

DRAFT REPORT

CALCULATION OF POTENTIAL IMPACT OF RELEASES FROM  
THE SEQUOYAH UF<sub>6</sub> FACILITY FOR THE YEAR 1976 AND 2000

KERR-McGEE CORPORATION

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## 1.0 INTRODUCTION

In July of 1977 the Kerr-McGee Nuclear Corporation requested<sup>1</sup> that Dames & Moore update the 1972 dose and manrem calculation for the Sequoyah UF<sub>6</sub> Facility<sup>2</sup> near Gore, Oklahoma. This report presents the results of an updated calculation using the computer code AIREM<sup>3</sup>. Both inhalation and ingestion dose and manrem were calculated for the years 1976 and 2000. The calculations for the year 1976 were based upon population data from the 1970 census and actual emissions, while the calculations for the year 2000 were based upon population growth estimates and projected emission rates.

## 2.0 SUMMARY

Calculations of annual individual dose and total population dose were made for the Sequoyah  $UF_6$  facility for the years 1976 and 2000 AD. The results of these calculations indicate that peak individual dose for each organ is lower than those results obtained from the 1972 calculations. All values are well below the radiation protection standard.

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### 3.0 INPUT DATA

#### 3.1 Meteorology

The meteorological data base used in this study is identical to that used in the previous study (43847 observations taken at Fort Smith, Arkansas during the period from January 1960 to December 1964)<sup>2</sup>. The joint frequency distribution of the wind direction and Pasquill stability class<sup>4</sup> and the mean wind speed for each wind direction/stability combination are presented in Tables 1 and 2, respectively. These differ from those used in 1972 only in that the stability categories D\* (day) and D\*\* (night) were combined to yield the D class and the F and G were combined to yield the F class. This was done to accommodate the input requirements of AIREM (it accepts only six stability categories). Frequencies and mean wind-speeds for each combined category were obtained by summing and taking a weighted average, respectively.

#### 3.2 Population

Demographic data for use in this study was provided by Kerr McGee<sup>5</sup> in a format consistent with input requirements for the AIREM code. Tables 3 and 4 present the data used in the analyses for the years 1976 and 2000, respectively. Each entry in these tables represents the population residing in an annular portion of a  $22\frac{1}{2}^{\circ}$  sector in a given direction away from the Sequoyah OF<sub>6</sub> Facility. The heaviest population for 1970 within ten miles of the site is located in annular section which contains the town of Vian ( $7\frac{1}{2}$  miles east of the plant site); a secondary peak in population occurs 3.5 to the northwest of the site. In the intervals between 10 and 50 miles the 1970 shows peaks 45 miles to the south south east (Fort Smith) and 25 miles to the northwest (Muskogee). The

population projections for the year 2000 were taken from publications of the Universities of Oklahoma<sup>7</sup> and Arkansas<sup>8</sup>. The demographic data for the year 2000 within 10 miles of the site shows a peak at Vian and secondary peak 3.5 miles to the northwest. In the region between 10 and 50 miles Fort Smith and Muskogee remain principal areas of concentrated population.

### 3.3 Emission and Related Input

Kerr McGee supplied information on the emissions<sup>5</sup> for the years 1976 and 2000 and its isotopic analysis<sup>6</sup>. Table 5 presents the isotopic analysis, while Tables 6 and 7 present the emission data for the years 1976 and 2000, respectively. Note that the distribution of mass between the soluble and insoluble components of the release for the 1976 release was obtained by scaling using the estimates for the year 2000. Table 8 presents the decay rates and dose conversion factors for each isotope considered in the AIREM calculation. The inhalation dose conversion factors were obtained by multiplying the adult inhalation factors contained in Nuclear Regulatory Commission Guide 1.109<sup>9</sup> (RG 1.109) by a nominal breathing rate of 7300 m<sup>3</sup>/yr. Ingestion dose conversion factors were obtained by using the RG 1.109 approach. The source strengths for the soluble emissions were used in the calculation of individual and population dose for the kidney, bone, and body, while the insoluble source strengths were used for the calculation of individual and population dose for the lung.

#### 4.0 RESULTS

##### 4.1 Total Population Dose and Individual Dose

Table 9 presents the total population dose for inhalation and ingestion doses in manrem for each organ for the years 1976 and 2000. These results include both elevated and ground level releases. The 1976 kidney dose is approximately the same as the 1972 dose. The whole body and lung dose for 1976 is smaller than the 1972 dose; this can be attributed to the use of different dose conversion factors and the use of an isotopic analysis. Table 10 illustrates the difference in the inhalation factors.

