KERR-McGEE NUCLEAR CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

August 13, 1977

INSPECTION AND ENFORCEMENT

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. J. E. Rothfleisch
Fuel Cycle Licensing Branch 1
Division of Materials and Fuel Cycle
Facility Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

DOCKET NO. 40-8027

Dear Mr. Rothfleisch:

Please refer to your letter of May 20 requesting that we supply you with revised dose estimates for the expanded Sequoyah Facility.

The calculated dose estimates are attached. The methodology described in ORNL 4992 was used. A discussion of the data is attached.

The dose estimates for the 50-mile radius will be provided promptly upon receipt from our consultant who has promised completion by August 22.

Please let me know if we can supply additional information.

Very truly yours,

W. J. Shelley, Director
Regulation and Control

WJS:ml

Attachments 3

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SEQUOYAH FACILITY

LICENSE SUB-1010

EXPANDED RATE 10,000 TPY

ESTIMATED DOSE
(mrem/yr)

LOCATION		ORGAN			
DIRECTION/DISTANCE (mi)		WB	BONE	KID	LUNG
NE, ½					
INHALATION	U-234	.024	.37	.089	.84
	U-235	.00096	.016	.0038	.037
	U-238	.022	.37	.084	.80
	TH-230	.0016	.058	.013	.0068
	RA-226	.00005	.0005	-	.0001
	TOTALS	.05	.81	.19	1.68
INGESTION	U-234	.0061	.099	.023	-
	U-235	.00016	.0027	.00061	-
	U-238	.0059	.089	.020	-
	TH-230	.000001	.00005	.00001	-
	RA-226	.0003	.003	-	-
	TOTALS	.07	.19	.04	-
GROUNDSHINE	U-234	.011	.013	.0036	.0045
	U-235	.003	.047	.022	.026
	U-238	.0079	.0077	.0018	.0024
	TH-230	.000009	.00001	.000004	.000005
	RA-226	.000002	.000002	.000001	.000001
	TOTALS	.02	.07	.03	.03
GRAND TOTAL		.14	1.07	.26	1.71
NE, 1					
INHALATION		.03	.48	.11	.98
INGESTION		.007	.12	.03	-
GROUNDSHINE		.01	.04	.02	.02
TOTALS		.047	.64	.16	1.0

SEQUOYAH FACILITY

LICENSE SUB-1010

EXPANDED RATE 10,000 TPY

ESTIMATED DOSE
(mrem/yr) (Continued)

LOCATION	ORGAN			
DIRECTION/DISTANCE (mi)	WB	BONE	KID	LUNG
E, 14				
INHALATION	.04	.64	.08	1.31
INGESTION	.01	.17	.04	-
GROUNDSHINE	.02	.05	.02	.03
TOTALS	.07	.86	.14	1.34
E, 4				
INHALATION	.001	.02	.004	.04
INGESTION	.0008	.01	.002	-
GROUNDSHINE	.005	.002	.0006	.0008
TOTALS	.0068	.032	.0066	.0408
SW, ½				
INHALATION	.23	2.76	.64	5.76
INGESTION	.04	.59	.13	-
GROUNDSHINE	.07	.23	.09	.11
TOTALS	.34	3.58	.86	5.87
SW, 1				
INHALATION	.14	1.62	.38	3.38
INGESTION	.02	.36	.08	-
GROUNDSHINE	.04	.13	.05	.07
TOTALS	.20	2.11	.51	3.45

SEQUOYAH FACILITY

LICENSE SUB-1010

EXPANDED RATE 10,000 TPY

ESTIMATED DOSE
(mrem/yr) (Continued)

LOCATION	ORGAN			
DIRECTION/DISTANCE (mi)	WB	BONE	KID	LUNG
SW, ½				
INHALATION	.03	.47	.11	..95
INGESTION	.008	.13	.03	-
GROUNDSHINE	.01	.04	.02	.03
TOTALS	.048	.64	.16	.98
W, 3				
INHALATION	.004	.07	.02	.13
INGESTION	.002	.03	.007	-
GROUNDSHINE	.002	.005	.002	.003
TOTALS	.008	.105	.029	.133
NW, ½				
INHALATION	.04	.65	.15	1.33
INGESTION	.01	.14	.04	-
GROUNDSHINE	.02	.07	.02	.02
TOTALS	.07	.86	.21	1.35
NW, 2				
INHALATION	.005	.08	.02	.16
INGESTION	.002	.09	.006	-
GROUNDSHINE	.002	.007	.003	.003
TOTALS	.009	.177	.029	.163

