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Docket 40-6659

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MEMORANDUM FOR: Docket No. 40-6659

FROM: Samuel Z. Jones, Project Manager
Operating Facilities Section II
Uranium Recovery Licensing Branch
Division of Waste Management

SUBJECT: PAGE CHANGES TO PETROTOMICS' ENVIRONMENTAL REPORT DATED APRIL 1, 1981

The enclosed are page changes to the Petrotomics' Environmental Report dated April 1, 1981. These changes were submitted by the licensee during a December, 1981 site visit by S. Jones and D. Sollenberger (NRC). The changes correct typographical errors in the original submittal and represent no changes to the content of the environmental report.

/s/

Samuel Z. Jones, Project Manager
Operating Facilities Section II
Uranium Recovery Licensing Branch
Division of Waste Management

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1.0 INTRODUCTION

Pursuant to Title 10, Code of Federal Regulations (CFR) Part 40, Section 40.31 and 40.32 (e), and to 10 CFR Part 51, Petrotomics Company is applying to the Nuclear Regulatory Commission (NRC) for renewal of NRC Source Material License No. SUA - 551 authorizing continued operation of the Petrotomics Uranium processing mill.

1.1 Current Activities

The Petrotomics Uranium Mill is located in the Shirley Basin area of Carbon County, Wyoming in a remote area of south central Wyoming. (See Figure 1-1) The mill is a conventional acid leach uranium ore processing plant. The function is to extract naturally-occurring uranium from ore mined in the immediate vicinity of the plant. The nominal throughput of the mill at the present time is 1,500 tons of ore per day with an average uranium content of about 0.2%. Presently known reserves are estimated to be sufficient for plant operation through 1994 at the current processing rate.

Mining is conducted by the open pit method consisting of topsoil removal, overburden removal followed by the removal of uranium bearing ore. Overburden is placed in a surface spoil pile during initial mining operations. These spoil piles are reclaimed as soon as possible when dumping is completed. When mining has progressed sufficiently the mined-out pits are backfilled with the overburden from pits being developed.

Decommissioning of the mill and reclamation of the tailings will take place at the end of mining. A surety arrangement consisting of a bond held by the Wyoming Department of Environmental Quality - Land Quality Division and purchased by Getty Oil is used to ensure that proper decommissioning of the mill and reclamation of the tailings is accomplished.

1.2 Background

The Petrotomics Uranium Mill began operation in 1962 as a 500 tons per day mill. In 1968, the mill was expanded to 1,000 tons per day throughput by the addition of three 80' thickeners, leach tanks and another solvent extraction circuit. In 1970, the mill was expanded again to the present capacity of 1,500 tons per day. A complete description of the mill circuit can be found in Section 3.3.

The tailings from milling operations have been placed in the tailings pond since the beginning of the operation in 1962. In 1977, an amendment to the Nuclear Regulatory Commission license allowed a new dam to be constructed over the old dam. The new dam raised the elevation of the tailings impoundment 65' to a final elevation of 7,100' above sea level. The dam was completed in September of 1979 and will provide for tailings disposal until 1986.

2.0 THE EXISTING ENVIRONMENT

2.1 LOCATION

The Petrotomics Uranium Mill (PUM) is located in Carbon County in southeastern Wyoming. (Figure 1). The mill site is about 120 miles west of the Nebraska border and 100 miles north of the Colorado border. The nearest major city is Casper, approximately 48 miles north. The nearest towns to the site are Medicine Bow, about 35 miles south, and Alcova, about 35 miles northwest. The site can be reached from State Highways 220 and 487 from Casper or via Federal Highway 30/287 north from Laramie to State Highway 487. The approximate coordinates of the PUM are: 42^{o} 20' north latitude and 106^{o} 11' 15" west longitude.

The site is at the elevation of about 7,100 feet and within an exclusion area of approximately 5,898 acres owned by Getty Oil. This area is fenced to prevent access by horses, sheep and cattle. The site topography is typical of eastern Wyoming plains with moderate elevation changes, i.e., the topography of the vicinity is characterized by rolling hills and valleys. Elevation differences of 250 feet are present within two to three miles distance. Local slopes are 20 to 40%.

The property boundaries are indicated in Exhibit 1 and a contour map of the area is provided in Exhibit 2.

2.2 USE OF ADJACENT LANDS AND WATERS

The land use in Shirley Basin is dominated by the activity of mining and milling industries. Prior to the present activities in the area, the use of the land was for general grazing and limited hunting. No farming activities are conducted in this semi-desert wilderness area as the growing season is short and natural moisture levels are inadequate for economical agriculture. About three miles north of the mill is the Pathfinder Mill which processes uranium ore supplied from mines west and south of it. At the conclusion of mining the land will be returned to natural contour and its original land use of stock (sheep and cattle) grazing and wildlife habitat. The addition of water impoundments should enhance these uses and add to the recreational value of the land.