The population doses for the year 2000 are again lower for the lung and body. The dose for kidney is approximately an order of magnitude higher than in 1972, while the bone dose is two orders of magnitude higher. Both of these increases result from the contribution of ingestion.

Tables 11 to 16 presents the individual inhalation and ingestion doses for the 1976 release for the kidney, lung, bone and body. Note that the ingestion dose has been limited to the kidney and bone, this decision was made on the basis of the relative sizes of the ingestion dose conversion factors. The peak individual inhalation dose are doses .014 mrem for the kidney, 2.4 mrem for the lung, .062 mrem for the bone, and .037 mrem for the body. The peak individual ingestion doses are .24 E-03 for the kidney and .001 for the bone.

Tables 17 to 22 present the individual inhalation and ingestion doses for each organ for the 2000 AD release. The peak inhalation doses are .022 mrem for the kidney, 3.2 mrem for the lung, .081 mrem for the bone, and .556 E-02 mrem for the body. The peak ingestion doses are .0016 mrem for the bone and .37 E-03 for the kidney. Table 23 presents a comparison between 1972, 1976 and 2000 peak individual doses.

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## 5.0 REFERENCES

1. Written Correspondence between Mr. I. Spickler of Dames & Moore and W.J. Shelley of the Kerr-McGee Nuclear Corporation, August 9, 1977.
2. Dames & Moore, 1972: Calculation of Potential Impact of Releases; Sequoyah UF<sub>6</sub> Facility; Kerr-McGee Corporation.
3. Airem Program Manual, A Computer Code for Calculating Doses and Ground Depositions Due to Atmospheric Emissions of Radionuclides, EPA-520/1-74-004, J.A. Martin, Jr., etal, May 1974.
4. Uniform Summary of Surface Weather Observations, Part A, Fort Smith, Arkansas Municipal Airport; Data Processing Division Climatic Center USAF; August 1963.
5. Written Correspondence between Mr. I. Spickler of Dames & Moore and W.J. Shelley of the Kerr-McGee Nuclear Corporation, July 30, 1977.
6. Written Correspondence between Mr. I. Spickler of Dames & Moore and W.J. Shelley of the Kerr-McGee Nuclear Corporation, August 9, 1977.
7. Supplement: Statistic Abstract of Oklahoma 1972, Center for Economic Research and Management Research University of Oklahoma, Norman, Oklahoma.
8. Population Estimate for Sebastian, Crawford, and Washington Counties, Arkansas, Industrial Research and Extension Center, University of Arkansas, Little Rock.
9. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109, March 1976.



TABLE 1

JOINT FREQUENCY TABLE (%)  
WIND DIRECTION -VS- STABILITY CLASS  
FORT SMITH, ARKANSAS  
1960-1964

Wind Direction	Stability Class					
	A	B	C	D	E	F
NNE	.04	.35	.37	1.31	.84	2.84
NE	.09	.82	1.30	2.85	1.86	6.68
ENE	.10	.97	2.46	6.76	2.07	4.26
E	.07	.55	1.21	4.92	1.07	1.80
ESE	.05	.38	.71	1.85	.51	.97
SE	.09	.46	.72	1.70	.47	1.24
SSE	.05	.30	.48	1.12	.29	.62
S	.06	.49	.68	1.63	.42	1.11
SSW	.06	.45	.99	2.14	.38	.88
SW	.09	.57	1.17	2.22	.52	1.66
WSW	.08	.49	.93	1.62	.55	1.84
W	.05	.30	.72	2.46	.94	1.00
WNW	.05	.27	.57	2.64	.49	.42
NW	.06	.25	.43	2.02	.44	.52
NNW	.03	.19	.37	1.82	.38	.45
N	.03	.27	.37	1.88	.69	1.17

TABLE 2  
 MEAN WIND SPEED (MSEC<sup>-1</sup>)  
 WIND DIRECTION -VS- STABILITY CLASS  
 FORT SMITH, ARKANSAS  
 1960-1964

Wind Direction	Stability Class					
	A	B	C	D	E	F
NNE	1.71	2.41	3.39	4.04	2.83	1.48
NE	1.72	2.51	3.10	3.15	2.74	1.55
ENE	1.89	2.69	3.55	3.96	3.05	1.63
E	1.81	2.60	3.78	4.52	3.17	1.48
ESE	1.93	2.60	3.83	4.20	2.95	1.44
SE	1.82	2.65	3.72	3.83	2.79	1.37
SSE	1.84	2.80	4.04	4.11	2.79	1.42
S	1.77	2.77	3.94	4.52	3.00	1.60
SSW	1.84	3.02	4.45	5.35	3.14	1.45
SW	1.90	2.80	4.42	5.26	3.40	1.45
WSW	1.94	2.80	3.88	4.46	3.36	1.68
W	1.88	2.83	4.00	5.23	3.89	1.85
WNW	1.89	2.92	4.11	6.05	3.97	1.90
NW	1.85	2.51	3.97	5.27	3.97	1.68
NNW	1.87	2.52	4.20	5.40	3.96	1.72
N	1.84	2.44	3.63	5.27	3.65	1.55

