APPENDIX W

FILTER AND RIPRAP LAYER THICKNESSES LOGS - DIVERSION DITCHES AND TAILING SWALE

#6 of 2/21/98 IPG

Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: TAILINGS SWALE 1997 WORK Measurement Method: Scale Audited & Verified MaBosh 2/10/98

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
2/4/98	2+00		6.0			3	7.5
2/4/98	3+00		6.0			3	6.0
2/4/98	4+00		6.5			3	6.0
2/4/98	5+00		7.0			3	6.0
2/4/98	6+00		6.5			3	6.0
2/4/98	7+00		6.0			3	6.0
2/4/98	8+00		6.5			3	7.5
2/4/98	9+00		6.0			3	6.0
2/4/98	10+00		6.5			3	6.0
2/4/98	11+00		6.0			3	6.0
2/4/98	12+00		6.0			3	6.0
2/4/98	13+00		6.5			3	6.0
2/4/98	14+00		6.0			3	6.5
2/4/98	15+00		6.0			3	6.0
2/4/98	16+00		6.0			3	6.5
2/4/98	17+00		7.0			3	6.0
2/4/98	18+00		7.0			3	6.5
2/4/98	19+00		6.0			3	7.0
2/4/98	20+00		7.0			3	6.0
2/4/98	21+00		6.0			VARIES (TRANSITION AREA)	10.5
2/4/98	22+00		6.0		6.5	12	18.0
2/4/98	23+00		6.5		6.0	12	18.0
2/4/98	24+00		6.0		7.0	12	18.0
2/4/98	25+00	- CONSTRUCTED IN 1994 AND NOT				12	18.0
2/4/98	26+00	DISTURBED. RIP RAP MEASURED ONLY				12	18.0
2/4/98	27+00		7.0		6.0	18	27.0
2/4/98	28+00		7.0		6.5	18	27.5

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Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: NORTH 1997 WORK Measurement Method: Scale Audited & Verified MaBashi 2/18/98

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
2/15/98	1+00		6.0		6.0	18	27.5
2/15/98	2+00		6.0			3	6.0
2/15/98	3+00		7.0			3	6.0
2/15/98	4+00		6.5			3	6.0
2/15/98	5+00		7.0		6.0	18	27.0
2/15/98	6+00		6.5		6.0	18	27.0
2/15/98	7+00		7.0			3	6.0
	8+00		6.0			3	6.0
2/15/98	9+00		6.5			3	6.5
2/15/98	10+00		6.5			3	6.0
2/15/98	11+00		6.0			3	6.0
2/15/98	12+00		7.0			3	6.0
2/15/98	13+00		6.5			3	6.5
2/15/98	14+00		6.5			3	6.5
2/15/98	15+00		6.0			3	6.0
2/15/98	16+00		7.0			3	6.0
2/15/98	17+00		7.0			3	6.0
2/15/98	18+00		6.5			3	6.0
2/15/98	19+00		6.5			3	6.5
2/15/98	20+00		6.5			3	6.5
2/15/98	21+00		7.0			3	6.5
2/15/98	22+00		6.5			3	6.0
2/15/98	23+00		7.0			3	6.5
2/15/98	24+00		7.0			3	6.5
	25+00		6.5			3	6.5
2/15/98	26+00		7.0			3	6.0
2/15/98	27+00		6.5			3	6.5
2/15/98	28+00		7.0			3	6.0
	29+00		6.5			3	6.0

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: NORTH

Measurement Method: Scale

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
2/5/98	30+00		7.0		6.0	18	27.0
2/5/98	31+00		6.5		6.5	18	27.5
2/5/98	32+00		6.5		6.0	18	27.5
2/5/98	33+00		6.0		6.0	18	27.5
2/5/98	34+00		6.5		6.0	18	27.5
2/5/98	35+00		7.0		6.0	18	27.5
2/5/98	36+00		7.0		6.0	18	27.0
2/5/98	37+00		6.5		6.0	18	27.5
2/5/98	38+00		6.0		6.0	18	27.0
2/5/98	39+00		6.0		6.0	18	27.5
2/5/98	40+00		7.0		6.0	18	27.5
2/5/98	41+00		6.0		6.0	18	27.0
2/5/98	42+00		6.5		7.0	18	27.5
2/5/98	43+00		6.0		6.0	18	27.0
2/5/98	44+00		6.0		6.5	18	27.0
2/5/98	45+00		6.0		6.0	18	27.5
2/5/98	46+00		6.5		6.5	18	27.0
2/5/98	47+00		6.5		6.5	18	27.5
2/5/98	48+00		6.0		6.0	18	27.0
2/5/98	49+00		6.0		6.0	18	27.0
2/5/98	50+00		6.0		6.0	18	27.0
2/5/98	51+00		6.0		6.0	18	27.5
2/5/98	52+00		6.5		7.5	18	27.0
2/5/98	53+00		6.0		6.0	18	27.0
2/5/98	54+00		6.5		6.5	18	27.5
2/5/98	55+00		6.0		6.0	18	27.0
2/5/98	56+44		6.5		6.0	18	27.0

Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: South

Measurement Method: Scale

Audited - Verified m.a. Rock 3/24/97

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I (B) Thickness	Filter II (C) D_{50}	Filter II (C) Thickness	RIPRAP (A) D_{50} (D)	RIPRAP (A) Thickness
3/20/97	0+00		6.0			3	6.5
3/20/97	1+00		6.0			3	6.5
3/20/97	2+00		6.5			3	6.0
3/20/97	3+00		6.5 ~~6.0~~			3	6.5
3/20/97	4+00		6.0			3	6.5
3/20/97	5+00		6.0			3	6.0
3/20/97	6+00		6.0		7.0	12	18.0
3/20/97	7+00		6.0		6.5	12	18.5
3/20/97	8+00		6.0			3	6.5
3/20/97	9+00		6.0			3	6.0
3/20/97	10+00		6.0			3	6.5
3/20/97	11+00		6.5			3	6.0
3/20/97	12+00		6.0			3	6.0
3/20/97	13+00		6.0			3	6.5
3/20/97	14+00		6.0			3	6.5
3/20/97	15+00		6.0			3	6.0
3/20/97	16+00		6.0			3	6.5
3/20/97	17+00		6.0			3	6.0
3/20/97	18+00		6.0			3	6.0
3/20/97	19+00		6.0			3	6.5
3/20/97	20+00		6.5			3	6.5
3/20/97	21+00		6.5			3	6.5
3/20/97	22+00		7.0			3	6.0
3/20/97	23+00		7.0		~~6.5~~	18	27.0
3/20/97	24+00		6.0		6.0	18	27.5
3/20/97	25+00		6.0			3	6.0
3/20/97	26+00		6.0			3	6.0
3/20/97	27+00		6.5			3	6.0
3/20/97	28+00		6.5			3	6.5

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: South

Measurement Method: Scale

Audited • Verified MaRoche 3/24/97

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
3/20/97	29+00		6.5			3	6.0
3/20/97	30+00		6.5			3	6.0
3/10/97	31+00		6.0		6.5	12	18.5
3/20/97	32+00		6.0		6.0	12	18.0
3/20/97	33+00		6.5		6.0	12	18.0
3/20/97	34+00		6.0			3	6.5
3/20/97	35+00		7.0			3	6.5
3/20/97	36+00		7.0			3	6.5
/97	37+00		6.0			3	6.5
3/10/97	38+00		6.0			3	6.5
3/20/97	39+00		6.5			3	6.5
3/20/97	40+00		7.0			3	7.0
3/20/97	41+00		6.0			3	6.5
3/20/97	42+00		6.5			3	7.0
3/20/97	43+00		6.5			3	7.0
3/20/97	44+00		6.0			3	6.0
3/10/97	45+00		6.0		6.5	18	27.0
3/10/97	46+00		6.0		7.0	18	27.0
3/20/97	47+00		6.5		7.0	18	27.0
3/10/97	48+00		6.0		7.0	18	27.0
3/10/97	49+00		6.5		6.5	18	27.0
3/10/97	50+00		6.0		7.0	18	27.0
3/10/97	51+00		6.0		6.5	18	27.5
3/20/97	52+00		6.5		6.0	18	27.5
3/20/97	53+00		6.0		6.0	18	27.0
/97	54+00		6.0		6.0	18	27.5
3/10/97	55+00		6.0		6.5	18	27.0
3/10/97	56+00		7.0		6.0	18	27.5
3/20/97	57+00		7.0		6.0	18	27.0

Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: South

Measurement Method: Scale

Added & Verified Nabesh 3/26/97

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
3/20/97	58+00		7.0		6.0	18	27.0
3/20/97	59+00		7.0		6.0	18	27.0
3/20/97	60+00		6.5		6.0	18	27.0
3/20/97	61+00		6.5			18	
	62+00	Not Yet Constructed				18	
	63+00					18	
	64+00					18	
	65+00					18	
			✓		✓		

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Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: South