A search of active surface water rights inside and within one half mile of the permit boundary was conducted. Surface water rights were also searched for three miles downstream of the permit boundary. Table 2-1 lists these surface water rights and gives the State Engineer's permit number, use and user of the water. Exhibit 3 shows the location of each of the surface water rights. All of the existing surface water rights which are listed in Table 2-1 are used by mining companies except the irrigation water rights of permit number 10154.

A search for active ground-water rights inside and within three miles of the permit boundary produced the list which is given in Table 2-2. The State Engineer's well permit number, use, probably aquifer, user and distance from Petrotomic's mine pit are given in this table. The pit which is closest to the ground-water right was used to determine the distance. The ground-water rights are shown on Exhibit 3 as a circle with the corresponding well permit number.

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The major impact on the Wind River Aquifer will be the lowering of water levels near the pits from mine dewatering. Other ground-water resources should not be impacted because they are not located in the pit areas. Drawdowns near the pits can be estimated from the Theis Equation. The Theis Equation was used with a programmable calculation to estimate the drawdown from both of Petrotomic's pits. This program was developed to sum the drawdowns from both pits for selected points. Impermeable boundaries near the pits would increase the drawdown in the areas of these boundaries. An impermeable boundary exists in the northwest corner of Section 34 and the northeast corner of Section 33. The extent of this boundary to the north is questionable. If the boundary is not continuous beyond what is shown on Exhibit 3, then this boundary is probably not very significant to the aquifer drawdown problem. A straight line impermeable boundary can be simulated by adding additional discharging points an equal distance inside of the boundary. The maximum impact from this boundary can be simulated with a discharge point inside the boundary an equal distance opposite Pit 33.

The drawdowns which are shown on Exhibit 3 were simulated with discharges from Pit 4, Pit 33 and an image to Pit 33 in the impermeable boundary. A transmissibity and storage coefficient (specific yield) of 15,000 gal/day/ft and 0.1 respectively were used for the aquifer in these calculations. An unconfined storage value was used instead of the confined because the majority of the flows to the pits will be governed by unconfined aquifer flow. A quick drawdown response of only a few feet (less then 10 feet) could be felt from the confining portion of the aquifer. If this occurs, the two and five foot drawdown lines could extend out two or three miles. Discharges of 1,000 gpm were for each of the two pits and the image discharge point. For ease in calculation, the discharges were started at the same time. The predicted drawdowns in Exhibit 3 should occur after 3 years of pit dewatering.

All of the ground-water rights are owned by mining companies except for permits 4385, 7871, 7872, 17402 and 31944. Permits 7871, 7872 and 17402 have a use of stock watering, while permits 4385 and 31944 are for a townsite. Drawdowns from Petrotomic's mine discharges for three years of operation in the Wind River Aquifer near each of these wells is estimated to be less than two feet. Drawdowns near these wells could be slightly higher than this if the confining portion of the aquifer controls inflow to the pits for a significant period of time. Drawdowns in the aquifer near each of these wells should not exceed 10 feet if the confining portion of the aquifer is significant.

Larger drawdowns will occur in some of the mining companies' wells, but should not create a problem because each company has dewatering operations which will impact their own wells more. Therefore, the impact on the Wind River Aquifer should not significantly influence any existing water rights.

Surface water rights should not be impacted by Petrotomic's Shirley Basin Mine. The mine pit reduces the drainage area during mining, but this reduction is not significant. The actual reduction in Sand Draw's drainage area from Pit 33 1-3 is approximately five percent. Therefore, the water yield from this drainage should not be reduced significantly. The irrigation water rights which are shown on Exhibit 3 are upstream of the conjunction of Sand Creek and the Little Medicine Bow River. Therefore, any reduction of flow to Sand Draw would not impact these irrigation rights.

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2.5 GEOLOGY

The Shirley Basin is a southward extension of the Wind River Basin and lies between the Sweeter Arch and the Laramie Range.

Deposits from every major diversion of geologic time can be found in the area. Except for the mountainous, geologic formations are mostly sedimentary and of recent (Cenozoic and Mesozoic) origin, with land forms typical of an arid climate. In the vicinity of the mine and mill sites the underlying rock is primarily sandstone.

The Shirley Basin area lies between the Laramie Mountains on the northeast and the Shirley Mountains on the southwest. It is an area of low to moderate relief that comprises four distinct geographic units.

The Shirley Basin is by far the largest and economically the most important of these geographic units. The basin is not well defined, but generally it is considered to lie in the Little Medicine Bow River drainage and to be bounded on the northwest by Bates Hole, on the north by the south edge of the Bates Creek drainage area (Dugway Rim), and on the east by the west flank of the Laramie Mountains. The south and southwest boundaries are outside of the area investigated. In this report, about 10 square miles of terrain near the southwest corner of the area is considered a part of the Shirley Basin even though it is drained by Dry Creek, a westward-flowing tributary of the North Platte River. The Shirley Basin is an area of low relief eroded in rocks of Cretaceous and Tertiary age.

