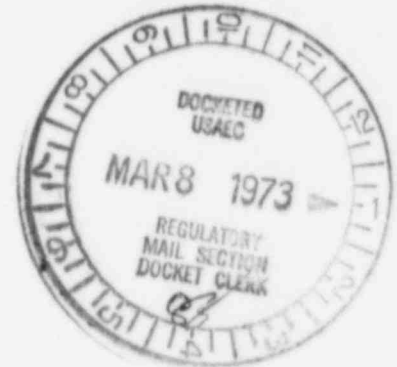


**KERR-McGEE CORPORATION**

KERR-McGEE BUILDING • OKLAHOMA CITY, OKLAHOMA 73102

March 7, 1973



Mr. James C. Malaro, Jr.
Directorate of Materials Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Malaro:

Subject: Application for Amendment to License
SUB-1010, Docket 40-8027
Disposal of Raffinate Liquids

In accordance with telephone conversations with Mr. Jack Rothfleisch of your staff, Kerr-McGee hereby submits a request for Amendment to License SUB-1010, Docket 40-8027, modifying provisions of earlier submittals for the disposal of raffinate liquids. This request for Amendment is not thought to be necessary by Kerr-McGee since it provides for a relatively minor change within the authority of the Group Vice President as described in the conditions of our license stated on Page 3, Appendix A of "Application for Source Material License" dated September 23, 1969.

During 1970 and 1971, several exchanges were held between Kerr-McGee and the AEC on the appropriate disposal of raffinate waste from the Sequoyah Facility. Since 1970, raffinate liquids have been stored in the permanent raffinate retention basins described in our submittal of November 5, 1970, "Design Criteria for Chemical Waste Disposal". An additional pond was built in 1971. The neutralization with lime slurry described in paragraph 2.4.1.2 of our submittal was changed in December 1971 to neutralization with gaseous ammonia in order to achieve more stoichiometric neutralization and lower costs and to avoid premature filling of the raffinate ponds with solid calcium hydroxide.

It is currently estimated that the second retention pond will be filled in the Fall of 1973 (September-December) depending upon the amount of net evaporation this year. It is imperative, therefore, that plans be made promptly to prepare additional storage or an alternative therefor.

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Mr. James C. Malaro, Jr.
March 7, 1973
Page Two

This Amendment is requested for the installation of a concentrator for neutralized supernatant liquid from the retention ponds and for the testing of a raffinate treatment system developed to eliminate radioactive components of the fresh and stored raffinate.

The installation of a submerged combustion burner was tested successfully on pond liquors in 1971 and it is proposed that a burner of 15,000,000 BTU/hr capacity be installed adjacent to the raffinate retention ponds for the purpose of maintaining current pond levels while determination of a final disposal method is being made.

A chemical treatment system has been explored in the laboratory and on a pilot plant basis consisting of treatment with ammonia to neutralize the excess nitric acid present in the raffinate and a subsequent treatment with barium nitrate to precipitate radium, thereby eliminating all radionuclides from the stored or fresh raffinate. The system has been successful in reducing resultant liquors to approximately 1/60 of the MPC value. It is proposed that the clarified supernatant liquid from such a treatment system be used to irrigate and fertilize the graded area in front of the plant and to the west of the plant road during the growing period of 1973 as a test of this method of permanent disposal. The operation of this test would be carefully planned and monitored so as to determine the effect of the addition of this ammonium nitrate to the foliage and the soil and to determine the residual levels of ammonia, nitrate and radium deposited on the foliage and soil during the test. Such a utilization of this material as fertilizer, if proven to be practical, would provide a permanent and beneficial method of disposal for raffinate solution.

Additional process descriptions have been written for these two systems and five copies are attached for your review. We would, of course, be pleased to discuss these process descriptions in greater detail if you so desire.

Sincerely,



W. J. Shelley, Director
Regulation and Control
Nuclear Division

WJS:srj
Attachments

KERR-McGEE CORPORATION
NUCLEAR OPERATIONS

March 7, 1973

ATTACHMENT "A"

Reference: License SUB-1010, Docket 40-8027
Kerr-McGee Sequoyah Facility

Subject: Additional Processes

New Pages
(3-7-73)

Revision Reason

VI-6.1.3 to
VI-6.1.13

Concentration of stored raffinate liquids by a submerged combustion burner.

VI-6.1.14 to
VI-6.1.21

Test of proposed process for removing radionuclides from raffinate liquids.