Measurement Method: Scale

Audited & Verified JA Parker 2/18/98

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
2/5/98	60+00		6.5		6.0	18	27.0
2/5/98	61+00		8.0		6.0	18	27.0
2/5/98	62+00		6.0		6.5	18	27.5
2/5/98	63+00		6.5		6.0	18	27.0
2/5/98	64+00		6.5		6.5	18	27.0
2/5/98	65+00		6.5		6.5	18	27.0
2/5/98	65+93		6.5		8.0	18	27.0

South Diversion Ditch
Filter I Thickness Verification

1/28/97

TOE THICKNESSES

	Left				Centerline				Right			
	Filter I	Borrow soil	Thickness		Filter I	Borrow soil	Thickness		Filter I	Borrow soil	Thickness	
Station	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)
0+00	6399.84	6399.45	0.39	4.5	6399.92	6399.35	0.57	7.0	6399.84	6399.43	0.41	5.0
1+00	6393.34	6392.92	0.42	5.0	6393.35	6392.90	0.45	5.5	6393.43	6392.93	0.50	6.0
2+00	6392.61	6392.04	0.57	7.0	6392.59	6392.09	0.50	6.0	6392.60	6392.16	0.44	5.5
3+00	6391.80	6391.32	0.48	6.0	6391.78	6391.23	0.55	6.5	6391.78	6391.18	0.60	7.0
4+00	6390.90	6390.49	0.41	5.0	6390.96	6390.38	0.58	7.0	6390.91	6390.51	0.40	5.0
5+00	6390.12	6389.69	0.43	5.0	6390.12	6389.69	0.43	5.0	6390.10	6389.56	0.54	6.5
6+00	6387.75	6387.27	0.48	6.0	6387.76	6387.29	0.47	5.5	6387.82	6387.40	0.42	5.0
7+00	6386.99	6386.56	0.43	5.0	6387.10	6386.61	0.49	6.0	6386.99	6386.51	0.48	6.0
8+00	6387.66	6387.19	0.47	5.5	6387.59	6387.14	0.45	5.5	6387.63	6387.19	0.44	5.5
9+00	6386.80	6386.30	0.50	6.0	6386.83	6386.44	0.39	4.5	6386.81	6386.34	0.47	5.5
10+00	6386.06	6385.59	0.47	5.5	6386.01	6385.60	0.41	5.0	6386.05	6385.63	0.42	5.0
11+00	6385.23	6384.74	0.49	6.0	6385.23	6384.81	0.42	5.0	6385.24	6384.58	0.66	8.0
12+00	6384.66	6384.19	0.47	5.5	6384.57	6384.11	0.46	5.5	6384.57	6384.06	0.51	6.0
13+00	6384.01	6383.68	0.33	4.0	6384.23	6383.64	0.59	7.0	6384.20	6383.69	0.51	6.0
14+00	6383.73	6383.26	0.47	5.5	6383.82	6383.30	0.52	6.0	6383.83	6383.39	0.44	5.5
15+00	6383.31	6382.95	0.36	4.5	6383.34	6382.86	0.48	6.0	6383.29	6382.83	0.46	5.5
16+00	6383.01	6382.53	0.48	6.0	6383.01	6382.50	0.51	6.0	6382.86	6382.46	0.40	5.0
17+00	6382.50	6382.05	0.45	5.5	6382.69	6382.19	0.50	6.0	6382.68	6382.20	0.48	6.0
18+00	6382.20	6381.67	0.53	6.5	6382.29	6381.81	0.48	6.0	6382.30	6381.83	0.47	5.5
19+00	6381.76	6381.19	0.57	7.0	6381.82	6381.36	0.46	5.5	6381.70	6381.37	0.33	4.0
20+00	6381.94	6381.26	0.68	8.0	6381.84	6381.39	0.45	5.5	6381.89	6381.53	0.36	4.5
21+00	6381.86	6381.39	0.47	5.5	6381.49	6380.99	0.50	6.0	6381.47	6380.95	0.52	6.0
22+00	6381.61	6380.96	0.65	8.0	6381.10	6380.52	0.58	7.0	6381.13	6380.53	0.60	7.0
23+00	6378.56	6377.94	0.62	7.5	6378.56	6377.95	0.61	7.5	6378.54	6377.97	0.57	7.0
24+00	6377.61	6377.14	0.47	5.5	6377.72	6377.24	0.48	6.0	6377.77	6377.22	0.55	6.5
25+00	6379.52	6378.97	0.55	6.5	6379.46	6378.98	0.48	6.0	6379.48	6378.87	0.61	7.5
26+00	6379.08	6378.55	0.53	6.5	6379.11	6378.54	0.57	7.0	6379.05	6378.55	0.50	6.0
27+00	6378.67	6378.06	0.61	7.5	6378.63	6378.20	0.43	5.0	6378.69	6378.15	0.54	6.5
28+00	6378.21	6377.69	0.52	6.5	6378.23	6377.66	0.57	7.0	6378.21	6377.69	0.52	6.0
29+00	6377.82	6377.35	0.47	5.5	6377.87	6377.30	0.57	7.0	6377.81	6377.27	0.54	6.5
30+00	6377.49	6376.89	0.60	7.0	6377.45	6376.88	0.57	7.0	6377.39	6376.82	0.57	7.0
31+00	6375.53	6375.01	0.52	6.0	6375.61	6375.14	0.47	5.5	6375.54	6375.14	0.40	5.0
32+00	6375.22	6374.69	0.53	6.5	6375.19	6374.65	0.54	6.5	6375.28	6374.69	0.59	7.0
33+00	6376.15	6375.63	0.52	6.0	6376.19	6375.53	0.66	8.0	6376.21	6375.59	0.62	7.5
34+00	6375.82	6375.29	0.53	6.5	6375.86	6375.22	0.64	7.5	6375.72	6375.30	0.42	5.0

