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**Tailings Reclamation Plan  
As Approved by NRC March 1, 1991  
License No. SUA - 1475**

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Church Rock Site  
Gallup, New Mexico

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Prepared For:

United Nuclear Corporation  
Gallup, New Mexico

Volume II - Tables, Figures

# **Tailings Reclamation Plan**

**As Approved by NRC March 1, 1991**

**License No. SUA - 1475**

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TABLE 1.1

PRECIPITATION - EVAPORATION DATA (a)  
CHURCH ROCK

Year	Average Temperature °F		Total Pan Evaporation		Precipitation (inches)	Net Pan Evaporation (inches)
	High	Low	Tailings Solution (inches)	Tap Water (inches)		
	1980	No data		75		
1981	No data		73	76	11.9	61
1982	67.3	35.9	66	67	16.1	50
1983	66.7	29.7	60	57	16.5	44
1984	68.5	28.7	65	69	12.1	53
1985	67.8	28.6	59	67	13.5	45
1986	67.6	31.2	58	59	18.0	41
1987	68.5	28.1	58	60	17.21	41
1988	68.4	31.7	64	66	11.66	52
1989	68.9	30.8	98	98	7.70	90
1990	67.5	32.4	82	84	16.63	65
Average (b)	67.6	30.8	68	68	14.1	54

Annual average temperature extremes: -20 to 100°F.

(a) On-site data collected by United Nuclear personnel.

(b) Average of values from 1980 to 1986 used since 1987 in water balance calculations for the site.



TABLE 2.1

## BACKGROUND Ra-226 ACTIVITY CONCENTRATION

	<u>Background Plot Number</u>		
	<u>Plot #1</u>	<u>Plot #2</u>	<u>Plot #3</u>
Number of measurements	13	10	13
Mean (pCi Ra-226/g soil)	0.65	0.88	0.84
Standard deviation	0.30	0.83	0.43
Standard deviation of the mean	0.083	0.26	0.12

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Notes:

1. Weighted overall mean = 0.78 pCi/g.
2. Analysis of variance shows no significant difference among means. The pooled standard deviation for all 36 samples is 0.53 pCi/g.
3. Ninety-five percent confidence limits on overall mean: 0.61 pCi/g  $\pm$  0.95 pCi/g.
4. Samples in Plots No. 1 and No. 3 were composited from drillholes and are representative of soils from 0-60 cm. Due to the rocky nature of Plot No. 2, all 10 samples were obtained from the surface.

TABLE 2.2  
BACKGROUND GAMMA EXPOSURE RATE READINGS  
(uR/hr)

<u>Background Plot Number</u>	<u>n</u>	<u>Mean</u>	<u>Standard Deviation</u>
1	55	11.3	0.92
2	44	11.5	1.6
3	52	11.6	1.5

---

Notes:

1. Weighted overall mean = 11.46 uR/hr.
  2. Corrected \* weighted overall mean =  $11.46(0.81) + 5.6 = 14.9$  uR/hr.
  3. Only two significant figures are considered reasonable for use in any further analyses. Therefore, the mean background external gamma radiation exposure rate is taken to be equal to 15 uR/hr.
  4. Analysis of variance shows no significant difference between the means of the three plots. The pooled standard deviation for the three plots is 1.35, or 12 percent. That is, 95 percent of the observations will fall between  $15 \pm (1.96)(0.12)(15)$  uR/hr, or 11.5 to 18.5 uR/hr. The probability of observing a gamma exposure rate due only to background greater than 18.5 uR/hr is 2.5 percent. The probability of observing a gamma exposure rate due only to background greater than 18 uR/hr is 5.0 percent.
- \* The correction factor is based on calibration against the Pressurized Ion Chamber.

