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Docket 40-8027

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LCRouse

JE Rothfleisch

JBMartin

DOCKET NO.: 40-8027

APPLICANT: Kerr-McGee Nuclear Corporation

FACILITY: Sequoyah Uranium Hexafluoride Production Plant

SUBJECT: EVALUATION OF REQUEST BY KERR-MCGEE NUCLEAR CORPORATION FOR AMENDMENT OF SOURCE MATERIAL LICENSE SUB-1010 TO AUTHORIZE TEST OF ON-SITE DISPOSAL OF SOLVENT EXTRACTION RAFFINATE.

1. Proposed License Amendment

By letter dated March 9, 1977, with enclosure, and in a second letter dated April 15, 1977, with enclosure, as amended April 26, 1977, Kerr-McGee Nuclear Corporation (KM) requested amendment of Source Material License SUB-1010 to authorize the test disposal of barium treated neutralized raffinate by distributing this material over about 160 acres of KM owned land immediately south of the Sequoyah Facility during the 1977 growing season. KM proposes to have the treated raffinate which contains about 80 g/l  $\text{NH}_4\text{NO}_3$  and less than 3pCi/l Ra-226 (0.1 pCi/gH) applied to the test area by contract with a commercial applicator using standard fertilizer spraying material. Approximately 1000 pounds of nitrogen per acre would be spread uniformly over the entire area in six treatments during the growing season except for a clear area of about 20 acres on the southwest side of the test plot which would receive about 1500 pounds of nitrogen per acre provided this heavier application produces no visible damage to the foliage.

The proposed action is to issue the amendment requested by the licensee with the test program to be conducted in accordance with the statements, representations and conditions contained in the application and enclosure dated March 9, 1977 as amended by letter and enclosure dated April 15, 1977 and as modified by several additional conditions developed by FCPF staff and described in a subsequent section of this evaluation.

2. Background Information

The Kerr-McGee Sequoyah Facility is currently licensed to produce 5000 tons per year of uranium as  $\text{UF}_6$  from ore concentrates supplied by various uranium mills. The process employed, generally referred to as the "wet process," involves dissolution of the ore concentrates in nitric acid followed by purification of the resulting impure uranyl nitrate solution

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by treatment in a solvent extraction (Sx) circuit. The impurities are rejected from the Sx circuit in the form of a "barren" aqueous solution termed Sx raffinate which contains nitric acid, ammonium nitrate and metallic salts along with small quantities of uranium and the radioactive daughter products of natural uranium decay. The raffinate solution is treated with ammonia to neutralize the acid content which precipitates most of the heavy metal ions along with most of the radioactive materials. Subsequent treatment of the clear solution from the neutralization step with barium nitrate precipitates essentially all of the residual radium as a barium-radium sulfate. A typical analysis of treated Sx raffinate after removal of the barium-radium sludge is reported by KM as that shown in Table 1.

Commencing with the 1973 growing season and repeated each year through 1976, USNRC has issued amendments to license SUR-1010 authorizing small scale test programs to investigate the effects of using treated raffinate as a fertilizer material under closely controlled conditions on about 3 acres of KM owned land within the project boundary. Reports covering the results of these tests were submitted by the licensee dated February 20, 1974, March 7 and March 12, 1975, and March 19, 1976.

In the 1973 study, the entire 3 acre plot was fertilized with treated raffinate only and some difficulty was experienced with burning of the foliage presumably due to frequent light applications of the test solution. After the foliage had recovered, application was resumed with less frequent, higher volume batches. Samples of soil and vegetation were taken in May 1973 prior to starting the test, in September 1973 and again in January 1974, along with control samples taken from an untreated area adjacent to the test area. The test results showed that the raffinate treatment produced a radium concentration well below the 10 CFR 20 discharge limits (30 pCi/l) and below the allowable drinking water standards (3 pCi/l). Moreover, the application of treated raffinate appeared to have a beneficial effect on the growth and vitality of bermuda grass forage without showing any measurable buildup of calcium, fluoride, sodium, uranium or radium in either the soil or the vegetation.