ADDITIONAL PROCESSES

INTRODUCTION

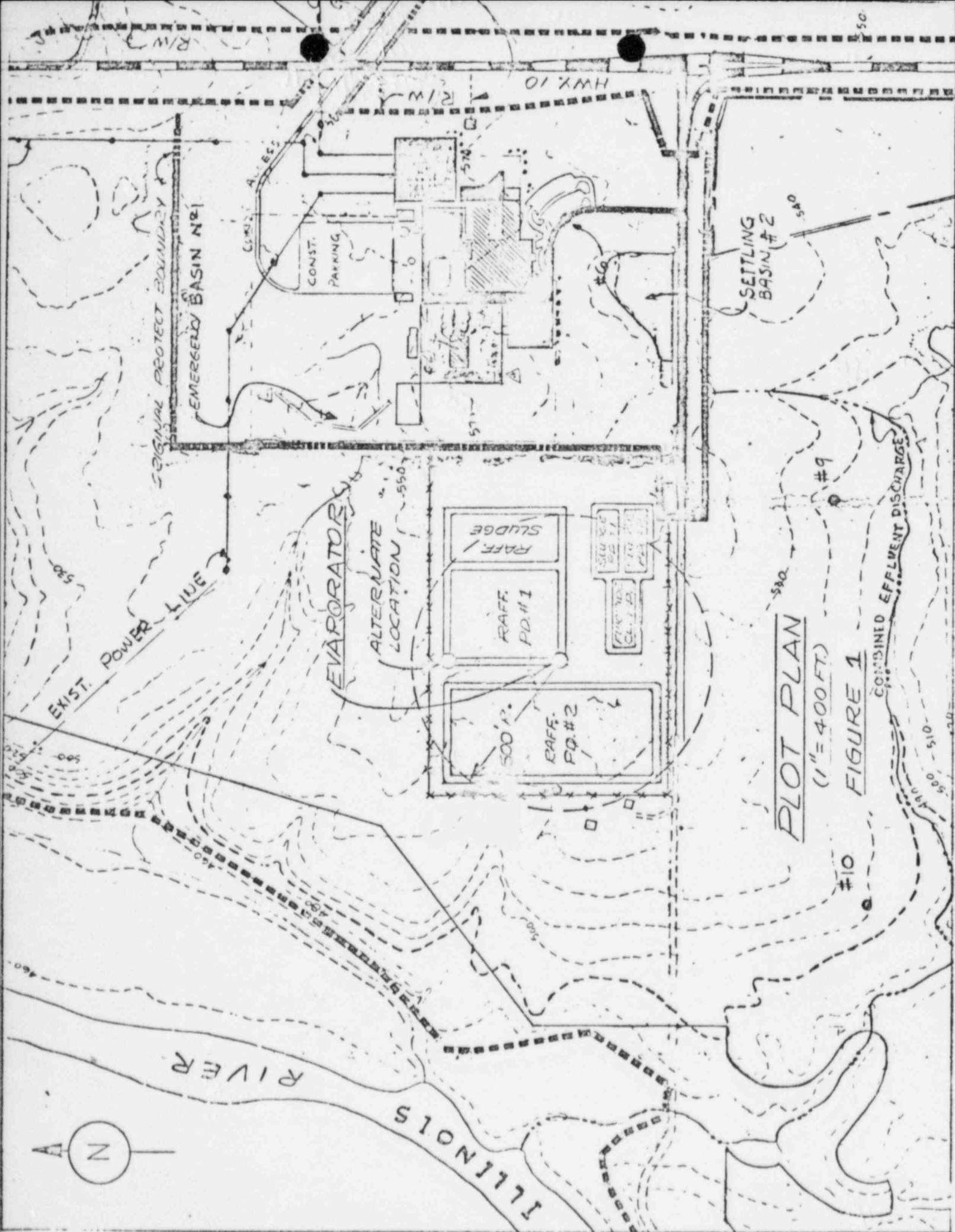
This Process Description covers the addition of a process for the concentration of stored raffinate in the raffinate storage ponds so as to avoid the construction of additional ponds when the present capacity is filled, estimated to be in the Fall of 1973.