TABLE 2.3

Ra-226 SOIL ACTIVITY CONCENTRATION VERSUS  
MEASURED GAMMA RAY EXPOSURE RATE

<u>X (uR/hr)</u>	<u>Ra-226 (pCi/g) Estimated Mean</u>
18	0.6
19	1.5
20	2.5
21	3.5
22	4.6
23	5.6
24	6.7
25	7.7

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Notes:

1. Ra-226 activity concentration = 6 pCi/g.
2. X (uR/hr) = 23.

TABLE 2.4

## SUMMARY OF BACKGROUND DRILLHOLE READINGS (a)

	<u>Plot #1</u>	<u>Plot #2</u>
Mean Surface Reading	1.3	1.2
Number of measurements	13	13
Standard deviation	0.28	0.27
Standard deviation of the mean	0.08	0.08
Mean Reading 0-15 cm	1.4	1.4
Number of measurements	13	13
Standard deviation	0.30	0.35
Standard deviation of the mean	0.08	0.10
Mean Reading 15-30 cm	1.7	1.7
Number of measurements	13	13
Standard deviation	0.25	0.50
Standard deviation of the mean	0.07	0.14
Mean reading >30 cm	1.9	2.1
Number of measurements	13	13
Standard deviation	0.23	0.74
Standard deviation of the mean	0.06	0.21
Overall mean 0-50 cm	1.7	1.7
Pooled standard deviation	0.27	0.56
Pooled standard deviation total		0.44

Due to the rocky nature of Background Plot No. 2, no drillholes could be advanced. Only surface soil samples were taken in this area. Drillholes were advanced with a gas auger.

- 
- (a) All borehole measurements are reported as readings with no units. The meter reads in counts/minute or mR/hr. However, neither of these units has any meaning except as a relative measurement. The meter must be calibrated for a particular probe under specific conditions of use. The borehole logger (BHL) was read on the mR/hr scale for ease of reading, but reporting these readings as exposure in mR/hr would be very misleading and incorrect.

TABLE 2.5

Ra-226 ACTIVITY CONCENTRATION VERSUS  
BHL READING FOR BOREHOLES

<u>BHL Reading (a)</u>	<u>Ra-226 (pCi/g) Estimated Mean</u>
3.0	2.4
4.0	3.8
5.0	5.2
6.0	6.6
7.0	8.0
8.0	9.4
9.0	10.8
10.0	12.2
11.0	13.6
12.0	14.9
13.0	16.3

Ra-226 activity concentration = 6 pCi/g  
BHL reading = 5.6

Ra-226 activity concentration = 16 pCi/g  
BHL reading = 12.8

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(a) BHL readings are reported without units as the units have significance only when the instrument is properly calibrated.

TABLE 2.6

Ra-226 ACTIVITY CONCENTRATION VERSUS  
BHL READING FOR DRILLHOLES

<u>BHL Reading (a)</u>	<u>Ra-226 (pCi/g) Estimated Mean</u>
3.0	4.5
4.0	6.2
5.0	7.8
6.0	9.4
7.0	11.0
8.0	12.7
9.0	14.3
10.0	15.9
11.0	13.6
12.0	14.9
13.0	16.3

Ra-226 activity concentration = 6 pCi/g  
BHL reading = 3.9

Ra-226 activity concentration = 16 pCi/g  
BHL reading = 10.1

- 
- (a) BHL readings are reported without units as the units have significance only when the instrument is properly calibrated.

TABLE 2.7A

BOREHOLE LOGGING RESULTS FOR DRILLHOLES LOCATED  
AROUND TAILINGS DISPOSAL AREA - RADIALS

Background borehole logger reading = 1.7

95 percent confidence limits for a single reading, 0.8 - 2.6

Estimated mean borehole logger reading for 6 pCi/g = 3.9

estimated mean borehole logger reading for 16 pCi/g = 10.1

<u>Depth</u>	<u>Radial Coordinate</u>				
	<u>C 30</u>	<u>C 55</u>	<u>C 80</u>	<u>D 50</u>	<u>D 65</u>
Surface	15.0 (a)	10.0 (a)	7.3 (a)	9.0 (a)	10.0 (a)
15 cm (0.5 ft)	8.5	7.5	7.0	5.0	6.1
30 cm (1.0 ft)	4.7	5.8	5.0	3.5	3.5
45 cm (1.5 ft)	3.5	5.0	3.9		2.6
60 cm (2.0 ft)		3.5	3.8		1.7
75 cm (2.4 ft)					1.6