Altitudes range from slightly below 6,900 feet along the Little Medicine Bow River in the southeastern part of the basin to about 7,800 feet on the Dugway Rim at the north boundary. The Little Medicine Bow River, a perennial stream that rises on the west flank of the Laramie Mountains, flows southward through the basin and joins the westward-flowing Medicine Bow River near the town of Medicine Bow.

Bates Hole, a prominent erosional feature in the northwestern part of the area, is drained by Stinking Creek and its tributaries. Stinking Creek is an intermittent stream that flows northward and joins the North Platte River about 30 miles northwest of the area. Relief in Bates Hole is moderate; altitudes range from about 6,100 feet along Stinking Creek at the north edge of the area to slightly over 8,000 feet on Chalk Mountain near its western edge. The floor of Bates Hole is composed of Cretaceous shales; in the walls are excellent exposures of Tertiary rocks ranging in age from Eocene to Miocene. Although Stinking Creek is a small intermittent stream, erosion of the soft rocks composing the rim of Bates Hole has been exceedingly rapid.

The Bates Creek drainage area lies north of the Shirley Bain, east of Bates Hole, and west of the Laramie Mountains. It is a high-standing almost terracelike area drained by northward-flowing Bates Creek and carved in rocks of Tertiary age. Altitudes range from about 7,000 feet on the northwest to about 7,800 feet on the east. Steep-walled narrow canyons dissect the northwestern part of the area; elsewhere dissection has been minor, and the component rocks are poorly exposed. Bates Creek reservoir, in the north-central part of the area, stores water for a short time after the spring runoff, but owing to excessive leakage through underlying permeable rocks, it is generally dry by midsummer.

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The west flank of the Laramie Mountains extends into the Northeastern part of the mapped area. Exposed here are coarse-grained granite rocks, diabase dikes, and metamorphic rocks of Precambrian age and limestone, sandstone, quartzite, and shale of Paleozioc age. Altitudes range from about 7,200 feet along the toe of the west flank of the Laramie Mountains to slightly above 8,400 feet in the northeast corner of the mapped area.

All of the economically important uranium deposits in the area occur in the Eocene Wind River formation, which was uncomformably deposited over several hundred feet of relief etched into the erosion surface of the folded Cenozoic and Mosozoic formations.

The major bedrock units in the mine vicinity are the Wind River and White River shale formations. The Wind River formation is divided onto (1) a lower part composed of fine-grained siltstones and mudstones (2) the upper part is composed of coarse grained, poorly sorted arkosic sandstones and granite pebble conglomerates, and numerous bedded lenses of siltstone and mudstone.

Rocks in the Shirley Basin area are of both igneous and sedimentary origin and range in age from Precambrian to Cenozoic. Quaternary surficial deposits fill some of the valleys and form terraces related to at least two erosion cycles earlier than the present. The sedimentary rocks, particularly those of Tertiary age, are widespread at the surface and are the host rocks for the uranium deposits. Igneous and metamorphic rocks of Precambrian age and sedimentary rocks of Paleozoic age crop out only in the northeastern part of the area, on the western flank of the Laramie Mountains. Rocks of Mesozoic age crop out in Bates Hole and along the southern border of the area, where erosion has removed the Tertiary rocks.

The Shirley Basin is structurally simple. It is an erosional feature whose position is governed to some extent by a broad syncline in the pre-Tertiary rocks. The syncline axis trends northwestward, parallel to the erosional axis of the basin, and lies 9-10 miles west of the basin axis. Paleozoic, Mesozoic, and to a lesser extent, Tertiary rocks have been broken by faults that show small displacements. Two faults with displacements of about 100 feet are just west of the project area.

Abrupt changes in lithology and thickness are characteristic of the Wind River formation in Shirley Basin. The thickest section is along a northwesterly trending zone in the central part of the basin where 450-550 feet of siltstone and sandstone overlies a major valley on the pre-Wind River erosion surface. In and near this zone the Wind River formation consists of interbedded fine- and coarse-grained rocks, in about equal amounts, interbedded with considerable lignite material.

Figure 2-1 depicts a representative geologic cross-section across the mill and tailings impoundment system; the line of cross-section is across the site in a north-south direction.

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2.6 SEISMOLOGY

The Petrotmics Mill is located on the east side of the Central Rocky Mountains in southcentral Wyoming. Based on the type and age of rocks, the age and style of deformation, and the levels of stress release indicated by size and frequency of earthquakes, the region is considered to be within the "Zone One" Seismic Risk area which is characterized by earthquakes of low frequency and low intensity. Earthquakes of this type have been reported in the general area during the past 100 years. Figure 2-2 shows the locations of reported earthquakes since 1869 with reported intensities of I to V modified Mercalli.