TOE THICKNESSES (continued)

	Left				Centerline				Right			
	Filter I	Borrow soil	Thickness		Filter I	Borrow soil	Thickness		Filter I	Borrow soil	Thickness	
Station	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)
35+00	6375.43	6374.89	0.54	6.5	6375.40	6374.84	0.56	6.5	6375.45	6374.88	0.57	7.0
36+00	6375.03	6374.49	0.54	6.5	6375.00	6374.47	0.53	6.5	6374.98	6374.45	0.53	6.5
37+00	6374.63	6374.14	0.49	6.0	6374.59	6374.07	0.52	6.0	6374.58	6374.15	0.43	5.0
38+00	6374.19	6373.69	0.50	6.0	6374.16	6373.68	0.48	6.0	6374.20	6373.69	0.51	6.0
39+00	6373.77	6373.26	0.51	6.0	6373.82	6373.27	0.55	6.5	6373.79	6373.24	0.55	6.5
40+00	6373.42	6372.90	0.52	6.0	6373.33	6372.87	0.46	5.5	6373.37	6372.87	0.50	6.0
41+00	6372.92	6372.45	0.47	5.5	6372.99	6372.59	0.40	5.0	6373.00	6372.51	0.49	6.0
42+00	6372.55	6371.99	0.56	6.5	6372.77	6372.42	0.35	4.0	6372.58	6372.18	0.40	5.0
43+00	6372.20	6371.70	0.50	6.0	6372.18	6371.69	0.49	6.0	6372.22	6371.80	0.42	5.0
44+00	6371.74	6371.25	0.49	6.0	6371.86	6371.37	0.49	6.0	6371.80	6371.28	0.52	6.0
45+00	6369.09	6368.55	0.54	6.5	6369.06	6368.62	0.44	5.5	6369.08	6368.60	0.48	6.0
46+00	6366.79	6366.39	0.40	5.0	6366.73	6366.16	0.57	7.0	6366.79	6366.37	0.42	5.0
47+00	6364.47	6364.08	0.39	4.5	6364.48	6363.77	0.71	8.5	6364.44	6363.77	0.67	8.0
48+00	6362.24	6361.81	0.43	5.0	6362.20	6361.66	0.54	6.5	6362.22	6361.73	0.49	6.0
49+00	6359.89	6359.35	0.54	6.5	6359.83	6359.11	0.72	8.5	6359.86	6359.35	0.51	6.0
50+00	6357.59	6357.04	0.55	6.5	6357.60	6357.15	0.45	5.5	6357.58	6357.16	0.42	5.0
51+00	6355.31	6354.83	0.48	5.5	6355.36	6354.98	0.38	4.5	6355.39	6354.79	0.60	7.0
52+00	6353.06	6352.46	0.62	7.5	6353.08	6352.56	0.52	6.0	6353.02	6352.53	0.49	6.0
53+00	6350.70	6350.26	0.44	5.5	6350.68	6350.23	0.45	5.5	6350.71	6350.23	0.48	6.0
54+00	6348.47	6347.92	0.55	6.5	6348.33	6347.90	0.43	5.0	6348.47	6347.92	0.55	6.5
55+00	6346.07	6345.60	0.47	5.5	6346.04	6345.54	0.50	6.0	6346.05	6345.54	0.51	6.0
56+00	6343.78	6343.26	0.52	6.0	6343.82	6343.16	0.66	8.0	6343.86	6343.22	0.64	7.5
57+00	6341.48	6340.93	0.55	6.5	6341.54	6340.89	0.65	8.0	6341.54	6340.96	0.58	7.0
58+00	6339.21	6338.65	0.56	7.0	6339.22	6338.66	0.56	6.5	6339.23	6338.59	0.64	7.5
59+00	6336.91	6336.23	0.68	8.0	6336.91	6336.33	0.58	7.0	6336.93	6336.37	0.56	6.5
60+00	6334.65	6334.05	0.60	7.0	6334.63	6334.03	0.60	7.0	6334.59	6333.99	0.60	7.0
61+00	6332.26	6331.69	0.57	7.0	6332.14	6331.72	0.42	5.0	6332.14	6331.64	0.50	6.0
62+00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0
63+00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0
64+00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0
65+00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.0
Measurement				t1				t2				t3