<u>Depth</u>	<u>Radial Coordinate</u>				
	<u>D 100</u>	<u>D 200</u>	<u>D 300</u>	<u>D 450</u>	<u>E 100</u>
Surface	6.5 (a)	4.0 (a)	3.2 (a)	2.4 (a)	8.0 (a)
15 cm (0.5 ft)	5.8	4.1	2.6	2.0	6.0
30 cm (1.0 ft)	3.5	3.9	2.2	2.0	3.9
45 cm (1.5 ft)	2.5	2.5	2.0	2.0	3.5
60 cm (2.0 ft)	2.1	2.0	2.0		

<u>Depth</u>	<u>Radial Coordinate</u>				
	<u>E 390</u>	<u>E 494</u>	<u>G 200</u>	<u>G 300</u>	<u>H 350</u>
Surface	3.4 (a)	2.1 (a)	2.6 (a)	2.3 (a)	2.0 (a)
15 cm (0.5 ft)	2.5	2.0	2.0	1.9	2.5
30 cm (1.0 ft)	2.1	2.0	1.4	1.7	3.0
45 cm (1.5 ft)	2.0	2.1	1.3	1.9	2.9
60 cm (2.0 ft)	2.1			1.9	

(a) Borehole logger readings.

TABLE 2.7A  
 BOREHOLE LOGGING RESULTS FOR DRILLHOLES LOCATED  
 AROUND TAILINGS DISPOSAL AREA - RADIALS  
 (Continued)

<u>Depth</u>	<u>Radial Coordinate</u>				
	<u>I 300</u>	<u>J 400</u>	<u>K 400</u>	<u>K 450</u>	<u>M 850</u>
Surface	2.6 (a)	2.8 (a)	3.2 (a)	2.5 (a)	2.5 (a)
15 cm (0.5 ft)	1.9	2.8	2.8	2.1	3.3
30 cm (1.0 ft)	1.7	3.2	2.3	2.0	5.0
45 cm (1.5 ft)	1.9				
60 cm (2.0 ft)	2.0				

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(a) Borehole logger readings.

TABLE 2.7B

BOREHOLE LOGGING RESULTS FOR DRILLHOLES  
LOCATED SOUTH OF THE DIVERSION DITCH

Background borehole logger reading = 1.7

95 percent confidence limits for a single reading, 0.8 - 2.6

Estimated mean borehole logger reading for 6 pCi/g = 3.9

Estimated mean borehole logger reading for 16 pCi/g = 10.1

<u>Depth</u>	<u>Location</u>		
	<u>SBDD-1</u>	<u>SBDD-2</u>	<u>SBDD-3</u>
Surface	2.2	2.2	2.9
15 cm (0.5 ft)	1.7	1.7	1.9
30 cm (1.0 ft)	1.7	1.4	1.5
45 cm (1.5 ft)	1.6	1.8	1.5
60 cm (2.0 ft)	1.6		

TABLE 2.7C

BOREHOLE LOGGING RESULTS FOR DRILLHOLES LOCATED  
AROUND TAILINGS DISPOSAL AREA - EAST FENCELINE

Background borehole logger reading = 1.7

95 percent confidence limits for a single reading, 0.8 - 2.6

Estimated mean borehole logger reading for 6 pCi/g = 3.9

Estimated mean borehole logger reading for 16 pCi/g = 10.1

<u>Depth</u>	<u>Location</u>		
	<u>FL 1</u>	<u>FL 2</u>	<u>FL 3</u>
Surface	3.7	2.4	3.3
15 cm (0.5 ft)	3.7	2.0	2.7
30 cm (1.0 ft)	2.8	1.7	2.5
45 cm (1.5 ft)	2.6	1.8	2.4
60 cm (2.0 ft)		2.0	2.4
75 cm (2.4 ft)		1.9	2.3

