scrubber or ventilation failure. The yellowcake-package-room, scrubber system will have a water-power interlock system that will shut down the dryer and minimize the amount of emissions in the event of water or power loss.

A prolonged loss of electrical power is considered unlikely since diesel generators will supply emergency power to mill. Failure of the standby generators during a prolonged power outage would leave the mill without power but is considered extremely unlikely.

A prolonged water loss is also considered unlikely as the water is available from a number of sources on the property.

b. Loss of ventilation for a prolonged period of time would require evacuation and/or special work procedures to be implemented in the areas affected.

2. Process Overflows

Loss of power would cause some pump boxes, and under worst conditions, portions of the leach, CCD and SX circuits to overfl Since all of these areas are contained within diked areas, clea id/or decontamination would proceed on a routine basis when pow curns.

.5 Scrubber Failure

1. Partial Failure

a. The failure of various mechanical components of the scrubber assembly could result in less than maximum efficiency in operation.

b. Failures would be detected through process instrumentation, direct observation, ammonia fumes and heat buildup.

c. Corrective action would be partly automatic through the instrumentation interlock system which shuts down the dryer and mechanical repair to the defective machinery.

d. Additional monitoring surveys would be taken to assess the extent of the impact upon the plant and general area environment. The measurable effects of a scrubber failure are expected to be limited and well below permissible emission standards.

2. Complete Failure

The same analysis holds true for complete failure. However, failure of the interlock devices would extend the period of emissions until the operator took corrective action. Extensive monitoring and cleanup might be required depending on conditions prevalent at the time of failure.

6.1.6 Boiler Explosion

The principal hazards connected with a boiler explosion would be subsequent fires and rupture of piping or tanks. The consequences of these are discussed in Sections 6.1.1 and 6.1.2.

6.1.7 Natural Disasters

1. Winds

a. Strong winds and severe storms are noted in the area. Severe winds would cause wave action within the tailings dam,

release of fugitive dusts from inactive areas, and partial building collapse. Fugitive dust could spread some radioactive ores, but it would be minor in nature and probably not be detectable at the established air quality monitoring stations. Dust control will be provided.

b. Excessively violent storms (tornadoes) could spread low level radioactivity and/or chemical solutions contained in the tailings dam, thickeners or other impoundments. Due to the low concentrations and wide dispersal effect by the winds, no significant increase in background levels would be expected.

2. Floods

a. Major precipitation which could cause flooding might result in dispersal of radionuclides along a downstream flood plain heading to the low points of the Great Divide Basin. Due to the nature of the drainage in the area, all flood plain channels could be surveyed and all contaminants conceivably recovered.

b. The effects of flooding upon the tailings dam are discussed in the Dames and Moore report previously cited and its supplement. It should be noted that if such a flood should occur, it would be confined to MINERALS property.

3. Seismological

The mill and ancillary facilities have been designed to withstand the maximum seismic disturbance probable in the area. Failure of the tailings dam due to seismic activity is discussed in the Dames and Moore report.

6.2 TRANSPORTATION

6.2.1 Probability and Impact

1. During the transportation of product from the mill, an accident could occur in which some uranium oxide would be released. This is the only radioactive material expected to be transported from the site. Because most of the radioactive daughters of uranium will have been removed in the extraction process, and because of the very slow regrowth of gamma-ray radiation, the uranium oxide will have a very low level of radioactivity.

The probability that a transportation accident will occur is about 10^{-6} per vehicle mile; it decreases to about 10^{-13} per vehicle mile for very severe accidents (AEC, 1972).

2. The extent of the environmental impact of a transportation accident involving the product would be very small. Even in the case of a severe accident, only a few drums are likely to be breached. The material has a very high density (approximately 7 g/cm^3) and is not easily dispersed.

6.2.2 Shipping Precautions

1. The product will be packed into steel drums to a net weight of approximately 900 pounds and then shipped to customers. The drums will be sealed and marked with the standard symbol for radioactive material. The vehicles transporting the product will also be properly marked.

2. Proper and safe shipment of radioactive materials is the responsibility of the Safety & Environmental Administrator. Prior to the shipment of any radioactive materials, Safe Shipping Procedures will be written. These procedures will require shipments of radioactive materials to be in compliance with applicable state and federal regulations.