For the 1974 study, four test plots ranging in size from 0.64 to 0.78 acre were used with raffinate plus commercial fertilizer applied to two plots, commercial fertilizer only, including nitrogen, applied to a third plot and commercial fertilizer only with no nitrogen applied to the fourth plot. In this test the raffinate treatment was modified in that the as produced raffinate was treated first with barium carbonate, then neutralized with ammonia. The test data showed that the plot treated with commercial fertilizer including 466 pounds of nitrogen received almost twice the Ra-226 as the plot treated with 1080 pounds of nitrogen supplied by raffinate and 2.4 times as much Ra-226 as the plot treated with 519 pounds of raffinate derived nitrogen. Nitrogen balances and recovery of nitrogen in the forage were poor. However, the test demonstrated that from the standpoint of nitrogen fertilization, raffinate

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treatments performed the same as commercial ammonium nitrate. It was recommended that the study be continued and that efforts be made to obtain complete water, nitrogen and radionuclide balances. No significant change in radium or nitrogen content of the total plant effluent was noted as a result of the test nor was any correlation found between the Ra-226 in the vegetation and the Ra-226 applied with the fertilizer.

The 1975 test program was conducted following a procedure similar to that used in the 1974 study. These test results reported by KM indicated the following:

- a. Sx raffinate can be treated to a Ra-226 level of less than 3 pCi/l and frequently less than 1 pCi/l.
- b. The quantity of Ra-226 introduced into the environment from treated raffinate, is insignificant compared to that contained in nature; i.e., of the total 708 nCi of Ra-226 applied to Test Plot No. 1, only 3 nCi was derived from the raffinate, 664 nCi from rainwater and the remainder from irrigation water and commercial fertilizers.
- c. Treated raffinate solution is equivalent to commercial ammonium nitrate in its effect on plant growth.
- d. Reasonable material balances for Ra-226 and nitrate are obtainable. These balances indicate no adverse effect on the environment.

Results of the 1976 test program have not yet been reported.

By letter dated April 29, 1976, KM applied for an amendment to License SUB-1010 authorizing the disposal of treated raffinate on about 250 acres of open grassland within the KM owned Sequoyah facility site. This proposal called for the application of up to 1000 pounds of nitrogen per acre spread at appropriate intervals throughout the growing season. An evaluation of this proposal, issued in memorandum form dated June 11, 1976, was based on information submitted by KM dated August 13, December 8 and 9, 1975 and April 29 and May 3, 1976. This information contains data describing the concentrations of chemical constituents and radionuclides in the treated raffinate along with data obtained from the small scale tests described above. It was concluded in this evaluation that the request to use treated raffinate as a fertilizer on 250 acres of pasture would meet the radiological safety limits of 10 CFR 20 for release of radionuclides to the environment. The radium content meets the USEPA proposed drinking water standards for radium. However, it was also concluded that the molybdenum content of the raffinate could cause toxicity in cattle and the nickel and copper content could cause plant damage. In rebuttal to these conclusions, based on an

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Investigation conducted by B. B. Tucker, Professor of Soil Fertility at Oklahoma State University acting as consultant to KM, it was reported to KM by letter dated September 22, 1976 and forwarded to NRC by letter dated September 29, 1976 that: "Based on the literature review of these elements, (Cu, Mo, and Ni) I must conclude that from the data collected there is no reason to suspect any deleterious effects to the forage production or on the raffinate treated plots at Gore." It should be pointed out that the potential for adverse effect on domesticated animals consuming the forage is academic since the present application does not propose the use of the forage produced as animal feed.

### 3. Discussion

Uniform application of 1000 pounds of nitrogen per acre in the form of treated raffinate having the composition shown in Table 1 would result in the addition of about 9  $\mu$ Ci of uranium, 9 nCi of Ra-226, 10 nCi of Th-230, and 18 nCi of Th-232 per acre over the 1977 growing season.