2.7 HYDROLOGY

The planned mining areas of Petrotomics in Shirley Basin addressed in this report fall in parts of Townships 27 and 28 North, Range 78 West, in Carbon County, Wyoming (Exhibit 3).

The Wind River formation of early Eocene age and the White River formation of Eligocene age are the principle outcropping geologic units in the mining areas. The White River formation overlies the Wind River north of Pathfinder's 3-A pit and in the vicinity of Petrotomics 33-1 pit. They are generally separated by a thin clay layer. The White River formation contains a significant water-bearing zone in Pathfinder's mining area, but the Wind River hosts the principle aquifer and ore zone in the Shirley Basin.

In this report two principle aquifers are discussed, the White River and the Wind River. It should be noted that the distinction between these aquifers is based on hydrologic and not strictly geologic considerations. In many cases what is referred to as the White River aquifer also includes upper Wind River formation sands. However, they are hydrologically connected to each other but hydrologically separated from the lower Wind River sands which are herein called the Wind River aquifer. A massive clay, approximately 80 ft. thick, in the upper portion of the Wind River formation separates the two aquifer systems.

2.7-1 Ground Water

Water levels near the mine pits in both the Wind River and White River aquifers have been significantly lowered due to mine dewatering in Shirley Basin. When mining and the accompanying pit dewatering ceases, the water levels will recover to some elevation close to that which existed before mining. Therefore, post mining water-levels elevations can be predicted by evaluating pre-mining water-level data.

Pre-mining water-level information in the Shirley Basin is sketchy at best. Harshman (1972) showed a generalized piezometric-contour map for the Shirley Basin based on 1959 data. His contours are probably drawn from water-level data observed in both Wind River and White River aquifer wells. Also, he indicates that the water-level contours generally follow topographic contours, with ground-water discharge into major drainages occurring generally

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Wind River Aquifer Water Quality

Wind River aquifer water is also the sodium-calcium bicarbonate-sulfate type. It ranges from moderately hard to very hard. Total dissolved solids concentrations are generally higher than those found the the White River aquifer, ranging from 315 mg/l to greater than 1,400 mg/l.

A general trend of increasing dissolved solids was observed from northeast to southwest in the study area. However, enough anomalies are present to preclude drawing a readily interpretable dissolved solids or conductivity contour map. One reason for this anomalous dissolved-solids variability may be due to the structure of the Wind River formation.

According to Harshman (1972), the Wind River sands, which comprise the Wind River aquifer as defined for this report, consist of an upper and a lower tongue of altered sands. The upper tongue is continuous in the study area, but the lower tongue apparently is not. Some of the deeper wells, including WI 3, U.S. 2205, U.W. 31943, and U.W. 47005, may be drawing water from sands of the lower tongue. The water from these wells all exhibit lower dissolved solids or conductivities than would have been expected from observation of the general trend of increasing dissolved solids from east to west. Lower dissolved solids in the lower tongue wells are consistent with higher tansmissivities observed during aquifer tests for these wells. High transmissivity generally correlates to a higher rate of water movement, which means the water spends less time in contact with the formation. The less time that water is in contact with a rock formation, generally, the lower will be the dissolved-solids content.

Chemical constituents that have been observed in Wind River aquifer wells in concentrations greater than those recommended by the EPA for domestic or aquatic life purposes include bicarbonate, cadmium, chromium, iron, lead, manganese, mercury, and ammonia nitrogen. The heavy metals which are considered potentially toxic, cadmium, chromium, lead and mercury, were detected in relatively high concentrations in only isolated instances. Most likely no threat to aquatic life would be present in a composite water supply like a reservoir. Iron and manganese would most likely precipitate out after oxygenation. Ammonia nitrogen should probably be monitored fairly closely to more adequately determine representative concentrations and areal extent.

Hem (1970) states that water supplies which have radium -226 concentrations not exceeding 3 picocuries/liter are acceptable according to Public Health Service standards without considering the total radiation exposure. No specific standards have been set for aquatic life purposes. Numerous Wind River aquifer well samples had radium -226 in relatively high concentrations, one as high as 220 picocuries/liter. Therefore, the Wind River aquifer would not be highly desirable as a domestic water supply, but should suffice as a water source for aquatic life habitats. Wind River aquifer water-quality data are presented in Table 2.6.