TABLE 3

POPULATION DISTRIBUTION  
1970 CENSUS  
SEQUOYAH FACILITY

DISTANCE (MILES)

SECTOR

	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
NNE	3	6	21	9	6	143	891	11114	2016	1480
NE	9	3	0	6	3	309	844	1394	5731	4913
ENE	12	15	3	15	6	190	742	913	1360	1195
E	3	27	33	24	53	1422	2988	1240	7327	18982
ESE	0	15	36	50	3	241	3712	3272	7432	57481
SE	0	6	3	48	15	53	309	2309	6525	7140
SSE	6	9	6	0	50	33	1204	1291	296	3751
S	3	12	0	0	12	12	2661	352	1037	780
SSW	0	3	0	3	30	119	491	1006	1582	3724
SW	3	0	0	12	6	160	1155	972	591	853
WSW	3	0	6	9	3	122	321	696	3324	968
W	0	0	24	202	27	176	1817	4256	1565	8211
WNW	3	0	170	164	5	70	953	1281	1995	1719
NW	3	18	489	46	27	103	12439	25522	4240	4836
NNW	3	3	14	49	19	122	1049	3023	5566	2354
N	3	9	3	12	42	303	119	3393	2428	4381

TABLE 4  
POPULATION DISTRIBUTION  
2000 PROJECTION  
SEQUOYAH FACILITY

SECTOR	DISTANCE (MILES)									
	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
NNE	13	16	96	59	27	393	1391	14614	3516	1680
NE	24	8	15	56	53	809	1044	1894	8216	6492
ENE	27	45	18	65	56	490	742	1113	1719	1195
E	13	87	133	174	503	4922	5899	1740	11319	28982
ESE	5	45	161	350	53	941	6712	3772	9817	85681
SE	0	16	18	348	115	203	431	4181	9325	11140
SSE	16	19	26	50	100	183	1304	1291	296	4501
S	13	27	10	50	212	162	2911	352	1537	1280
SSW	0	8	10	53	280	369	491	1006	1582	5724
SW	8	0	10	112	56	460	1555	1022	1091	1545
WSW	8	0	16	59	53	372	521	1396	4324	968
W	0	0	99	952	327	826	3317	4756	2193	9471
WNW	8	0	370	614	115	320	3953	2281	2495	2019
NW	13	48	1589	346	227	403	18439	36555	5540	12836
NNW	8	8	64	349	119	422	1649	4723	9066	5854
N	13	29	18	112	342	803	119	5393	3628	6007

TABLE 5  
ISOTOPIC\* ANALYSIS FOR SEQUOYAH FACILITY (APRIL 1977)

<u>Isotope</u>	<u>UF<sub>6</sub> pCi/gm (Soluable UF<sub>6</sub>)</u>	<u>Plant Dust pCi/gm (Insoluable)</u>
U-238	2.25E+05	2.44E+05
U-235	6.47E+03	1.11E+04
U-234	2.29E+05	2.30E+05
Th-230	4.78E+01	1.58E+02
Ra-226	3.70E+00	1.77E+01

\*U-238 values calculated from chemical uranium analysis

Ra-226 includes Ra-224

Th-230 and U-234 values for analysis of alpha pulse height

U-235 from analysis of gamma pulse height

TABLE 6

## EMISSION RATES\* FOR 1976 FOR THE SEQUOYAH FACILITY

<u>Release Type</u>	<u>Total (g month<sup>-1</sup>)</u>	<u>Soluable (g month<sup>-1</sup>)</u>	<u>Insoluable (g month<sup>-1</sup>)</u>
Elevated			
Main Stack	12	0	12
Scrubber	1980	1980	0
Total	1992	1980	12
Ground Level			
Samp Rm	111	0	111
Roof Vent	1750	175	1575
Roof Hatches	1414	141	1273
Dust Collector	308	31	277
Total	3583	347	3236

\* Note that soluable and insoluable fractions were assumed to be proportional to that given for the year 2000.