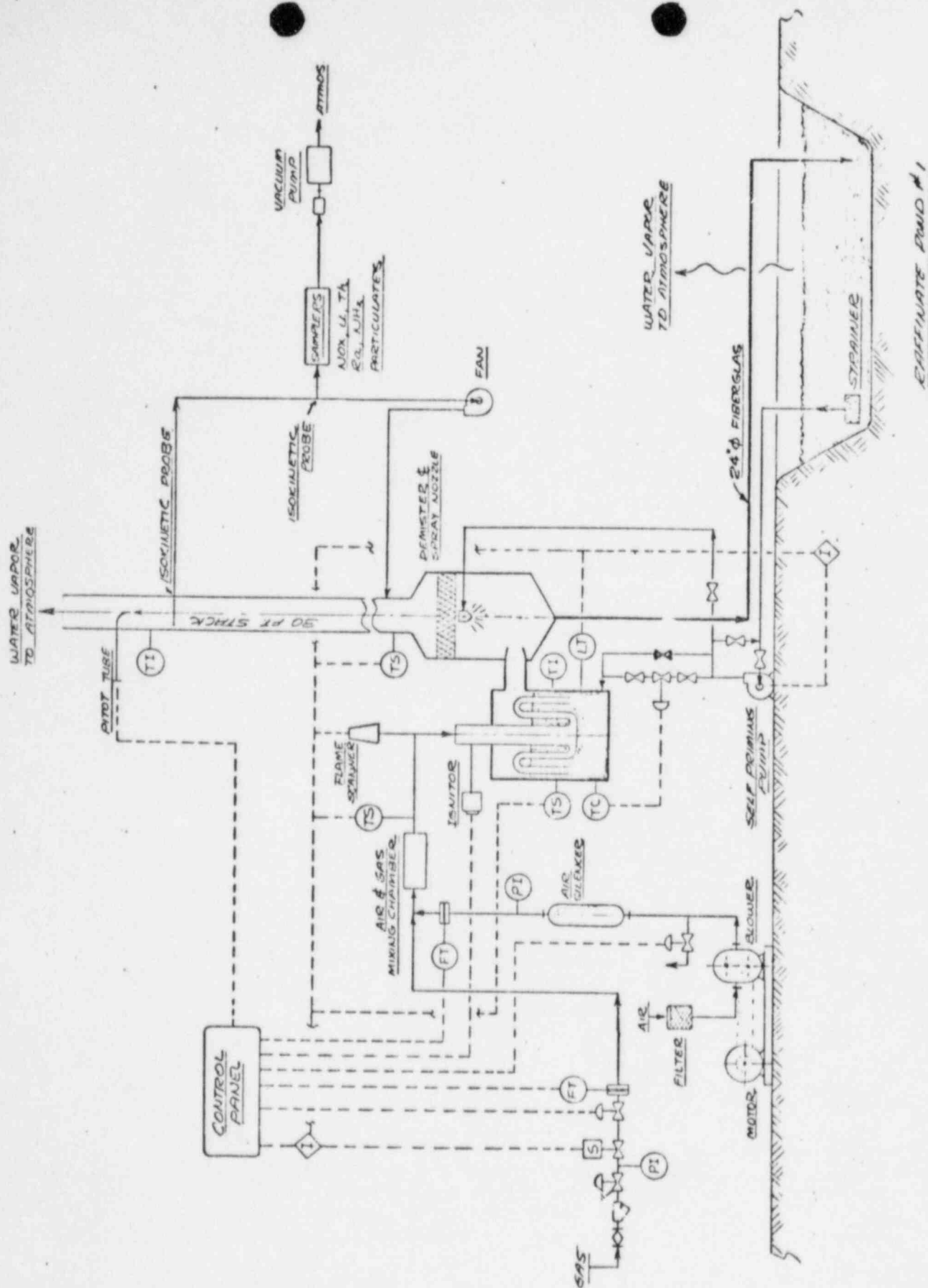
This concentration will be achieved by the installation of a submerged combustion burner manufactured by Ozark-Mahoning Company with a thermal capacity of 15,000,000 BTU/hour and an evaporation rate of approximately 5 gpm, 300 gphr. This evaporator will be installed so that the raffinate fluid in the ponds is piped through the evaporator once and returned to the raffinate ponds thus providing additional evaporative surface for the heated fluid. Additional evaporation (20 gpm) is expected to occur from the surface of the ponds over that normally occurring due to atmospheric conditions.

PROCESS DESCRIPTION

The process of the Sequoyah Uranium Hexafluoride Conversion Plant is well documented by License Application leading to License SUB-1010, Docket 40-8027 and subsequent Environmental Reports dated November 1971, June 1972, and December 1972.

The conversion process employs the use of a solvent extraction system to separate uranium from contaminating materials present in the uranium concentrates supplies to the plant as feed materials. The contaminants rejected by the solvent extraction system are contained in an aqueous solution approximately 1 molar in nitric acid after removal of excess TBP and hexane. This solution is neutralized and is currently stored in retention basins until a permanent method of disposal can be developed.