6.2.3 Product Recovery

1. In the event of a transportation accident, MINERALS would supp an technical assistance that would be necessary to aid cl an up the spill.

2. If the product were spilled on land, it would be easily detected by the use of sensing equipment. It could then be picked up and reclaimed to prevent any significant long-term environmental impacts.

3. If the product were spilled into a lake or slow-moving stream, it would probably be dispersed over a relatively large area, making clean up extremely difficult. However, due to this rapid dispersion and the low radioactivity of the product, such an accident is not expected to result in any significant environmental impact or danger to human beings.

6.3 OTHER ACCIDENTS

6.3.1 Chemical Releases

Other mishaps such as overflows from process tanks, chemical explosions, fires, or large spills of reagents such as sulfuric acid or kerosene are credible accidents that may occur in uranium mill operations, as in any chemical process industry.

1. All reagents are stored within diked areas to fully contain them on site in the event of a spill.

2. With the exception of ammonia, all spills of stored chemicals would be absorbed in the soils or contained in the immediate vicinity of the storage tank.

3. Spilled liquids could be pumped to the process or to the tailings pond. However, a portion of the chemical may be absorbed in the soil and require cleanup. Spillage in the mill will be washed down and pumped back into the mill circuit.

6.3.2 Ammonia Releases

An ammonia spill or tank rupture would result in ammonia vapor dispersal to the environment. However, concentrations would be quite low and offsite consequences would be negligible.

6.3.3 Operator Error

1. Errors in judgment and mistakes in execution are an inherent aspect of any human endeavor. To ameliorate the effects of human fallibility, control instrumentation has been provided wherever possible to detect or correct process malfunction. Additionally, extensive training programs and standard operating instruction will be devised and used.

2. The effects of operator error may vary over a wide range of severity. Close supervision by experienced personnel will, in most cases, limit the effects of such errors to local impact.

6.3.4 Industrial Accidents (Personnel Injury)

Injuries to personnel and damage to equipment are recognized hazards in any industrial endeavor. These hazards are of major concern to management and continuous-positive steps will be taken to limit their occurrence. A comprehensive and strongly enforced safety program and accident prevention training course will be part of the general employment criteria for all employees.

The effects of any industrial accident can encompass the full range of severity listed in Table 6.0.1.

6.3.5 Impact

The environmental effects of these types of accidents will be confined to the plant site, and the probability of the accidents having any significant effect on the offsite environment is negligible due to the facility's isolated location.

6.4 EMERGENCY ACTIONS

The Safety & Environmental Administrator will establish emergency procedures for the project. A detailed SPCC (Spill Prevention Countermeasure and Control) plan will be prepared and will be familiar to all supervisory personnel. As the project develops, a complete and detailed Emergency Action Plan will be developed.

6.4.1 Responsibility

1. The Safety & Environmental Administrator is responsible for:

   a. Developing emergency procedures.
   b. Procuring and periodically testing emergency equipment.
   c. Emergency training programs.
   d. Assessing onsite and offsite safety and environmental conditions.
   e. Coordinating assessment of the cause and effectiveness of corrective actions following emergencies.
   f. Notifying corporate and regulatory personnel as required.

2. The Mill Superintendent is responsible for:

   a. Insuring that mill personnel receive the Emergency Training as provided through management.
   b. Keeping a current file of Emergency Procedures for use by supervisors and personnel.

3. The Maintenance Superintendent is responsible for:

   a. Insuring that maintenance personnel received the Emergency Training as provided through management.
   b. Keeping a current file of Emergency Procedures for use by supervisors and personnel.
   c. Assigning work crews for emergency situations.
   d. Repairing and/or maintaining emergency equipment.

APPENDIX A

EMERGENCY PLANS TO BE DEVELOPED

1. SPCC (Spill Prevention Countermeasure and Control)
2. Bomb Threat
3. Civil Disorders
4. Fire Prevention and Control
5. Emergency Rescue and First Aid
6. Personnel (Radiation Training)
7. Security

7.0 QUALITY ASSURANCE

The quality assurance program will cover mill design, construction and operation to assure safety, reliability and economy of operation. Qualified personnel from MINERALS will review all phases of construction and will insure compliance to the quality assurance program discussed below.