Reservoirs

Several samples for chemical analysis have been collected from Petrotomic's phase 9, phase 10 and pit 4 reservoirs. The results of these analyses are presented in Table 2.6 of one with the results of White River and Wind River aquifer water sample analyses. Although these reservoirs should be representative of Wind River aquifer water, several major constituents and total dissolved solids are somewhat higher than those observed in

TABLE 2-7

JOINT FREQUENCY OF ANNUAL AVERAGE WIND SPEED AND DIRECTION

(expressed in percent, with 2.2% calm distributed in the table)

	SPEED, mph						
DIRECTION	0-3	4-6	7-10	11-16	17-21	21	TOTAL
N	0.4%	1.5%	1.4%	0.8%	0.3%	0.1%	4.5
NE	0.4	1.9	2.2	2.1	0.6	0.1	7.3
NE	0.2	1.0	1.4	1.0	0.2	0.1	3.9
ENE	0.3	0.9	1.1	0.6	0.1	0.0	2.9
E	0.4	1.3	1.7	.12	0.2	0.1	4.9
ESE	0.2	0.7	0.7	0.4	0.1	0.0	2.1
SE	0.2	0.6	0.5	0.2	0.0	0.0	1.5
SSE	0.2	0.7	0.4	0.1	0.0	0.0	1.4
S	0.2	0.7	0.4	0.3	0.1	0.0	1.7
SSW	0.2	0.9	1.8	4.5	4.3	2.4	14.1
SW	0.2	0.9	2.8	6.3	4.5	2.1	16.8
WSW	0.4	1.7	5.2	4.8	2.0	0.9	15.0
W	0.8	2.9	4.5	2.8	1.0	0.6	12.6
WNN	0.3	1.3	1.0	0.9	0.3	0.1	3.9
NW	0.2	1.1	1.0	0.5	0.2	0.0	3.0
NNW	0.4	1.8	1.3	0.6	1.2	0.1	4.5
	4.9%	19.9%	27.4%	27.1%	14.1%	6.6%	

Meteorological data from Casper (48 miles north of the site) has been used because, in the opinion of the staff, they are generally representative of the Shirley Basin Area. Strong winds occasionally occur, the strongest recorded speed was 81 mph (130 kmph) from the southwest in March, 1956.

Local topography strongly influences the daily micrometeorological conditions at the site. The degree of dilution of airborne contaminants from normal operating releases will be determined by small-scale turbulence in the local area in combination with the prevailing wind and the mode of release (ground level or elevated). Onsite collection of data on precipitation, temperature, relative humidity, wind velocity, and wind direction was begun in June 1978.

The average annual precipitation in Casper is 11.2 inches (28 cm), but relatively large variations in monthly and seasonal totals take place:

LEACHING (continued)

Discharge from the leaching tanks is through upcomers from the bottom of the tanks. Air lifts are not required, since at 50-55% solids, no sand segregations occurs. Wear plates are installed in the bottom of the tanks, however, to prevent damage from tramp oversize from the grinding circuit.

LIQUID-SOLID SEPARATION

Separation of the pregnant solution from the leached solids is accomplished by countercurrent decantion through six stages of 55' diameter x 12' deep thickeners or one of two sets of three stage 80' diameter x 14' deep thickeners. Approximately 2.5 tons of wash solution is added to the last thickener per ton of feed ore. Part of the wash is recirculated raffinate from the solvent extraction circuit. Sulfuric acid may also be added to the last thickener to maintain the pH between 1.5 and 1.6.

Thickener underflows average 59% solids. Underflow from the final thickeners containing about 0.015 grams of dissolved uranium per liter of solution, are sampled and pumped to tailings.

A flocculant is mixed with the slurry feeding to each thickener to maintain an average solids settling rate of one inch per minute and this results in a clear solution depth of between 5 and 6' in the thickeners. Actual flocculant requirements are established by operator test to determine the settling rate, and adjustments to the rate of reagent addition made accordingly. Total flocculant consumption is approximately 0.05 pounds per ton or ore.

The pregnant solution overflowing the first thickener contains approximately 0.75 grams of U_3O_8 per liter and 200 ppm of suspended solids.

SOLUTION CLARIFICATION

The pregnant solution is fed into a 22' diameter x 12' deep clarifying thickener. Additional clarification is obtained by pressure filtration through three U.S. filters precoated with Solkaflok and Dicalite. The clarified solution is then pumped to the solvent extraction circuit.

SOLVENT EXTRACTION CIRCUIT

Extraction of the uranium from the clarified pregnant solution to an organic phase and subsequent stripping from the organic phase to a concentrated and purified pregnant strip solution is accomplished in four extraction and four stripping stages. All eights stages, with their associated mixing and settling compartments, are contained in a single divided, 5' deep rectangular tank constructed of concrete and lined with fiberglass. The circuit is divided into three separate sets of extraction and stripping stages, each independent of each other. Settling compartments are 13' wide x 25' long in the extraction stages and 6' wide x about 20' long in the stripping stages. The mixing compartments are approximately 6' x 5'.

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SOLVENT EXTRACTION CIRCUIT (continued)

Turbine-type agitators raise the liquid level in the mixing compartments sufficiently to eliminate the need for external pumps and piping. The organic phase advances by overflowing each settling compartment into the next mixing stage. Aqueous solutions are drawn from the bottom of the settling compartments through riser pipes which may be adjusted in height to control the aqueous-organic interface level. These solutions then flow the the following mixer in a direction opposite to that of the organic.