TABLE 7

## EMISSION RATES\* FOR 2000 FOR THE SEQUOYAH FACILITY

Release Type	Total (g month <sup>-1</sup> )	Soluble (g month <sup>-1</sup> )	Insoluble (g month <sup>-1</sup> )
Elevated			
Main Stack	28	0	28
Scrubber	4633	4633	0
Total	4661	4633	28
Ground Level			
Samp Rm <sup>1</sup>	260	0	260
Roof Vent <sup>1</sup>	2301	230	2071
Roof Hatches <sup>1</sup>	1852	185	1667
Dust Collector <sup>1</sup>	403	40	363
Total	4816	455	4361

<sup>1</sup> Assumed 30% UO<sub>3</sub>, 30% UO<sub>2</sub>, 30% UF<sub>4</sub>, 10% UO<sub>2</sub>F<sub>2</sub>

\* Estimated on the basis a .25 rate increase of the increased production (i.e., a factor of 1.31)

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TABLE 8

## ISOTOPE PROPERTIES USE IN AIREM CALCULATION

Isotope	Decay ( $\text{sec}^{-1}$ )	Inhalation Dose Conversion Factor				Ingestion Dose Conversion	
		$(\frac{\text{m rem}}{\text{sec}} / \text{ci/m}^3)$				Factor $(\frac{\text{m rem}}{\text{pci}})$	
		Kidney	Lung	Bone	Body	Bone	Kidney
U-238	4.87E-18	5.05E+05	1.07E+07	2.22E+06	1.31E+05	7.67E-04	1.75E-04
U-235	3.10E-17	5.42E+05	1.13E+07	2.31E+06	1.40E+05	8.02E-04	1.87E-04
U-234	8.90E-13	5.76E+05	1.21E+07	2.08E+06	1.49E+05	8.37E-04	1.99E-04
Th-230	3.96E-13	1.48E+08	1.44E+08	5.30E+08	1.47E+07	2.08E-03	5.69E-04
Ra-226	1.98E-11	1.57E+04	2.71E+07	2.89E+07	2.11E+07	3.05E-01	1.63E-04



TABLE 9

## RADIONUCLIDE CONTRIBUTION TO POPULATION DOSE (man rem)

<u>Organ</u>	1976 Release				2000 Release		
	<u>1972 Calculation</u>	<u>Inhalation</u>	<u>Ingestion</u>	<u>Total</u>	<u>Inhalation</u>	<u>Ingestion</u>	<u>Total</u>
Kidney	5.59E-02	3.331E-03	.55E-01	5.83E-02	1.978E-02	.29	3.09810 <sup>-1</sup>
Lung	6.12E-01	1.13E-01	NA	1.13E-01	4.268E-02	NA	4.268E-02
Bone	1.40E-02	1.546E-02	.23	2.45E-01	5.031E-02	1.3	1.350
Body	4.731E-03	6.679E-04	-*	6.67E-04	4.728E-03	-*	4.728E-03

\*Not included because ingestion dose factors much smaller than for other organs.

TABLE 10  
COMPARISON OF ADULT INHALATION FACTORS (mrem/pCi)

<u>Organ</u>	<u>1972 Scenario Inhalation Factors</u>	<u>1976 &amp; 2000 Scenarios Inhalation Factors*</u>
Kidney	8.00E-02	2.34E-03
Lung	1.10E-01	4.90E-02
Bone	2.00E-02	9.99E-03

\* Averaged over U-238, U-235, and U-234 (principal components of isotopic analysis)