TABLE 2.7D

BOREHOLE LOGGING RESULTS FOR DRILLHOLES LOCATED  
AROUND TAILINGS DISPOSAL AREA - WEST OF  
TAILINGS DISPOSAL AREA

Background borehole logger reading = 1.7  
95 percent confidence limits for a single reading, 0.8 - 2.6

Estimated mean borehole logger reading for 6 pCi/g = 3.9  
Estimated mean borehole logger reading for 16 pCi/g = 10.1

<u>Depth</u>	<u>Location</u>			
	<u>Catch Basin No. 1</u>		<u>Catch Basin No. 2</u>	
	Hole 1	Hole 2	Hole 1	Hole 2
Surface	8.6	12.5	75.0	51.0
15 cm (0.5 ft)	6.5	27.0	114.0	87.0
30 cm (1.0 ft)	3.0	52.0	162.0	159.0
45 cm (1.5 ft)	2.2	55.0	100.0	off scale
60 cm (2.0 ft)	2.0	43.0	31.0	off scale
75 cm (2.4 ft)	1.6	10.5	8.6	161.0
90 cm (2.9 ft)	1.8	3.7	6.0	75.0
105 cm (3.4 ft)	1.8	2.5	5.1	35.0
120 cm (3.9 ft)		1.9	4.2	10.5
135 cm (4.4 ft)			3.9	7.8
150 cm (4.9 ft)			3.2	6.4
165 cm (5.4 ft)				6.2

<u>Depth</u>	<u>Location</u>	
	<u>WTA 3-1</u>	<u>WTA 3-2</u>
Surface	4.1	4.1
15 cm (0.5 ft)	3.2	2.6
30 cm (1.0 ft)	3.9	2.6
45 cm (1.5 ft)	5.1	
60 cm (2.0 ft)	4.1	
75 cm (2.4 ft)	3.5	

TABLE 2.7E

BOREHOLE LOGGING RESULTS FOR DRILLHOLES LOCATED AROUND  
TAILINGS AREA - ELEVATED ACTIVITY AREA ON RADIAL "N"

Depth	Radial Coordinate															
	<u>N-1</u>	<u>N-2</u>	<u>N-3</u>	<u>N-4</u>	<u>N-5</u>	<u>N-6</u>	<u>N-7</u>	<u>N-8</u>	<u>N-9</u>	<u>N-10</u>	<u>N-11</u>	<u>N-12</u>	<u>N-13</u>	<u>N-14</u>	<u>N-100 A</u>	<u>N-150 D</u>
Surface	15.0	2.0	2.1	5.9	1.8	1.4	1.9	6.1	11.0	3.6	1.3	1.5	3.5	4.5	12.8	25.0
15 cm (0.5 ft)	35.0	2.1	2.2	12.0	1.6	1.2	5.0	11.1	34.0	7.6	1.2	1.7	4.5	6.2	29.0	42.0
30 cm (1.0 ft)	14.1	2.5	2.6	32.0	1.6	1.3	12.6	36.0	52.0	30.0	1.5	1.7	7.5	8.6	13.9	50.0
45 cm (1.5 ft)	5.8	2.5	2.6	35.0	2.1	1.2	32.0	54.0	41.0	40.0	1.6	1.5	8.5	9.2	5.7	17.5
60 cm (2.0 ft)	3.2	2.5	2.7	16.6	3.2		39.0	41.0	11.5	11.2	1.8	1.7	7.5	8.1	3.1	6.1
75 cm (2.4 ft)	2.2		2.1		7.4		48.0	12.6	4.8	4.4	1.8	1.8	5.3		2.5	3.0
90 cm (2.9 ft)					26.0		14.4	3.9	2.6	2.2					2.1	2.1
105 cm (3.4 ft)					37.0			2.0	2.1	1.8					2.1	2.1
120 cm (3.9 ft)					29.0			1.8	2.1	1.7						
135 cm (4.4 ft)					9.5											
150 cm (4.9 ft)					4.5											

Note: Background borehole logger reading = 1.7  
95 percent confidence limits for a single reading, 0.8 - 2.6

Estimated mean borehole logger reading for 6 pCi/g = 3.9  
Estimated mean borehole logger reading for 16 pCi/g = 10.1