ATTACHMENT

DOSE ESTIMATES REQUESTED MAY 20, 1977

Assumptions and Discussion

I. Rate of Release

In view of the objections to the conclusions reached on page 3 of our submittal of January 3, the release rate assumption was re-examined. This re-examination included reviewing releases experienced from 1970 through 1976. Compared with production rates, it was found that no correlation could be made between the rate of production and the rate of release. Consequently, Table I which presents the estimated rates of soluble and insoluble release to be experienced at the increased level of production is based upon the assumption that:

a. direct process discharges through the boiler stack, the UF_6 scrubber and the sampling plant discharge increase directly with production,

b. indirect discharges through the dust collector, the roof hatches and vents will increase at 25% of the rate of increase of production,

c. the calculation is based upon 1976 history extrapolated by these assumptions.

II. It should be specifically noted that the dose of the various isotopes is calculated from the isotopic analysis performed by the Kerr-McGee Technical Center analytical laboratory as given on Table II of the attached.

III. The equations used are given on Table III.

IV. It is calculated (Table III, Eqn III) that the inhalation dose from resuspension would equal 1% of the original inhaled dose. Since the highest dose of 9.39 mrem/yr occurring 1/2 mile southwest of the plant would give a resuspension dose of .09 mrem/yr, the resuspension dose was disregarded in totalling the estimated dose.

V. The dose for submersion was calculated and would be a maximum bone dose of $.7 \times 10^{-6}$ mrem/yr 1/2 mile southwest of the plant. Consequently, this submersion dose is also omitted from the attached total dose.

VI. In accordance with your request, these manual calculations have been made by the methodology described in ORNL 4992. It is understood that Dames & Moore who are performing the 50-mile dose calculations are using a program devised by the EPA known as "AIRREM" which, we understand, is acceptable.

TABLE I

ESTIMATED RELEASE RATE FROM SEQUOYAH STACKS BASED ON 1976 EXPERIENCE

	1976	EXP	
PROD RATE (MT/mo)	322	756	(2.34)

	RELEASE g/mo		ESTIMATED SOL	INS
ELEVATED				
MAIN STACK	12	28		28
SCRUBBER	1980	4633	4633	
			4633	28
GROUND LEVEL				
SAMP RM	111	260		260
ROOF VENT(1)	1750	2301	230	2071
ROOF HATCHES(1)	1414	1852	185	1667
DUST COLLECTOR(1)	308	403	40	363
		9477	455	4361

1. Assume release increases at a rate of .25 of the increased population.

$2^x = 1.25 \quad x = .322$

$2.34^{.322} = 1.31$

2. Releases assumed to increase directly proportional to production.

(1) Assumed 30% UO_3, 30% UO_2, 30% UF_4, 10% UO_2F_2

TABLE II

SEQUOYAH ISOTOPIC ANALYSIS

APRIL 1977

Isotope	UF_6 pCi/gm As UF_6	Plant Dust pCi/gm As Received
U-238	$2.25 \times 10^5 \pm 2\%$	$2.44 \times 10^5 \pm 3\%$
U-235	$6.47 \times 10^3 \pm 2.5\%$	$1.11 \times 10^4 \pm .53\%$
U-234	$2.29 \times 10^5 \pm 2.2\%$	$2.30 \times 10^5 \pm 3\%$
Th-230	$4.78 \times 10^1 \pm 2.4\%$	$1.58 \times 10^2 \pm 1.2\%$
Ra-226	$3.70 \times 10^0 \pm 18\%$	$1.77 \times 10^1 \pm 15\%$

U-238 values are calculated from chemical uranium analysis.
Ra-226 includes any Ra-224 present.
Th-230 and U-234 values are by alpha pulse height analysis.
U-235 by gamma pulse height analysis.