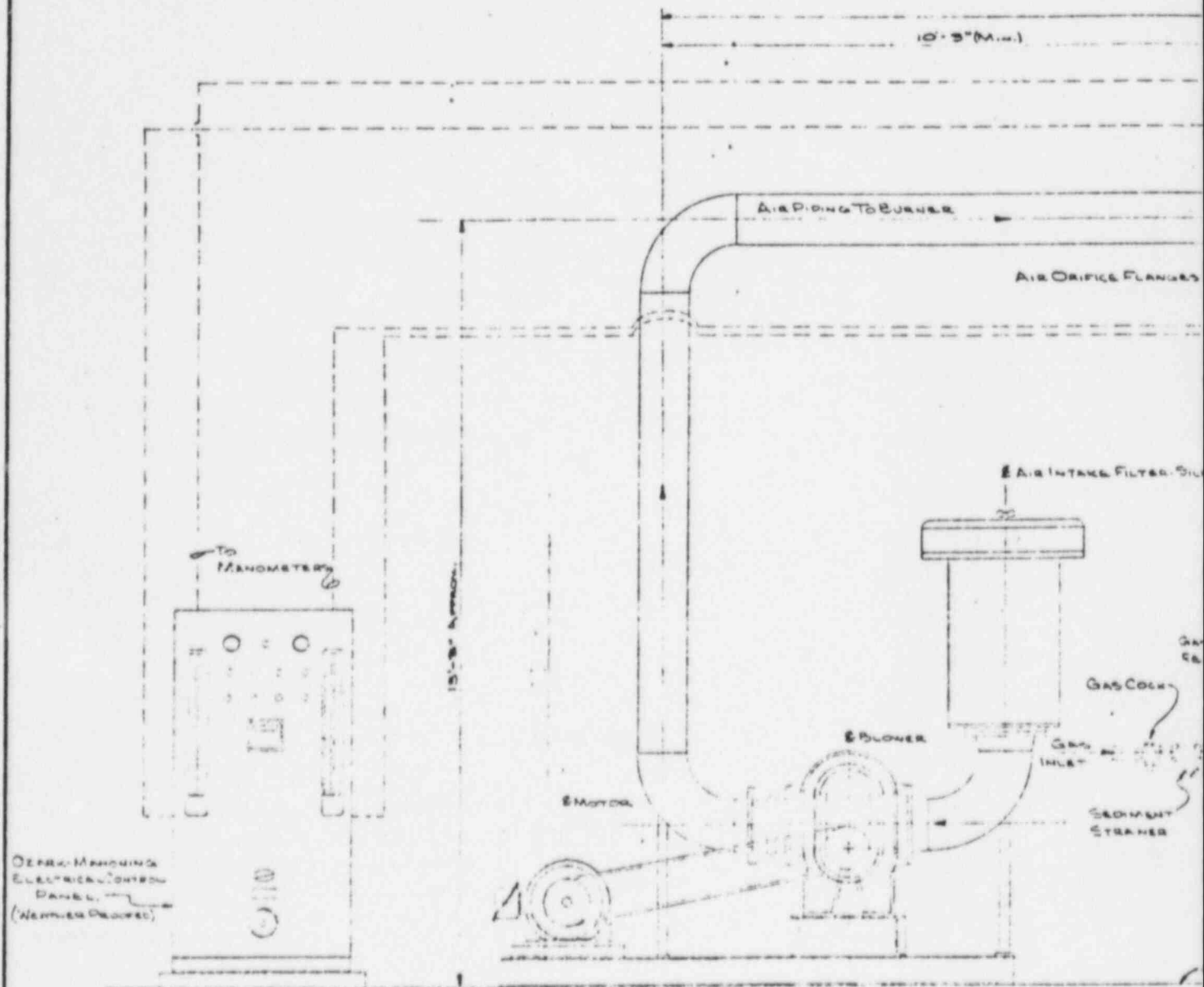
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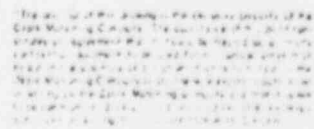
balance of all materials of interest is given on Table I. These data have been extrapolated from the operation of a 300,000 BTU/hr burner tested in 1971.

We understand from Ozark-Mahoning Company that the SCB design produces a NO_x free effluent gas since the reaction time in the burner is short and the temperature of the gases is low. The detailed configuration of the burner and combustion tank is shown on the attached Ozark-Mahoning Company Drawing ODL-1433. The separator and stack will be fabricated in accordance with Kerr-McGee specifications.

The effluent gas and entrained liquid is conducted to a vapor disengagement tank 48" in diameter by 60" high. Mounted approximately 50" from the bottom of the disengagement tank is a 6" thick York wire mesh demister. Immediately below the demister is a spray nozzle through which approximately 100 gpm of cold raffinate solution is sprayed to reduce liquid entrainment. The York wire mesh demister consists of knitted wire mats mounted on a lightweight support grid. The mesh is fabricated from .001" stainless steel wire to a density of approximately 12 lb/cf and a surface area of 110 sft/cuft. Demisters of this type demonstrate an entrainment separation efficiency of greater than 99.9 weight percent over a wide range of vapor velocity while experiencing a pressure drop of no more than 1" of water gage.