7.1 DESIGN

During design, the General Manager, or his delegate, will be responsible for:

1. Reviewing and approving all specifications for all equipment, construction materials and construction procedures.
2. Final implementation of controls to insure proper criteria are used.
3. Insuring that design criteria complies with OSHA, MESA or other applicable standards or codes.

7.2 CONSTRUCTION

During construction, the General Manager, or his delegate, will be responsible for:

1. Preparing procedures and material specifications.
2. Reviewing and approving specifications.
3. Reviewing and approving procurement documents that conform to specifications.
4. Reviewing, approving and documenting design changes.
5. Implementing a receiving inspection system to assure that materials and components are inspected for conformance to specifications.
6. Making frequent inspections to insure all construction is within design specifications.

7.3 ACCEPTANCE TESTS

Prior to mill operation, the Mill Superintendent will verify:

1. Proper operation of level indicators and alarms.
2. Leaktightness of process piping systems.
3. Separation of sanitary and process water systems.
4. Mill circuit is self-contained.
5. Operability of automatic systems.
6. Proper function of the ventilation systems and air cleaning equipment.

Prior to mill operation, the Safety & Environmental Administrator will verify that:

1. General Plant safety requirements are met.
2. Emergency equipment and systems are operational.

7.4 OPERATION

The Mill Superintendent will be responsible for operation and will implement a training program for operating personnel to insure that each employee is thoroughly familiar with their jobs and the hazards associated with them.

The Maintenance Superintendent will be responsible for maintenance and will:

1. Implement a training program for maintenance personnel to insure that each employee is thoroughly familiar with their jobs and with the hazards associated with them.
2. Annually review the training program to determine its effectiveness.
3. Review and approve maintenance procedures and their revision.
4. Maintain a master file of maintenance procedures and revisions.
5. Develop and implement a preventive maintenance program.
6. Establish a program for testing equipment critical to the safety of employees and the public.

7.5 RADIATION PROTECTION AND ENVIRONMENTAL MONITORING

7.5.1

The Safety and Environmental Administrator will be responsible for radiation protection and environmental monitoring and will:

1. Develop and implement a radiation protection orientation and training program for all employees.
2. Perform annual reviews of training to determine its effectiveness.
3. Review and approve sampling and surveying procedures and their revisions.
4. Review and approve sampling and surveying procedures for industrial safety and radiation protection.
5. Review and approve procurement of radiation protection and environmental monitoring instruments, calibration standards and materials critical to safety of employees and the public.
6. Establish and maintain quality control program utilizing independent laboratories to verify sample analysis accuracy.

7. Annually review safety records and radiation records for adherence to ALARA philosophy.

7.5.2

The Corporate Medical Department will:

1. Participate in the development and implementation of a radiation monitoring program.
2. Review and approve radiation sampling and surveying procedures and equipment.
3. Review all radiation monitoring results.
4. Review methods, equipment and results of in-house and consulting laboratories relative to radiation.
5. Participate in the development and implementation of an overall radiation protection and training program for appropriate employees.
6. Review content of training courses, literature and aids.
7. Participate in the selection of radiation protection instruments.
8. Review radiation protection procedures, equipment and records and approve as necessary.

8.0 EVALUATION OF ALTERNATIVES

8.0 EVALUATION OF ALTERNATIVES

This Section discusses briefly the various alternatives considered and the proposed courses of action to be followed. The alternatives considered in designing the proposed mill are described in Section 10.0 of the Environmental Report. The economic and social effects of mill construction and operation (both costs and benefits) are discussed in Section 8.0 of the ER and benefit-cost analysis of the entire project (mining and milling) is presented in Section 11.0.

8.1 MILL ALTERNATIVES

There are no existing uranium mills in the vicinity of the proposed Sweetwater project that have the capacity to process the ore from this deposit. Consequently, it is necessary for MINERALS to construct its own mill.

8.1.1 Processing Methods

The grinding and processing circuits were designed after detailed mineralogical, filtration, economic, and metallurgical studies. The design was kept to standard practice as dictated by experience in mill design. No innovative circuits or design features were included; however, some minor design features were incorporated to correct operational problems associated with mills operating in similar climates and conditions.