Eisenbud in Environmental Radioactivity reports the overage radium content of rocks and soils as 0.7 pCi/g with a range of 0.2 to 2.06 pCi/g, the uranium content of limestone and other sedimentary rocks as 1.2 to 1.3 ppm and the thorium-232 content of sandstones, shales and limestones ranging from 0.14 to 1.1 pCi/g. KM reports the soil radium content of the area as 0.25 pCi/g and the uranium content ranging from 0.5 to 5 ppm. Assuming the radium at 0.25 pCi/g, uranium at 2.5 ppm, thorium-232 at 0.5 pCi/g, the thorium-230 in secular equilibrium with the uranium-238, and the soil density at 2 g/cm<sup>3</sup>, the calculated content of these radionuclides in the upper 1 cm of soil and the percentage increase in concentration resulting in the application of 1000 pounds of nitrogen per acre is shown in the following tabulation:

Radionuclide	Background Content of Top 1 cm of Soil pCi/ acre	Addition at 1000 lbs N per acre pCi/acre	Concn Increase in Top 1 cm of Soil %
Ra-226	$2.02 \times 10^7$	$9 \times 10^3$	0.045
U-natural	$1.37 \times 10^8$	$9 \times 10^6$	6.6
Th-230	$6.74 \times 10^7$	$10 \times 10^3$	0.015
Th-232	$4.05 \times 10^7$	$18 \times 10^3$	0.044

Thus, the only radioactive component for which a detectable increase in concentration might be expected would be total uranium.

It should be pointed out that the concentrations of the various radionuclides reported in the raffinate are all at least two orders of magnitude below the 10 CFR 20 Appendix B, Table II, Column 2 allowable concentrations for release to uncontrolled areas. Moreover, in accordance with the criteria given in Footnote No. 5 of Appendix B, the radionuclides

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could be considered as not present.

Upon spraying the treated raffinate solution on the soil, the radioactive constituents will either remain in the soil or vegetation or will seep into the ground. If it is assumed that all of the radionuclides are uniformly deposited on the surface of the soil and are then resuspended in the air with a resuspension factor of  $10^{-8}$  per meter, the concentration of uranium in the air will be about  $2 \times 10^{-17}$   $\mu\text{Ci/ml}$  while the Ra-226, Th-230, and Th-232 airborne concentrations will be  $2.2 \times 10^{-20}$ ,  $2.6 \times 10^{-20}$  and  $4.5 \times 10^{-20}$   $\mu\text{Ci/ml}$  respectively. These values are several orders of magnitude below the maximum allowable concentrations listed in 10 CFR 20 Appendix B, Table II, Column 1. In the event that the raffinate seeps into the ground, the movement of the contained radionuclides will be slow due to ion exchange with the soil. Moreover, since the initial concentrations of the nuclides are substantially below MPC and will be further diluted if they reach the ground water, no measurable contamination or environmental impact on underground water is anticipated.

Based on this analysis, it is concluded that the proposed amendment is non-substantive and insignificant from the standpoint of environmental impact and pursuant to subparagraph 51.5 (c)(3)(d)(3) of 10 CFR 51, no environmental impact statement, negative declaration, or environmental impact appraisal need be prepared.

#### 4. Recommendation

On the basis of the findings in the current assessment coupled with the stringent controls described by the licensee in his application, it is recommended that Source Material License No. SUB-1010 be amended to authorize the test disposal of barium treated neutralized raffinate in accordance with the statements, representations, procedures and conditions described by the licensee subject to the following conditions:

As discussed and agreed upon in a telephone conversation between J. E. Rothfleisch and W. J. Shelley on April 25, 1977 and confirmed by letter dated April 26, 1977, notwithstanding the procedures described by the licensee in his applications and enclosures dated March 9 and April 15, 1977 as amended April 26, 1977, the following conditions shall apply to this amendment.

- a. The licensee shall install a diversion ditch along the north-south "enceline" of the soybean field at the west boundary of the test plot to prevent contamination of the field by surface runoff. The ditch shall be sloped to cause any test plot runoff to flow to the south side of the north dike. Collected runoff shall be analyzed and disposed of as described on page 6 of the licensee's application.