Exhaust gases are conveyed from the top of the disengagement tank to the atmosphere approximately 30 feet above grade level in a 36" diameter stainless steel pipe. The stack will be sampled by an isokinetic probe removing approximately 20-40 cfm through a recycle loop and a fan returning the material to the stack immediately above the demister. This recycle loop will be sampled by a secondary isokinetic probe passing the sample to impingers and a particulate sampling filter which will measure





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TABLE I
MATERIAL BALANCE FOR
SUBMERGED COMBUSTION EVAPORATOR

Material	Feed	Product	Stack Emissions	
Combustion (250 scfm natural gas)	lbs/hr		lbs/hr	
Natural gas	650	--	--	
Oxygen	2,514	--	--	
Nitrogen	8,363	--	8,363	
Carbon Dioxide	--	--	1,729	
Combustion Water	--	--	1,415	
Raffinate (225 gpm)				
Chemical	lbs/day	lbs/day	lbs/day	gm/sec
Nitrates	99,792	99,778	13.5	.0711
Ammonia	6,480	6,433	47.4	.2498
Total Solids	137,700	137,690	10.0	.0527
Pond Water	112,500#/hr	110,000#/hr	6.0×10^4	315.0
Radionuclides	$\mu\text{Ci/day}$	$\mu\text{Ci/day}$	$\mu\text{Ci/day}$	$\mu\text{Ci/sec}$
Uranium	24,493	24,492	1.0	$.116 \times 10^{-4}$
Thorium	9,202	9,201	0.7	$.081 \times 10^{-4}$
Radium	1,717	1,717	0.1	$.012 \times 10^{-4}$

NO_x , NH_3 and collect all particulates, thence to a vacuum pump and the atmosphere at .5-1 cfm. The samplers will be initially examined for radioactive contaminants on a daily basis and chemical gases on a weekly basis.

Table II provides an estimate of the pertinent air effluent concentrations calculated as discussed below. These effluent concentrations have been extrapolated from data generated during the test of a 300,000 BTU/hr submerged combustion burner conducted late in 1971.

TEST DATA FROM 300,000 BTU/HR SUBMERGED COMBUSTION BURNER

In late 1971 a test SCB was secured from Ozark-Mahoning to test the application of this process to concentration of the raffinate pond liquids. Nine test operations were completed in the three month period from November 15-February 24. The test unit was installed adjacent to the No. 1 raffinate pond as shown on Figure 3. At the end of each operation, the liquid was returned to the raffinate pond. The purpose of these tests was to vary operating parameters to examine the efficiency of the heater, the degree of operational problems and measure the stack effluent composition and concentration.

During most of the runs, the burner was operated as an evaporator resulting in higher concentrations and temperatures than is planned to apply to the proposed installation. Therefore, the data applicable to run 9 (see Table II) was used as a base for extrapolation to the expected results of the proposed installation. This run was chosen due to the high ratio of feed to evaporation and it covered the temperature range in which we were interested for the proposed installation.

The feed to this run was not neutralized with ammonia as is our present practice thereby resulting in significantly more uranium and thorium in solution than is expected. The stack effluents

TABLE II
Run 9 - 2/24/72

Heat Rate	300,000 BTU/hr
Temperature	120-180°F
Stack Discharge-Dry	49 scfm
Stack Sample Rate	25 scfhr
Feed/Evaporation Ratio	51

Feed Composition*

Total Solids	51 g/l
Nitrates	32.8 g/l
Ammonia	2.8 g/l
Uranium	.05 g/l
Thorium	$59 \times 10^{-8} \mu\text{Ci/ml}$
Radium	$140 \times 10^{-8} \mu\text{Ci/ml}$