## INDIVIDUAL (INHALATION) DOSE, 1976 AD, SEQUOYAH FACILITY: KIDNEY (MREM)

UNIFORM RELEASE RATE

AFFECTED SYSTEM	3-1	1-2	2-3	3-6	DISINTEGRATIONS 3-10	11-20	20-30	30-40	40-50
TRP	.33E-02	.70E-03	.60E-03	.20E-03	.10E-03	.14E-04	.55E-05	.12E-05	.11E-05
NR	.40E-02	.11E-02	.80E-03	.90E-03	.16E-03	.17E-04	.80E-05	.37E-05	.25E-05
TRP	.45E-02	.11E-02	.80E-03	.43E-03	.31E-03	.30E-04	.60E-05	.34E-05	.12E-05
E	.36E-02	.53E-03	.52E-03	.30E-03	.23E-03	.32E-04	.83E-05	.41E-05	.26E-05
ESE	.22E-02	.30E-03	.33E-03	.21E-03	.16E-03	.19E-04	.61E-05	.33E-05	.11E-05
SF	.22E-02	.60E-03	.32E-03	.21E-03	.16E-03	.16E-04	.51E-05	.24E-05	0.
SSF	.15E-02	.27E-03	.28E-02	.17E-03	.16E-03	.15E-04	.45E-05	.24E-05	0.
S	.33E-02	.60E-03	.51E-03	.33E-03	.12E-03	.20E-04	.53E-05	.29E-05	0.
SSW	.61E-02	.14E-02	.90E-03	.60E-03	.23E-03	.15E-04	.50E-05	.29E-05	0.
SW	.14E-01	.34E-02	.22E-02	.15E-02	.50E-03	.12E-03	.14E-04	.70E-05	.42E-05
WSW	.13E-01	.34E-02	.20E-02	.13E-02	.40E-03	.12E-03	.26E-04	.12E-04	.73E-05
W	.70E-02	.14E-02	.10E-02	.60E-03	.22E-03	.35E-04	.14E-04	.69E-05	.44E-05
WNW	.35E-02	.80E-03	.51E-03	.33E-03	.11E-03	.15E-04	.57E-05	.31E-05	.11E-05
NW	.41E-02	.80E-03	.50E-03	.30E-03	.13E-03	.15E-04	.57E-05	.32E-05	.11E-05
NNW	.23E-02	.58E-03	.32E-03	.21E-03	.70E-04	.87E-05	.36E-05	.11E-05	0.
N	.34E-02	.60E-03	.40E-03	.31E-03	.11E-03	.20E-04	.54E-05	.29E-05	.10E-05

TABLE 12

## INDIVIDUAL (INHALATION), 1976 AD, SEQUOYAH FACILITY: LUNG (MREM)

AFFECTED SUFFIX	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	UNIFORM RELEASE RATE		
											20-30	30-40	40-50
ONE	.43E+00	.42E+01	.11E+01	.59E+02	.36E+02	.10E+02	.42E+03	.1E+03	.1E+03	.1E+03	.1E+03	.1E+03	.69E+04
NE	.65E+00	.45E+01	.16E+01	.75E+02	.49E+02	.20E+02	.49E+03	.49E+03	.21E+03	.1E+03	.1E+03	.1E+03	.81E+04
ENF	.60E+00	.51E+01	.10E+01	.80E+02	.53E+02	.22E+02	.43E+03	.43E+03	.10E+03	.1E+03	.1E+03	.1E+03	.68E+04
E	.44E+00	.43E+01	.10E+01	.85E+02	.53E+02	.23E+02	.55E+03	.55E+03	.22E+03	.13E+03	.13E+03	.13E+03	.80E+04
FSE	.25E+00	.27E+01	.11E+01	.57E+02	.36E+02	.16E+02	.43E+03	.43E+03	.19E+03	.10E+03	.10E+03	.10E+03	.68E+04
SF	.27E+00	.26E+01	.11E+01	.57E+02	.36E+02	.16E+02	.43E+03	.43E+03	.16E+03	.09E+04	.09E+04	.09E+04	.58E+04
SSF	.23E+00	.23E+01	.10E+01	.55E+02	.34E+02	.15E+02	.42E+03	.42E+03	.13E+03	.07E+04	.07E+04	.07E+04	.49E+04
S	.44E+00	.37E+01	.13E+01	.60E+02	.41E+02	.19E+02	.41E+03	.41E+03	.17E+03	.09E+04	.09E+04	.09E+04	.59E+04
SSW	.10E+01	.62E+01	.20E+01	.99E+02	.74E+02	.34E+02	.42E+03	.42E+03	.16E+03	.08E+04	.08E+04	.08E+04	.53E+04
SW	.20E+01	.16E+00	.52E+01	.99E+02	.74E+02	.34E+02	.42E+03	.42E+03	.16E+03	.08E+04	.08E+04	.08E+04	.53E+04
WSW	.14E+01	.14E+00	.54E+01	.99E+02	.74E+02	.34E+02	.42E+03	.42E+03	.16E+03	.08E+04	.08E+04	.08E+04	.53E+04
W	.42E+00	.74E+01	.27E+01	.14E+01	.47E+02	.37E+02	.40E+03	.40E+03	.40E+03	.22E+03	.22E+03	.22E+03	.14E+03
WNW	.44E+00	.35E+01	.12E+01	.64E+02	.39E+02	.17E+02	.43E+03	.43E+03	.18E+03	.09E+04	.09E+04	.09E+04	.64E+04
NW	.54E+00	.37E+01	.13E+01	.65E+02	.40E+02	.17E+02	.43E+03	.43E+03	.18E+03	.09E+04	.09E+04	.09E+04	.64E+04
NNW	.31E+00	.22E+01	.77E+02	.59E+02	.24E+02	.10E+02	.27E+03	.27E+03	.11E+03	.06E+04	.06E+04	.06E+04	.40E+04
N	.40E+00	.36E+01	.13E+01	.65E+02	.39E+02	.17E+02	.49E+03	.49E+03	.16E+03	.09E+04	.09E+04	.09E+04	.60E+04