Solution feed rates to each extraction circuit average 250 gallongs per minute of pregnant solution and 120 gallons per minute of organic. Recycle of the organic from the settler back to the mixer in each stage maintains a 3:2 ratio of organic to aqueous solutions and, therefore, an organic continuous system in the mixers. Raffinate discharged from the extraction circuit contains less than 0.001 gram of U_3O_8 per liter and is either recycled as part of the CCD circuit wash solution or discarded as tailings.

Loaded organic, containing about 2.5 grams of U_3O_8 per liter, is stripped with ammonia. The pregnant strip solution has a pH of 3.8 to 4.0 and contains between 35 and 40 grams of U_3O_8 per liter. Aqueous solutions are recycled in the stripping circuit to maintain a ratio in the mixers of about eight parts aqueous to one part organic.

The organic phase is composed of a mixture of 3½% tertiary amine and 2½% tridecanol in kerosene.

Solution flow rates are monitored and controlled in the SX circuit by calibrated V-noch weirs and regulator valves. Relative flow rates of organic and aqueous solutions are based on obtaining desired uranium concentrations at important points in the plant are determined for control purposes by the operators using quantitative tests.

PRECIPITATION AND DRYING

The pregnant strip solution from the solvent extraction circuit is pumped to yellowcake precipitation. The yellowcake is precipitated from solution by pH adjustment to 7.7 to 7.9 with anhydrous ammonia in two agitated tanks in series.

The precipitation discharge slurry is sent to a yellowcake thickener. The thickener area allows the yellowcake solids to settle to the bottom where they are raked to the center well and pumped out. The solution overflows the thickener launder and is held in a surge tank prior to reuse in the solvent stripping circuit.

The yellowcake is pumped into a thickener wash tank where the precipitate is washed prior to being pumped to the centrifuge. The thickener wash underflow is pumped to a centrifuge where the slurry is washed, partially dewatered, and then calcined in the U_3O_8 roaster.

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All construction was done by personnel from Petrotomics Company. Clearing and grubbing of topsoil in the embankment addition area began May 15, 1978. Construction of the embankment addition began May 22, 1978 and was completed September 15, 1979.

Subgrade Preparation

Topsoil was stripped from the dam foundation prior to commencement of excavation for the north and south cutoff walls and placement of the embankment soils. Subgrade preparation consisted of scarifying, adjusting the moisture content, and recompacting the natural foundation soils according to the moisture and density specifications for the project. Removal of soft, wet areas around the existing seepage ponds and other localized soft pockets was completed and this material was replaced with compacted impervious fill. Considerable compactive effort was required in all locations to achieve the moisture and density specifications during subgrade preparation.

Excavation of the north and south cutoff trenches was made according to construction plans and specifications.

A slurry wall cutoff was constructed by Engineered Constructors, Inc. of Pittsburg along the centerline of the embankment addition connecting the north and south compacted earth cutoff trenches. The slurry wall cutoff consisted of a vertical walled trench 2.5' wide excavated by backhoe into bedrock through a slurry consisting of a colloidal bentonite-water suspension. The bentonite-water slurry was replaced with a viscous soil-bentonite mixture as required by specifications.

Main Embankment

Placement of impervious fill in the dam prism began with the north and south cutoff trench backfill and construction of the slurry cutoff wall working surface pad and continued with placement in the main body of the dam.

A horizontal sand drainage blanket was constructed beneath the downstream slope of the embankment addition to the dimensions shown on the construction drawings.

On August 5, 1978, preparation was made to stockpile impervious fill material taken from the 6,980 bench of the operating mine pit. This material was stockpiled northwest of the construction site. Moisture was added to the fill during stockpiling. By the end of the 1978 construction season, sufficient impervious fill material had been stockpiled to complete the project.

During the 1979 construction season, fill was placed at a satisfactory rate and was placed to specification requirements. The embankment addition was completed on September 15, 1979. Final shaping of the slopes and excavation of the downstream seepage collection trench continued for an additional two weeks.

Instrumentation

Plans called for installation of 25 piezometers, 45 surface settlement and horizontal monuments, and six settlement sensors.

Of the 25 piezometers in the piezometer network, 10 were installed as foundation piezometers and 15 were installed as embankment piezometers. Since installation of the piezometers, there has been a slow decrease in the flow of water into the downstream seepage collection ponds. The installation of the slurry wall cutoff and overburden pressures exerted by the main embankment addition have decreased the underseepage through the embankment.

To monitor the horizontal and vertical movement of the embankment, monuments were installed at several locations on the dam.

The embankment settlement sensors were installed to monitor the settlements associated with the slurry cutoff wall.