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- b. The location of the monitoring well shown in Area 5 on the map submitted with the April 15, 1977 application shall be changed to a site in the extreme southwest corner of Area 3.
- c. The licensee shall collect samples of soil water (from soil sorption cups) and ground water (from monitor wells) approximately 10 days to 2 weeks after each application of treated raffinate is completed. Each sample shall be analyzed for pH, nitrogen, copper, nickel, molybdenum, uranium, radium, and thorium. In the event that the ground water samples indicate an increase in radium or thorium concentration of 1.0  $\mu\text{Ci/l}$  or more above background levels or an increase in uranium concentration of 50 percent or more above background, the licensee shall immediately notify USNRC and shall cease the application of treated raffinate to the test plot.
- d. In the April 1978 completion report for the 1977 growing season test, the licensee shall include an analysis and evaluation of the test results in addition to presenting the raw test data.

Original Signed by

J. E. Rothfleisch  
 Fuel Processing & Fabrication Branch  
 Division of Fuel Cycle & Material  
 Safety

Enclosure:  
 As stated

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DATE	5/3/77	5/4/77				

TABLE I

## TREATED RAFFINATE ANALYSIS

<u>PARAMETER</u>	<u>ANALYSIS</u>
<u>mg/l</u>	
Ag	<0.001
As	0.54
Ba	3.0
B	23.
Cd	<0.001
Co	0.5
Cr	0.04
Cu	50.
Fe	1.
Hg	<0.001
Mg	310.
Mn	0.9
Mo	260.
Ni	16.
Pb	0.004
Se	<0.005
V	0.8
Zn	1.4
U	0.80 (avg of Nos. ranging 0.13 -1.5)
<u>pCi/l</u>	
Ra (sol.)	0.22
Ra (insol.)	0.33
Th-230	0.89
Th-232	1.12



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

MAY 9 4 1977

DOCKET NO.: 40-8027

APPLICANT: Kerr-McGee Nuclear Corporation

FACILITY: Sequoyah Uranium Hexafluoride Production Plant

SUBJECT: EVALUATION OF REQUEST BY KERR-MCGEE NUCLEAR CORPORATION FOR  
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It should be pointed out that the concentrations of the various radionuclides reported in the raffinate are all at least two orders of magnitude below the 10 CFR 20 Appendix B, Table II, Column 2 allowable concentrations for release to uncontrolled areas. Moreover, in accordance with the criteria given in Footnote No. 5 of Appendix B, the radionuclides

treatments performed the same as commercial ammonium nitrate. It was recommended that the study be continued and that efforts be made to obtain complete water, nitrogen and radionuclide balances. No significant change in radium or nitrogen content of the total plant effluent was noted as a result of the test nor was any correlation found between the Ra-226 in the vegetation and the Ra-226 applied with the fertilizer.

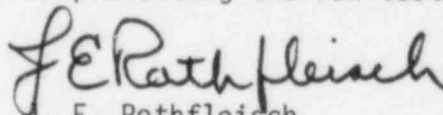
The 1975 test program was conducted following a procedure similar to that used in the 1974 study. These test results reported by KM indicated the following:

- a. Sx raffinate can be treated to a Ra-226 level of less than 3 pCi/l and frequently less than 1 pCi/l.
- b. The quantity of Ra-226 introduced into the environment from treated raffinate, is insignificant compared to that contained in nature; i.e., of the total 708 nCi of Ra-226 applied to Test Plot No. 1, only 3 nCi was derived from the raffinate, 664 nCi from rainwater and the remainder from irrigation water and commercial fertilizers.
- c. Treated raffinate solution is equivalent to commercial ammonium nitrate in its effect on plant growth.
- d. Reasonable material balances for Ra-226 and nitrate are obtainable. These balances indicate no adverse effect on the environment.

Results of the 1976 test program have not yet been reported.