# INDIVIDUAL (INHALATION) DOSE, 1976 AD, SEQUOYAH FACILITY: DORE (MREM)

AFFECTED SECTION	1-1	1-2	2-1	2-2	3-1	3-2	4-1	4-2	5-1	5-2	6-1	6-2	7-1	7-2	8-1	8-2	9-1	9-2	10-1	10-2	11-1	11-2	12-1	12-2	13-1	13-2	14-1	14-2	15-1	15-2	16-1	16-2	17-1	17-2	18-1	18-2	19-1	19-2	20-1	20-2	21-1	21-2	22-1	22-2	23-1	23-2	24-1	24-2	25-1	25-2	26-1	26-2	27-1	27-2	28-1	28-2	29-1	29-2	30-1	30-2	31-1	31-2	32-1	32-2	33-1	33-2	34-1	34-2	35-1	35-2	36-1	36-2	37-1	37-2	38-1	38-2	39-1	39-2	40-1	40-2	41-1	41-2	42-1	42-2	43-1	43-2	44-1	44-2	45-1	45-2	46-1	46-2	47-1	47-2	48-1	48-2	49-1	49-2	50-1	50-2	51-1	51-2	52-1	52-2	53-1	53-2	54-1	54-2	55-1	55-2	56-1	56-2	57-1	57-2	58-1	58-2	59-1	59-2	60-1	60-2	61-1	61-2	62-1	62-2	63-1	63-2	64-1	64-2	65-1	65-2	66-1	66-2	67-1	67-2	68-1	68-2	69-1	69-2	70-1	70-2	71-1	71-2	72-1	72-2	73-1	73-2	74-1	74-2	75-1	75-2	76-1	76-2	77-1	77-2	78-1	78-2	79-1	79-2	80-1	80-2	81-1	81-2	82-1	82-2	83-1	83-2	84-1	84-2	85-1	85-2	86-1	86-2	87-1	87-2	88-1	88-2	89-1	89-2	90-1	90-2	91-1	91-2	92-1	92-2	93-1	93-2	94-1	94-2	95-1	95-2	96-1	96-2	97-1	97-2	98-1	98-2	99-1	99-2	100-1	100-2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000

TABLE 14

INDIVIDUAL (INHALATION) DOSE, 1976 AD, SEQUOYAH FACILITY: BODY (MIREM)

[illegible]

1976 AD - SEQUOYAH FACILITY  
INDIVIDUAL (INGESTION) DOSE IN (NREM) FOR KIDNEY

AFFECTION SECTION	6-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
BAF	50E-04	10E-04	10E-04	10E-04	10E-04	10E-04	10E-04	11E-06	63E-07	42E-07
BE	10E-04	10E-04	10E-04	10E-04	10E-04	10E-04	10E-04	11E-06	74E-07	42E-07
ENE	75E-04	10E-04	11E-04	74E-04	10E-04	10E-04	10E-04	13E-06	66E-07	42E-07
F	50E-04	10E-04	10E-04	55E-05	34E-05	19E-05	56E-06	16E-06	81E-07	51E-07
ESE	37E-04	10E-04	55E-05	34E-05	24E-05	11E-05	37E-06	12E-06	65E-07	42E-07
SE	37E-04	10E-04	55E-05	34E-05	24E-05	11E-05	34E-06	10E-06	55E-07	35E-07
SSF	31E-04	10E-04	47E-05	30E-05	21E-05	10E-05	29E-06	80E-07	47E-07	30E-07
S	65E-04	10E-04	40E-05	54E-05	37E-05	19E-05	49E-06	10E-06	58E-07	37E-07
SSW	10E-04	23E-04	15E-04	11E-04	74E-05	40E-05	10E-05	11E-06	56E-07	34E-07
SW	24E-04	47E-04	37E-04	25E-04	17E-04	95E-05	21E-05	26E-06	14E-06	83E-07
MSW	22E-04	47E-04	33E-04	21E-04	15E-04	73E-05	19E-05	44E-06	23E-06	14E-06
X	12E-04	10E-04	17E-04	11E-04	76E-05	37E-05	97E-06	25E-06	14E-06	87E-07
WNW	59E-04	14E-04	84E-05	54E-05	37E-05	19E-05	46E-06	11E-06	62E-07	40E-07
NW	64E-04	14E-04	96E-05	63E-05	43E-05	22E-05	51E-06	11E-06	62E-07	40E-07
NNW	34E-04	51E-05	53E-05	34E-05	24E-05	12E-05	29E-06	70E-07	39E-07	25E-07
N	57E-04	14E-04	79E-05	52E-05	36E-05	19E-05	47E-06	11E-06	57E-07	37E-07