Stack Effluents

	<u>$\mu\text{Ci/ml} \times 10^{-12}$</u>
Uranium	9.6
Thorium	6.6
Radium	.9

*See Text

EVAPORATOR FLOW DIAGRAM FOR FEED RECYCLE

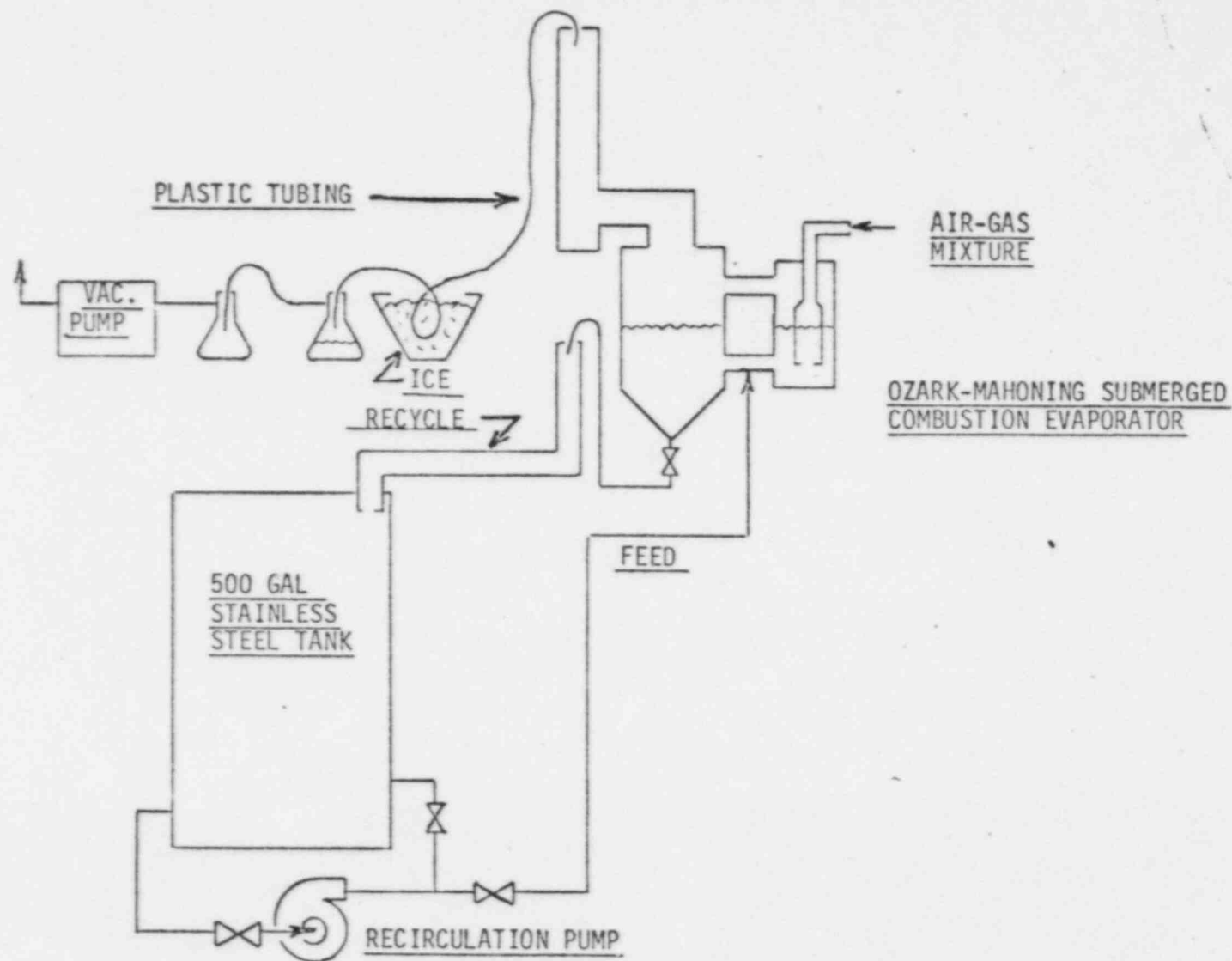


FIGURE 3

from this run, however, were used as a basis for the effluent calculations given below though the stack, during the test run, was not equipped with a demister.

EFFLUENT

The above material balance data shows the concentration of effluent gases as discharged from the stack. The table below gives the estimated concentration of these gases at ground level approximately 500 feet from the point of emission as calculated from the assumptions:

1. Effective stack height - 30'
2. Discharge rate shown on Table I above
3. Wind velocity - 5 miles per hour (the lowest average wind velocity from one direction for the Sequoyah Facility)
4. Stability condition D
5. Distance to point of maximum concentration and XU/Q_{\max} calculated from Figure 3.9, "Workbook of Atmospheric Dispersion Estimates" by USEPA, 1970. $XU/Q_{\max} = 1200$

TABLE III
CONCENTRATIONS

<u>Chemical</u>	<u>Feed</u> <u>g/l</u>	<u>Maximum Ground</u> <u>Level</u> <u>mg/m³</u>
Nitrate	37	.05
Ammonia	2.4	.175
Solids	51	.037
<u>Radionuclides</u>	<u>$\mu\text{Ci/ml}$</u>	<u>$\mu\text{Ci/ml}$</u>
Uranium	1.8×10^{-6}	$.008 \times 10^{-12}$
Thorium	1×10^{-8}	$.0055 \times 10^{-12}$
Radium	140×10^{-8}	$.00075 \times 10^{-12}$

As can be seen from Table III, maximum air concentrations located approximately 500 feet from the point of emission are well below recommended levels for chemicals and 10 CFR 20 limits for radionuclides. The radius of 500 feet is well within Sequoyah site boundaries and would not endanger the public.

