

Regulatory

File Cy.

DOCKET NO. 40-8027

**KERR-MCGEE CORPORATION**

KERR-MCGEE BUILDING • OKLAHOMA CITY, OKLAHOMA 73102

February 16, 1973

Mr. Donald A. Nussbaumer
Directorate of Materials Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545



Dear Mr. Nussbaumer:

Re: Disposal of Raffinate Liquids
License SUB-1010, Docket 40-8087

Please refer to our earlier exchange of information on the above subject during 1970 and 1971. Since 1970, raffinate liquids have been stored in the raffinate retention basins described in our submittal of November 5, 1970, "Design Criteria for Chemical Waste Disposal". An additional pond was built in 1971 to provide for the additional accumulation of discarded liquid raffinates. The neutralization with lime slurry, as described in paragraph 2.4.1.2 of the subject submittal, was changed in December 1971 to neutralization with gaseous ammonia in order to achieve more stoichiometric neutralization, 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. As a consequence, it is imperative that alternate methods of disposal be examined in order to avoid the construction of additional ponds on less favorable topography or at a greater distance from the plant. As a consequence of the need to evolve a permanent disposal system for the radionuclides contained in the raffinate, a chemical treatment system has been explored in the laboratory and on a pilot plant basis. The treatment system consists of neutralization with ammonia which precipitates uranium and thorium as hydrous oxides and subsequently with a soluble barium compound (barium nitrate) to precipitate radium and barium sulfates simultaneously. These experiments have proven successful in that radium concentrations in resultant supernatant liquids have approached $.05 \times 10^{-8}$ $\mu\text{Ci/ml}$, approximately 1/60 of MPC. It is believed that lower concentrations are achieved but the

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difficulty of determination at such low levels precludes the establishment of a controlled reliable analysis in this range. It is planned that the clarified supernatant liquid from such a treatment system be used to sprinkle 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 supervised so as to secure the level of residual radionuclides left with the grasses, the residual amount of nitrate remaining after the growing season, and the amount of nitrate flushed to surface water by rainfall during this period. A more complete description of the process is attached. If such a system proved to be a practical method for permanent disposal of raffinate solutions, process modifications would be made and a significant area of the Sequoyah site used for such disposal.

The form of this submission is informational rather than regulatory in the belief that there is nothing novel in this treatment and the use of ammonium nitrate as fertilizer solution is well documented and has long since been reduced to commercial practice. Discharge of radioactive materials to the environment would be held to a very small fraction of the provisions of 10 CFR 20. Therefore, we do not believe that formal regulatory submission is necessary.

Five copies of the process description are included for your review and we would, of course, be pleased to discuss this in further detail if you so desire.

Sincerely,



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

WJS:srj

Attachment

PROCESS DESCRIPTION
RAFFINATE TREATMENT
SEQUOYAH HEXAFLUORIDE PLANT
LICENSE SUB-1010, DOCKET 40-8087

INTRODUCTION

The process of the Sequoyah Uranium Hexafluoride Conversion Plant is well documented by License Application leading to License SUB-1010, Docket 40-8087, 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.

PROCESS DESCRIPTION

Uranium ore concentrates are received in 55 gallon drums at the Sequoyah Facility, sampled and digested in a 45% solution of nitric acid, the uranium extracted in a countercurrent TBP hexane solvent extraction system, reextracted by water, concentrated, denitrated, reduced with hydrogen, hydrofluorinated and fluorinated to product quality UF_6 where it is then condensed, loaded into cylinders and shipped to one of three U.S. Government diffusion cascades for enrichment of the U_{235} isotope as a source of nuclear reactor fuel. The contaminants entering the process with the uranium concentrates are separated in the solvent extraction system as an aqueous solution containing metallic impurities and ions other than nitrate and all of the accompanying radioactive daughter products of uranium. Aqueous "raffinate" is washed with hexane to remove any residual TBP, decanted to separate entrained hexane, and pumped to one of two raffinate hold tanks for the measurement of unextracted uranium. If the uranium has not been completely extracted, it is recycled into the extraction system for further treatment. If analysis demonstrates that uranium concentration is below 1 gm/l, approximately .25% of the incoming uranium-rich digest solution, the raffinate solution is ready for discard.

Currently, this raffinate is treated with ammonia to neutralize the excess nitric acid present and pumped to a permanent retention basin where it is held pending the development of a process for disposal of the solid material, including the radionuclides, contained in the raffinate.

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. As a consequence of

these tests, it has been 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. 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 as received to perform this precipitation. As a result of this treatment, it has been found that the treated raffinate solution has approximately the analysis shown on Table I.

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 ammonium 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. More 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.

PERMANENT 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,

TABLE I

<u>Chemical</u>	<u>Raffinate #1</u>	<u>Raffinate #2</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 $\pm 100\%$.

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 pumped through an underground sprinkling system to the graded area immediately in front of the Sequoyah Facility. The area west of the entrance road, north and east 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.

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.

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. Distribution would be achieved through the

construction of appropriate surface channels and dikes rather than a sprinkling system. Topography is desirable to provide gradual distribution of the treated solution without undue runoff and, at the same time, provide essentially uniform distribution to all plant life in the area.

U.S. ATOMIC ENERGY COMMISSION
MATERIALS DATA INPUT

4 SOURCE AND REFERENCE COPY



DOCKET NUMBER 040-08027	MAIL CONTROL NO. 01111	DATE REQUEST REC'D 02/16/73	PROGRAM CODE (PRIMARY)
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SECONDARY PROGRAM CODES:				
#1	#2	#3	#4	#5

INDIVIDUAL	NAME	NAME
	NAME	NAME
	NAME	NAME

ORGANIZATION	ORGANIZATION NAME Kerr-McGee Corporation	TYPE OF ORGANIZATION	
	DEPARTMENT OR BUREAU	U. S. GOVERNMENT AGENCY	EDUCATIONAL INSTITUTION
		MEDICAL INSTITUTION	INDUST

ADDRESS	BUILDING, STREET	CITY Oklahoma City	STATE OK	ZIP CODE 73102
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APPLICANT'S COMMUNICATION DATED: 02/13/73	CLASSIFICATION U	ASSIGNED TO:	RESULTING AMD. NO.
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ENCLOSURES:

Process Description Raffinate Treatment Sequoyah Hexafluoride Plant

UNCLASSIFIED DESCRIPTION:

Ltr. requesting an amendment to SUD-1010 to install a large burner with the capacity to evaporate sufficient liquids to maintain current pond levels, also their plans for an additional storage or alternate disposal.

DISTRIBUTION: RO
PDR

ACKNOWLEDGED

DO NOT REMOVE

OTHER REFERRALS			
NAME	DATE	NAME	DATE
Buchanan: W/Reg. file cy & folder 3 extras	2/16		crj