07672

## 1976 AD - SEQUOYAH FACILITY

TO JES  
AFFECTION



TABLE 17

INDIVIDUAL (INHALATION) DOSE, 2000 AD, SEQUOYAH FACILITY: KIDNEY (MREM)

AFTERCTFD SFCID#	Individual (Mrem)									
	1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10
NNE	500E-02	170E-02	100E-02	600E-03	450E-03	220E-03	200E-04	100E-04	100E-04	340E-05
NE	700E-02	230E-02	150E-02	100E-02	700E-03	350E-03	320E-04	120E-04	120E-04	380E-05
ENE	720E-02	220E-02	140E-02	900E-03	600E-03	350E-03	660E-04	130E-04	130E-04	330E-05
E	570E-02	200E-02	110E-02	740E-03	520E-03	260E-03	710E-04	170E-04	170E-04	490E-05
ESE	400E-02	130E-02	720E-03	450E-03	310E-03	150E-03	440E-04	130E-04	130E-04	390E-05
SE	330E-02	110E-02	620E-03	400E-03	270E-03	160E-03	430E-04	100E-04	100E-04	330E-05
SSE	330E-02	110E-02	620E-03	400E-03	270E-03	160E-03	430E-04	920E-05	920E-05	290E-05
S	520E-02	180E-02	110E-02	750E-03	520E-03	260E-03	690E-04	110E-04	110E-04	350E-05
SSW	300E-02	100E-02	600E-03	380E-03	250E-03	130E-03	330E-04	530E-05	530E-05	310E-05
SW	720E-02	220E-02	140E-02	900E-03	600E-03	350E-03	290E-04	120E-04	120E-04	720E-05
WSW	220E-01	730E-02	440E-02	290E-02	200E-02	120E-02	250E-03	510E-04	510E-04	130E-04
W	390E-02	130E-02	730E-03	450E-03	310E-03	150E-03	740E-04	200E-04	200E-04	630E-05
NNW	150E-02	500E-02	300E-02	190E-02	130E-02	700E-03	320E-04	110E-04	110E-04	560E-05
NW	210E-02	700E-02	420E-02	270E-02	180E-02	100E-02	310E-04	530E-05	530E-05	320E-05
NNW	300E-02	100E-02	600E-03	380E-03	250E-03	130E-03	100E-04	110E-04	110E-04	340E-05
N	500E-02	170E-02	100E-02	600E-03	450E-03	220E-03	200E-04	100E-04	100E-04	290E-05

TABLE 18

INDIVIDUAL (INHALATION) DOSE, 2000 AD, SEQUOYAH FACILITY: LUNG (MREN)

[illegible]

## INDIVIDUAL (INHALATION) DOSE, 2000 AD, SEQUOYAH FACILITY; DONE (MREM)

AFFECTED SPECIES	1-1	1-2	2-3	3-4	4-5	10-16	10-20	20-30	30-40	40-50
NNNE	14E-01	59E-02	29E-02	10E-02	11E-02	34E-03	73E-04	29E-04	15E-04	76E-05
NE	27E-01	60E-02	37E-02	24E-02	17E-02	65E-03	66E-04	33E-04	17E-04	11E-04
ENE	25E-01	58E-02	16E-02	24E-02	17E-02	64E-03	21E-03	35E-04	15E-04	74E-05
E	19E-01	51E-02	29E-02	10E-02	13E-02	63E-03	10E-03	47E-04	22E-04	13E-04
ESE	12E-01	35E-02	16E-02	11E-02	74E-03	37E-03	11E-03	34E-04	17E-04	89E-05
SE	12E-01	13E-02	16E-02	11E-02	74E-03	36E-03	11E-03	24E-04	14E-04	76E-05
SESE	10E-01	20E-02	15E-02	9E-02	60E-03	33E-03	91E-04	24E-04	12E-04	65E-05
S	10E-01	26E-02	26E-02	16E-02	13E-02	66E-03	16E-03	30E-04	15E-04	79E-05
SSW	34E-01	77E-02	51E-02	35E-02	25E-02	13E-02	64E-04	30E-04	14E-04	70E-05
SW	41E-01	19E-01	12E-01	62E-02	50E-02	29E-02	66E-03	73E-04	35E-04	20E-04
WSW	74E-01	19E-01	11E-01	70E-02	49E-02	24E-02	61E-03	13E-03	62E-04	37E-04
W	39E-01	10E-01	57E-02	36E-02	24E-02	12E-02	19E-03	72E-04	37E-04	22E-04
WNW	20E-01	40E-02	24E-02	16E-02	12E-02	60E-03	91E-04	30E-04	15E-04	77E-05
NNW	23E-01	53E-02	32E-02	21E-02	14E-02	70E-03	79E-04	29E-04	15E-04	72E-05
NW	13E-01	30E-02	17E-02	11E-02	78E-03	38E-03	49E-04	18E-04	76E-05	46E-05
NNNW	19E-01	45E-02	26E-02	17E-02	12E-02	59E-03	15E-03	27E-04	13E-04	66E-05