ADDITIONAL PROCESSES

INTRODUCTION

The process of the Sequoyah Uranium Hexafluoride Conversion Plant is well documented by License Application leading to License SUB-1010, Docket 40-8027, and subsequent Environmental Reports dated November 1971, June 1972 and December 1972.

The conversion process employs the use of a solvent extraction system to separate uranium from contaminating materials present in the uranium concentrates supplied to the plant as feed materials. The contaminants rejected by the solvent extraction system are contained in an aqueous solution approximately 1 molar in nitric acid after removal of excess TBP and hexane. This solution is neutralized and is currently stored in retention basins until a permanent method of disposal can be developed.

It is proposed to further treat such neutralized solution with a soluble barium salt (barium nitrate) thereby precipitating the Radium₂₂₆, a radioactive daughter product of normal uranium, as a sulfate with a barium sulfate carrier thereby eliminating all radioactive sources from the supernatant liquid remaining. This dilute ammonium nitrate solution can be used directly as a fertilizer solution or further enriched in ammonium nitrate and used in its normal concentrations of approximately 32% as a commercial source of fertilizer solution. In this manner, the radionuclides are separated from the bulk of liquid waste resulting from the solvent extraction cycle and may be permanently disposed of as solids by burying in accordance with 10 CFR 20.304.

ADDITIONAL TREATMENT

During 1972, a series of tests were conducted in the laboratory

and in pilot plant equipment erected for that purpose to further treat the raffinate solution to eliminate the radionuclide content of the solution. The test equipment, as shown on Figure 1, is fabricated of mild steel and located on the dike of Pond No. 1.

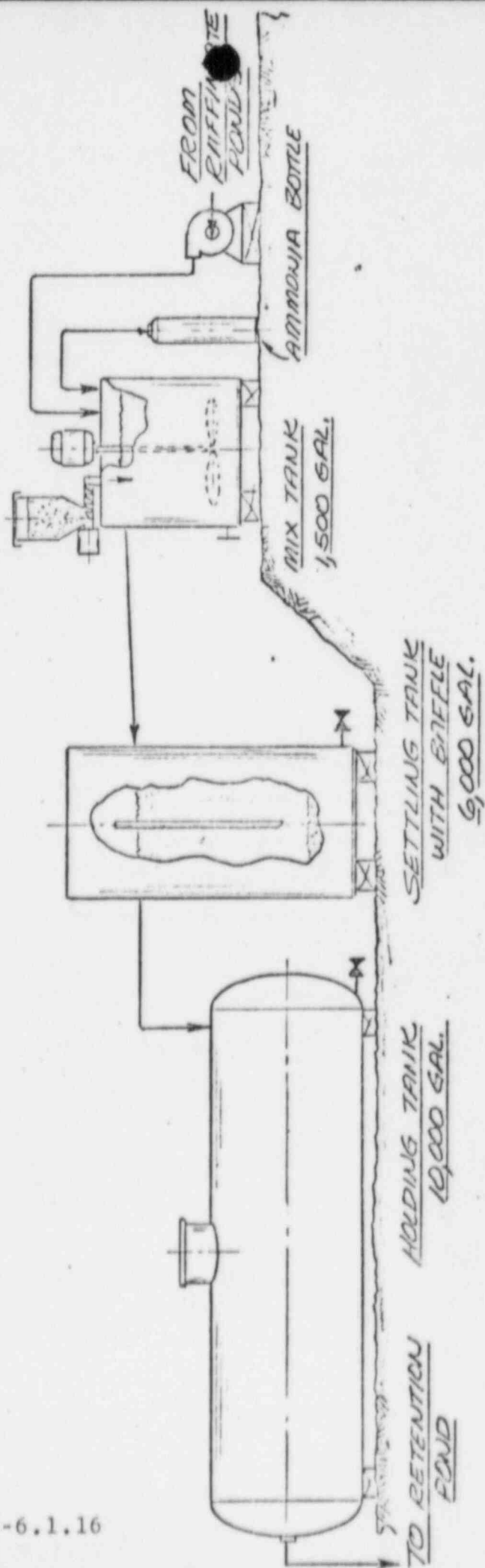
These tests demonstrated that the solution portion of the raffinate stream can be treated with a soluble barium salt, barium nitrate, which will precipitate as a sulfate and, simultaneously, remove the radium as a sulfate. The results of the last series of tests are shown on Table I. It is believed that this barium precipitation occludes the radium sulfate as it is formed so that radium sulfate is entrapped in the solid particle of essentially barium sulfate. Adequate sulfate concentrations are contained in the solution originating with the feed materials to perform this precipitation.

As a result of this treatment, the treated raffinate solution will have approximately the analysis shown on Table II. This analysis will vary with the age of the feed material, the concentration method used and the amount of dilution with rainwater received by the raffinate after storage in the pit.