A conventional acid leach process was chosen because studies found the ore to consume relatively low amounts of acid yielding high extractions of uranium. Both impact and grinding in a rod mill and grinding in a semi-autogenous ball mill were considered. The semi-autogenous grinding circuit was chosen because of its reliability and lower maintenance.

Ore cannot be economically process through the grinding and leach circuits of a mill when it is below a certain grade. This cutoff varies but is estimated to be 0.029 percent. Rather than waste the low-grade material from the pits, it will be heap-leached. While this extraction method results in a lower recovery of uranium than would be obtained by conventional agitation leaching in tanks, the process is much less complex and the costs are lower. Consequently, its use for lower grade material will result in the recovery of uranium that otherwise would not have been recovered during the project.

The uranium oxide extracted during acid leaching can be concentrated by using either solvent extraction or resin ion-exchange. MINERALS will use both methods: solvent extraction for the high-grade ore, and resin ion-exchange for the leachate from low-grade material. Yellowcake crushing, grinding and packaging is confined to one building to maximize control and minimize emissions by limiting the number of handling operations and exposure points. The completely closed system was determined to be best for exposure control and is consistent in keeping with the goal of "as low as reasonably achievable". The building will be kept at negative pressure.

Selling and shipping wet slurry was also considered in lieu of yellowcake processing but was discounted due to a lack of market.

8.1.2 Mill Siting

Within the economic hauling distance from the mine, biological communities are relatively uniform. There are variations in species composition and productivity over the area; however, these variations are largely in response to small microclimatic and edaphic changes and are therefore relatively minor. There are no unique habitats within the area that are more likely to support protected, threatened, or endangered species than other areas. Consequently, the placement of the mill within this area could not be made on the basis of biological considerations, since the impact would be essentially the same for any location within it.

This statement is also true for other environmental considerations. Air quality, water quality, socioeconomics, and cultural resources will be affected in essentially the same manner regardless of the location of the mill within the area.

Due to prevailing southwesterly winds, placement of the mill in most locations to the west of the ore deposits would expose mining personnel to radiation from the mill complex. In addition, preliminary investigations indicate that there is a potential for the discovery of further uranium depcsits west of the ore to be mined. For these two reasons, placement of the mill west of the ore deposits was rejected.

Since locations within this area cannot be differentiated on the basis of environmental or safety considerations, the mill was sited on the basis of economics. The mill was placed as close to the ore body as possible in order to provide the shortest ore haulage distance and create the least amount of surface disturbance. The mill

site was examined for stability and no faulting was discovered. Drilling was also performed to ensure that there were no ore deposits beneath the site.

8.2 TAILING ALTERNATIVES

Studies of various tailing management systems were considered and are discussed in detail in the supplement to the Environmental Report entitled "Analysis of Tailings Disposal Alternatives". The location of the tailings impoundment was carefully chosen to meet many rigorous requirements for stability, safety and efficiency. It was located close to the mill in order to preclude the construction of an extensive pipeline system to transport the tailings slurry, thus minimizing any danger of accidental slurry spills. The impoundment was located to the southeast of the mill so that the prevailing southwesterly winds would not carry any radon gas generated from the tailings into the mill. Soil type, ground stability and topography were also considered in locating the tailings impoundment.

A range of possible alternatives for disposal of tailings were considered. Seven alternatives considered in detail are listed below:

- Slurry pipeline to mine pit
- Slurry pipeline to specially-excavated pit
- Settling pond, evaporation pond and dry transport to mine pit
- Tailing impoundment, synthetic liner, soil cap
- Tailing impoundment, bentonite liner, soil cap
- Tailing impoundment, natural foundation and soil cap
- Tailing impoundment, natural soil liner and cap

Availability of construction materials, cost of materials and construction, integrity, confinement in the event of major catastrophy, impacts to air and water quality and final disposition were all factors considered in evaluating the various alternatives.

It was determined that construction of an excavated tailings impoundment and natural soils evaporation pond dam lined with a synthetic membrane, provided the most environmentally sound management. The lack of available suitable clays in the vicinity and the high costs and availability of nearby manufactured bentonite eliminated these alternatives for liners.

A detailed design of the tailing impoundment is presented in "Design of Tailings Retention Basin", Dames and Moore, March 16, 1977, and in the supplemental report entitled, "Proposed Subsurface Tailings Disposal" dated June 1978.