By letter dated April 29, 1976, KM applied for an amendment to License SUB-1010 authorizing the disposal of treated raffinate on about 250 acres of open grassland within the KM owned Sequoyah facility site. This proposal called for the application of up to 1000 pounds of nitrogen per acre spread at appropriate intervals throughout the growing season. An evaluation of this proposal, issued in memorandum form dated June 11, 1976, was based on information submitted by KM dated August 13, December 8 and 9, 1975 and April 29 and May 3, 1976. This information contains data describing the concentrations of chemical constituents and radionuclides in the treated raffinate along with data obtained from the small scale tests described above. It was concluded in this evaluation that the request to use treated raffinate as a fertilizer on 250 acres of pasture would meet the radiological safety limits of 10 CFR 20 for release of radionuclides to the environment. The radium content meets the USEPA proposed drinking water standards for radium. However, it was also concluded that the molybdenum content of the raffinate could cause toxicity in cattle and the nickel and copper content could cause plant damage. In rebuttal to these conclusions, based on an

- b. The location of the monitoring well shown in Area 5 on the map submitted with the April 15, 1977 application shall be changed to a site in the extreme southwest corner of Area 3.
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- d. In the April 1978 completion report for the 1977 growing season test, the licensee shall include an analysis and evaluation of the test results in addition to presenting the raw test data.



J. E. Rothfleisch  
Fuel Processing & Fabrication Branch  
Division of Fuel Cycle & Material  
Safety

Enclosure:  
As stated



could be considered as not present.

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Based on this analysis, it is concluded that the proposed amendment is non-substantive and insignificant from the standpoint of environmental impact and pursuant to subparagraph 51.5 (.) (3) (d) (3) of 10 CFR 51, no environmental impact statement, negative declaration, or environmental impact appraisal need be prepared.

#### 4. Recommendation

On the basis of the findings in the current assessment coupled with the stringent controls described by the licensee in his application, it is recommended that Source Material License No. SUB-1010 be amended to authorize the test disposal of barium treated neutralized raffinate in accordance with the statements, representations, procedures and conditions described by the licensee subject to the following conditions:

As discussed and agreed upon in a telephone conversation between J. E. Rothfleisch and W. J. Shelley on April 25, 1977 and confirmed by letter dated April 26, 1977, notwithstanding the procedures described by the licensee in his applications and enclosures dated March 9 and April 15, 1977 as amended April 26, 1977, the following conditions shall apply to this amendment.

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TABLE I

## TREATED RAFFINATE ANALYSIS

<u>PARAMETER</u>	<u>ANALYSIS</u>
<u>mg/l</u>	
Ag	<0.001
As	0.54
Ba	3.0
B	23.
Cd	<0.001
Co	0.5
Cr	0.04
Cu	50.
Fe	1.
Hg	<0.001
Mg	310.
Mn	0.9
Mo	260.
Ni	16.
Pb	0.004
Se	<0.005
V	0.8
Zn	1.4
U	0.80 (avg of Nos. ranging 0.13 -1.5)
<u>pCi/l</u>	
Ra (sol.)	0.22
Ra (insol.)	0.33
Th-230	0.89
Th-232	1.12



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

APR 29 1977

*JK*  
*Docket # 40-8027*

L. C. Rouse, Chief  
Fuel Processing & Fabrication  
Branch  
Division of Fuel Cycle & Material  
Safety

NOTIFICATION OF INTENDED ACTION BY DIVISION OF SAFEGUARDS

APPLICANT: Kerr-McGee Center

LICENSE NO.: SUB-1010

DOCKET NO.: 40-8027

ADDRESS: Oklahoma City, OK

DATE OF APPLICATION: 3/9/77

MAIL CONTROL NO.: 6273

We have examined the above application and have determined:

- ☒ A. No action by this Division is required. We have no objection to your Branch taking appropriate action independently.
- ☐ B. Licensing action by this Division is necessary. We will contact you to coordinate simultaneous licensing action with your Branch.
- ☐ C. Special or unusual aspects should be resolved. We will contact you to discuss.
- ☐ D. Please inform the licensee of the requirements stated in paragraph 70.51(b), (c), and (d) regarding records, material control & accounting procedures, and physical inventories.



*E. J. McAlpine*  
E. J. McAlpine  
Division of Safeguards

# **OVERSIZE DOCUMENT PAGE PULLED**

## **SEE APERTURE CARDS**

NUMBER OF PAGES: 1

ACCESSION NUMBER(S):

8512200082

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