TABLE III

I. INHALATION

a) Release Rate

$$\frac{g}{mo} \quad \frac{mo}{30.4d} \times \frac{d}{24h} \times \frac{h}{60min} \times \frac{min}{60s} = 3.81 \times 10^{-7} \frac{g}{mo} = g/sec$$

b) Activity Release Rate

$$\frac{pCi}{g} \quad \frac{(g)}{(sec)} = \frac{pCi}{sec}$$

c) Concentration at Point A

$$C_A = C_o \frac{X}{Q} = \frac{pCi}{sec} \times \frac{sec}{m^3} = \frac{pCi}{m^3}$$

$$\frac{pCi}{m^3} \times \frac{\mu Ci}{10^6 pCi} \times \frac{m^3}{10^6 ml} = \frac{pCi}{m^3} \times 10^{-12} = \frac{\mu Ci}{ml}$$

d) DOSE $= \frac{\mu Ci}{ml} \times \frac{20m^3}{day} \times \frac{365\ da}{yr} \times \frac{10^6 ml}{m^3} \times \frac{10^3 mrems}{rem} \times \frac{rems}{\mu Ci}$

DOSE $= 7.3 \times 10^{12} \frac{\mu Ci}{ml}$ DCF $=$ mrem/yr

II. Exposure from Ground

DOSE = Conc x Deposition Rate x DCF x 30 yr

$$\text{DOSE} = \frac{10^{-2}\text{m}}{\text{sec}} \times \frac{10^{2}\text{gm}}{\text{m}} \times 3.17 \times 10^{7}\frac{\text{sec}}{\text{yr}} \times \frac{\text{mrems}}{\text{yr}} \times \frac{\text{cm}^2}{\mu\text{Ci}} \times 30\ \text{yr}$$

$$\text{DOSE} = 9.6 \times 10^{8}\ \frac{\mu\text{Ci}}{\text{ml}}\ \text{DCF} = \frac{\text{mrem}}{\text{yr}}$$

III. Resuspension

DOSE = Conc x Deposition Rate x Resuspension Rate

$$\text{DOSE} = \frac{\mu\text{Ci}}{\text{cm}^3} \times \frac{10^{-2}\text{m}}{\text{sec}} \times \frac{10^{2}\text{cm}}{\text{m}}\ \ 3.15 \times 10^{7}\frac{\text{sec}}{\text{yr}} \times 30\ \text{yr} \times \frac{\text{Resus. Factor}}{10^{-9}} \times \frac{10^{-2}\text{m}}{\text{cm}}$$

$$\text{DOSE} = \frac{\mu\text{Ci}}{\text{ml}}\ 9.51 \times 10^{-3} = 1 \times 10^{-2}\ \frac{\mu\text{Ci}}{\text{m}} = 1\%\ \text{of Inhalation Dose}$$

Therefore not included

IV. Submersion

$$\text{DOSE} = \frac{\mu\text{Ci}}{\text{ml}}\ (\text{DCF}) = \frac{\mu\text{Ci}}{\text{ml}}\ \frac{(\text{mrem/yr})}{(\ \mu\text{Ci/ml})} = \text{mrem/yr}$$

V. Ingestion

$$\text{DOSE} = \frac{\mu\text{Ci}}{\text{ml}}\ (\text{Deposition Rate})\ \frac{(\text{Uptake})}{(\text{Unit Deposition})}\ \text{DCF}$$

$$\frac{\mu\text{Ci}}{\text{ml}} \times \frac{10^{6}\text{ml}}{\text{m}^3} \times \frac{10^{-2}\text{m}}{\text{sec}}\ \ 3.15 \times 10^{7}\ \frac{\text{sec}}{\text{yr}} \times \frac{\mu\text{Ci/da}}{\mu\text{Ci/m}^2\text{da}} \times \frac{\text{rem}}{\mu\text{Ci}} \times \frac{10^{3}\text{mrem}}{\text{rem}}$$

$$= \frac{\mu\text{Ci}}{\text{ml}}\ 3.15 \times 10^{14}\ \frac{\mu\text{Ci/da}}{\mu\text{Ci/m}^2\text{da}} \times \frac{\text{rem}}{\mu\text{Ci}} = \frac{\text{mrem}}{\text{yr}}$$