As will be noted, the solution contains a measurable amount of ammonium nitrate, a valuable commercial fertilizing compound. Ammonium nitrate is normally manufactured by the synthesis of ammonia and nitric acid, the subsequent reaction of the two, and absorption in water. It is solidified as a molten salt with a water content of about 20% of the resultant particle, packaged and sold as a high nitrogen solid containing approximately 33% available nitrogen. Dilute solutions, 32% ammonium nitrate, are also distributed commercially for certain uses. Such solutions are normally made by transporting the solid ammonium nitrate from the manufacturer, dissolving and diluting to the standard concentration at a distribution point, and delivering the solution locally.

FLOW DIAGRAM
FOR REDUCING RADIONUCLIDES IN RAFFINATE

BARIUM NITRATE
FEED BIN



VI-6.1.1.16

FIGURE 1

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TABLE I
RAFFINATE TREATMENT TEST RESULTS

<u>Date of Test</u>	<u>pH</u>	<u>BA Concentration</u> <u>g/l</u>	<u>Ra Concentration</u> <u>$\mu\text{Ci/ml} \times 10^{-8}$</u>
Ammonia Neutralization Then Added Barium Nitrate			
12/29/72	7.6	.1	.6
1/5/73	6.2	.4	.3
1/11/73	7.5	.8	.03*
1/3/73	8.3	1.2	1.2
1/16/73	7.7	1.6	1.1
1/19/73	8.0	3.0	.03*
Barium Nitrate Added Then Neutralized With Ammonia			
1/3/73	7.8	.2	.2
1/10/73	7.5	.6	.03*
1/12/73	8.1	1.0	.03*
1/14/73	7.8	1.4	.03*
1/18/73	8.8	2.0	.03*
Untreated			
Average of 12 Samples	6.4	---	100.0

*Minimum detectable and standard deviation of analytical procedure

TABLE II

	<u>Raffinate #1</u>	<u>Raffinate #2</u>
<u>Chemical</u>		
Ammonia	1.57 g/l	6.69 g/l
Nitrate	6.7 g/l	8.2 g/l
Fluoride	20 mg/l	46 mg/l
Sulfate	700 mg/l	2400 mg/l
Calcium	6490 mg/l	2650 mg/l
Sodium	1290 mg/l	1420 mg/l
Chlorine	56 mg/l	90 mg/l
Bicarbonate	11 mg/l	129 mg/l
Iron	0.5 mg/l	15 mg/l
Magnesium	68.5 mg/l	265 mg/l
<u>Radionuclides*</u>	<u>$\mu\text{Ci/ml}$</u>	
Uranium	1.8×10^{-6}	
Thorium	1×10^{-8}	
Radium	$.05 \times 10^{-8}$	

*Typical analysis from several tests with a range of $\pm 100\%$.

TEST DISPOSAL

The most economical disposal of this solution would be direct application as a fertilizing solution to a selected plot of ground or crop. In view of the origin of the solution, considerable resistance may be expected without further demonstration of its nondeleterious effects. It is, therefore, planned that a test solution from the pilot plant treatment unit now in operation be sprinkled on the graded area immediately in front of the Sequoyah Facility. The area west (see following page) of the entrance road, north and west of the No. 1 settling basin, has been planted in bermuda and rye grass and drains to the edge of the settling basin where surface water is collected in a concrete lined ditch and conducted to the west where it joins the outfall from the settling basin and is combined with the total outfall stream from the plant just north of the Port Facility Road. Immediately after combination, it is piped under the road into a stilling basin where, in combination with the other streams, it is sampled for effluent quality. In this manner, any effects on the plants growing in the area could be measured with the planted area east of the entrance road used as a control and the effects of this ammonium nitrate solution measured during the 1973 growing season.

The test area (approximately 400' x 400') would receive at least 400 pounds of available nitrogen per acre. The rate will be increased gradually until routine (each eight hours) average analysis of the combination stream reaches 9 ppm nitrogen (maximum permitted by the Oklahoma Water Quality Standards) or until observable damage occurs to plants. The rate will remain steady during the balance of the growing season.

Prior to this test, plants existing in this area and the control area and the soil in both areas would be sampled and analyzed for the content of nitrogen and radionuclides. The quantity and content of the fluid used as a fertilizer solution would also be

measured and the plants and soil again measured upon the completion of the test. Plants in the control area east of the entrance road will be analyzed as a control.

FUTURE DISPOSITION

With the demonstration that this treated solution can be employed as a fertilizer solution without cumulative effects on the plant life, installation of a correct treatment system of sufficient size to treat the entire raffinate flow would be installed and the treated solution disposed of by distribution over the lands laying to the south and east of the plant.