Other Construction Details

The downstream collector trench was designed to contain the PMF and to serve to collect any seepage through the embankment from the sand blanket and return it to the seepage collection ponds which are also designed to contain the PMF. The downstream collector trench was completed the week of September 20, 1979. The pump return system from the seepage ponds into the main tailings impoundment has been inservice throughout construction of the project and remains in service at this time. See Exhibit 4 for drawings of tailings impoundment. No discharge of liquids is made from the property.

The release of airborne contaminants to the surrounding environs will be controlled as follows:

1. Dust from Ore Piles-Because the ore is fairly coarse and has a moisture content of 12-15%, dust from the ore piles does not contribute significant problems to personnel or operation in this area. During a condition of high wind and dry periods, the ore piles can be wetted by mine water.

2. Tailings Dust-Since the mill tailings are primarily under water, dust has not been observed. The tailings which are exposed and have dried out have a stabilizing residue (principally gypsum) which is not subject to dusting. A sprinkler system is also used to wet exposed tailings and aid in the evaporation of liquids from the impoundment.

3. Ore Crushing Dust-Crushing is done in a two stage process, first by a coarse crushing in a jaw crusher and then by a hammermill. In both processes baghouse dust collectors are used to collect dust at points of generation. The collected dust is redeposited on the feed belt to ore storage.

4. Dust from Hauling Road-The area around the mill is paved and dusting in general is kept to a minimum by watering the hauling roads during dry windy periods.

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5. Dust from Yellowcake Drying and Loading-Vapors and dusts from this part of the milling process are passed through air cleaning scrubbers with an air cleaning efficiency greater than 99% for particulate matter. 1,600-1,800 cfm or air from the dust collecting points, centrifuges, pulverizers and barrel loading room is passed through the scrubber along with vapors from the dryer. Vapors from the dryer are predominantly ammonia and water. Any reduced scrubber efficiency is avoided as it not only means a release of contaminants U_3O_8 to the environment but also means a loss in mill product. During normal operations it is estimated that less than .02 pounds of yellowcake per hour is lost to the general environment.

3.6 Other Mill Waste

Odors from process equipment ammonia precipitators may on occasion be noticeable close to the tanks in the mill process building, but are rarely detected around the plant site. The leach tanks have air circulators. The air is released to the atmosphere from the top of the tanks by vents. Propane is used for mill equipment and plant space heaters. The stack emissions from these propane burners do not include contaminants such as SO_2 and are in compliance with the Wyoming Ambient Air Quality Standards. The mobile equipment are standard diesel units burning low sulfur fuel. All vehicles are maintained by the applicant to keep the amount of exhaust fumes to a minimum. Approximately 25,000 gallons of motor oil is used per year.

3.7 The Mine

The uranium ore zone at the Petrotomics' site is located about 200 to 300' below the ground surface. Mining is conducted by the open pit method which consists of overburden removal followed by the removal of uranium bearing ores. The topsoil is removed prior to overburden removal and stored for future use during reclamation and restoration of the area.

The ore body is below the present water table resulting in infiltration of water into the bottom of the pit. To keep the working area dry, the pit is dewatered by pumping water out of a low sump which is fed by a trench cut around the outside edge of the pit. The water from this sump is pumped through a 10" pipe to an old pit approximately 2 miles to the southeast.

Some of the overburden removed from the pits is placed in spoil piles on the surface. The overburden piles are then sloped, shaped and reclaimed to blend in with the surrounding topography. The majority of the stripped overburden will be placed back in pits as a backfill material. Once mining has progressed sufficiently, the mining sequence will consist of stripping one pit, mining one pit and backfilling one pit, all at the same time. This sequence of mining reduces the area disturbed by stripping and waste storage. The final pit will be reclaimed without backfilling, resulting in a fresh water lake being formed as the groundwater table returns to natural levels when pit dewatering is terminated.

The pit stripping and hauling of the overburden is accomplished with electric powered shovels and diesel-electric trucks in addition to the conventional diesel-powered scrapers and spreaders. The steep slopes created in the waste dump storage areas are modified by conventional grading equipment to ensure slopes of 3:1.

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4.0 ENVIRONMENTAL CONSIDERATIONS

4.1 Environmental Effects of Site Preparation, Mill Construction and Mine Opening

The Petrotomics Mill began operation in 1962 and has operated almost continuously since that time. During the last license renewal of Source Material License SUA-551, the U. S. Nuclear Regulatory Commission, Division of Materials and Fuel Cycle Facilities Licensing, prepared an environmental impact appraisal for the Uranium Milling Facility. "On the basis of this appraisal, the Commission concluded that the environmental impact created by the renewal of the license is of a magnitude not warranting an environmental impact statement for the proposed section, and that a negative declaration to this effect is appropriate." Since this letter was issued very little, if any, change has taken place in the environment in Shirley Basin.