## INDIVIDUAL (INHALATION) DOSE, 2000 AD, SEQUOYAH FACILITY; WHOLE BODY (MREM)

2000 AD - SEQUOYAH FACILITY  
INDIVIDUAL (INGESTION) DOSE IN (MREM) FOR BONE

AFFECTED SECTOR	0-1	1-2	3-4	4-5	5-10	10-20	20-30	30-40	40-50
NLF	.60E-03	.17E-03	.11E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04
NF	.50E-03	.17E-03	.11E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04
ENE	.52E-03	.17E-03	.11E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04
E	.61E-03	.17E-03	.11E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04	.10E-04
ESF	.24E-03	.94E-04	.51E-04	.51E-04	.51E-04	.51E-04	.51E-04	.51E-04	.51E-04
SE	.26E-03	.90E-04	.51E-04	.51E-04	.51E-04	.51E-04	.51E-04	.51E-04	.51E-04
SSE	.23E-03	.76E-04	.46E-04	.46E-04	.46E-04	.46E-04	.46E-04	.46E-04	.46E-04
S	.30E-03	.13E-03	.79E-04	.79E-04	.79E-04	.79E-04	.79E-04	.79E-04	.79E-04
SSW	.64E-03	.21E-03	.15E-03	.15E-03	.15E-03	.15E-03	.15E-03	.15E-03	.15E-03
SW	.16E-02	.51E-03	.35E-03	.35E-03	.35E-03	.35E-03	.35E-03	.35E-03	.35E-03
WSW	.16E-02	.51E-03	.31E-03	.31E-03	.31E-03	.31E-03	.31E-03	.31E-03	.31E-03
W	.84E-03	.24E-03	.16E-03	.16E-03	.16E-03	.16E-03	.16E-03	.16E-03	.16E-03
WNW	.62E-03	.13E-03	.75E-04	.75E-04	.75E-04	.75E-04	.75E-04	.75E-04	.75E-04
NW	.44E-03	.15E-03	.92E-04	.92E-04	.92E-04	.92E-04	.92E-04	.92E-04	.92E-04
NNW	.27E-03	.83E-04	.50E-04	.50E-04	.50E-04	.50E-04	.50E-04	.50E-04	.50E-04
N	.40E-03	.12E-03	.75E-04	.75E-04	.75E-04	.75E-04	.75E-04	.75E-04	.75E-04

(12672)

# 2000 - AD SEQUOYAH FACILITY INDIVIDUAL (INGESTION) DOSE IN (MREM) FOR KINDEY

AFFECTED SECTION	0-1	1-2	2-3	3-4	4-5	5-16	10-20	20-30	30-40	40-50
SECT	.0000-00	.0000-00	.10-00	.10-00	.00-00	.00-00	.00-00	.10-00	.10E-06	.65E-07
SECT	.10-00	.00-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.12E-06	.74E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.11E-06	.64E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.15E-06	.92E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.12E-06	.75E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.10E-06	.63E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.08E-07	.55E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.11E-06	.67E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.10E-06	.55E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.24E-06	.14E-06
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.41E-06	.25E-06
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.25E-06	.16E-06
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.11E-06	.65E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.10E-06	.62E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.65E-07	.39E-07
SECT	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.10-00	.20-00	.93E-07	.57E-07

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TABLE 23

COMPARISON OF PEAK INDIVIDUAL DOSES (mrem)

<u>Organ</u>	<u>1972</u>	<u>1976</u>	<u>Ingestion</u>	<u>2000</u>	<u>Ingestion</u>
		<u>Inhalation</u>		<u>Inhalation</u>	
Kidney	6.20E-01	6.1E-03	2.4E-04	8.9E-03	1.6E-03
Lung	1.12E+01	2.4E+00	-	3.2E-00	-
Bone	1.55E-01	6.21E-02	1.0E-03	8.1E-02	3.7E-04
Body		3.7E-03	-	5.7E-03	-

07872