The environmental effects which cannot be avoided are summarized as follows:

Small quantities of radioactive and non-radioactive materials are released into the environs surrounding the plant and small amounts of U_3O_8 are deposited onto the mill property and on the vegetation and soil in unrestricted areas downwind from the mill. However, the release of such small quantities does not cause a significant impact on the environment.[2]

The local ground water system will be slightly disturbed for a period of 12-15 years due to the mining operation. Since the area is sparsely populated and remote, the impact is expected to be minimal.

The relocation of earth from open pit mining and the formations of a tailings pond resulted in a change in the local topography. Following reclamation and restoration, this charge will not be noticeable. There will be a change of the plant life system in the immediate area of the mine and mill for a period of 12-15 years. However, the revegetation program will definitely reestablish suitable vegetation in the area. Changes in the animal life of the area are expected to be minimal.

4.2 Irreversible and Irretrievable Commitments of Resources

4.2-1 Land

About 160 acres of land will be covered with tailings and require restrictions on digging or other forms of intrusion. This may indefinitely prevent the development of these lands. This is considered an irreversible commitment of resources.

If historic and archeological resources have been disturbed and/or destroyed during past construction activities, the scientific data that might be obtained from study of material remains and their location are an irretrievable loss. No historic or archeological resources have been identified in the disturbed areas.

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While there will be a temporary restriction of use of about 1,375 acres of land normally used by local wildlife and very limited grazing, it is expected that after the land reclamation and vegetation planting, wildlife and sheep grazing will be reestablished.

There will also be a change in the topography of the site involving approximately 500 acres and 110 million cubic yards of earth resulting from overburden removal during open-pit mining. In view of the restoration and reclamation program to be carried out by Petrotomics, the 1,200 acre site (excluding the tailings retention system) is expected to be restored to its former productivity upon completion of activities. The land costs are considered to be essentially those associated with removing 1,375 acres of land from grazing for approximately 12-15 years which could be considered to be valued at $0.37 per acre per year.

There will be created a stabilized tailings pile covering about 175 acres and involving tailings containing solidified waste chemicals and dilute concentrations of radioactive uranium and its daughter products. This land will be restricted from use for a certain period. In case of failure to revegetate the tailings because of other factors such as the chemicals and acidity involved in the tailings, the cost would be about $0.37 per acre per year for grazing purposes.

There has been a slight increase in population and additional traffic generated in connection with the Petrotomics project. Whether any real value can be assigned to resulting changes in the cultural and social factors of the area is debatable. However, the financial benefits to the area will outweigh the possible social and cultural costs connected with the project. The company sponsored townsite, which was developed for the employees and families of Pathfinder Uranium Mine, offers opportunities for an educational, cultural and social atmosphere normally not available in similar remote areas. Any adverse impact of the project on recreation is expected to be minor in view of the relatively small area (as compared to the entire Shirley Basin) involved.

The activities by Petrotomics result in small releases of chemicals and radioactive materials into the environs surrounding the site. Because of the small quantities of materials involved and the dilution and dispersion that now occur, and will continue for the life of the plant, the potential environmental impact is not considered measurable. Thus, the environmental and ecological costs are indeterminably small.

The project will result in a permanent extraction of 26 million pounds of natural uranium as a natural resource.

The ultimate costs resulting from the licensing of the Petrotomics Uranium Mill are found to be: minor changes in certain social and cultural circumstances in nearby communities; a temporary reassignment of land use; the creation of a stabilized tailing retention system which may have to be restricted for a length of time; depletion of a natural resource; a temporary (12-15 years) adverse aesthetic impact from open-pit mining; and the discharge of small amounts of chemical and radioactive effluents into surrounding environs.

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12.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

All licenses, permits and other approvals of construction and operations required by the Federal, State, local and regional authorities for the protection of the environment is listed below. Discharge permits under Section 402 of the Federal Water Pollution Control Act, as amended, do not apply since no liquid is discharged from the property.

FEDERAL AGENCIES

U. S. Nuclear Regulatory Commission

1. Source Materials License SUA-551, expires April 30, 1981 Docket no. 40-6659.
2. Byproduct Materials License 49-17289-01, expires December 31, 1981.
3. Byproduct Materials License 49-17289-02, expires February 28, 1983.

Environmental Protection Agency (EPA)

1. Spill Prevention Control and Containment Plans (SPCC): Approved plans for two, one million gallon storage tanks.
2. Resource Conservation and Recovery Act (RCRA): Filed for and received identification number for Petrotomics. This identified hazardous chemicals on the property.
3. Toxic Substances Control Act (TSCA): Storage and identification of PCB's on the property.

Bureau of Land Management (BLM)

1. Road, powerline and telephone right-of-way approval.
2. Progressing to satisfy the BLM's new (January, 1981) requirements for mine and reclamation plans for Federal lands.

Soil Conservation Service (SCS)

1. Cooperation on property soil sampling.

USDA, High Plains Research Station

1. Cooperation on vegetation and sampling projects.

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