THICKNESSES AT TOP

	LEFT				RIGHT			
	Filter I	Borrow soil	Thickness*		Filter I	Borrow soil	Thickness*	
Station	top elevation	toe elevation	(ft)	(in)	top elevation	toe elevation	(ft)	(in)
0+00	6405.83	6405.28	0.55	6.5	6405.94	6405.41	0.53	6.5
1+00	6399.27	6398.74	0.53	6.5	6401.03	6400.47	0.56	6.5
2+00	6402.37	6401.78	0.59	7.0	6402.33	6401.80	0.53	6.5
3+00	6401.77	6401.23	0.54	6.5	6401.36	6400.89	0.47	5.5
4+00	6400.66	6400.09	0.57	7.0	6400.70	6400.17	0.53	6.5
5+00	6399.89	6399.29	0.60	7.0	6399.96	6399.41	0.55	6.5
6+00	confluence				6399.09	6398.45	0.64	7.5
7+00	6398.83	6398.30	0.53	6.5	6399.10	6398.51	0.59	7.0
8+00	6398.69	6398.16	0.53	6.5	6398.79	6398.22	0.57	7.0
9+00	6400.86	6400.31	0.55	6.5	6399.69	6399.14	0.55	6.5
10+00	6398.89	6398.41	0.48	6.0	6400.17	6399.51	0.66	8.0
11+00	6397.85	6397.28	0.57	7.0	6397.99	6397.45	0.54	6.5
12+00	6397.98	6397.45	0.53	6.5	6397.99	6397.40	0.59	7.0
13+00	6397.36	6396.85	0.51	6.0	6397.50	6396.90	0.60	7.0
14+00	6391.10	6390.51	0.59	7.0	6392.69	6392.10	0.59	7.0
15+00	6396.55	6396.00	0.55	6.5	6392.56	6391.99	0.57	7.0
16+00	6396.33	6395.77	0.56	6.5	6392.33	6391.77	0.56	6.5
17+00	6396.15	6395.65	0.50	6.0	6392.20	6391.61	0.59	7.0
18+00	6395.80	6395.38	0.42	5.0	6391.98	6391.45	0.53	6.5
19+00	6395.79	6395.22	0.57	7.0	6391.77	6391.14	0.63	7.5
20+00	6401.25	6400.71	0.54	6.5	6395.85	6395.28	0.57	7.0
21+00	6395.23	6394.70	0.53	6.5	6395.50	6394.89	0.61	7.5
22+00	6395.23	6394.74	0.49	6.0	6392.27	6391.69	0.58	7.0
23+00	6396.30	6395.71	0.59	7.0	6394.94	6394.37	0.57	7.0
24+00	confluence				6394.79	6394.24	0.55	6.5
25+00	6389.54	6388.91	0.63	7.5	6390.56	6390.27	0.29	3.5
26+00	6388.75	6388.10	0.65	8.0	6390.14	6389.87	0.27	3.0
27+00	6388.05	6387.53	0.52	6.0	6389.73	6389.15	0.58	7.0
28+00	6388.05	6387.26	0.79	9.5	6388.98	6388.63	0.35	4.0
29+00	6387.58	6386.98	0.60	7.0	6388.84	6388.25	0.59	7.0
30+00	6386.85	6386.32	0.53	6.5	6388.06	6387.73	0.33	4.0
31+00	confluence				6387.89	6387.29	0.60	7.0
32+00	6390.18	6389.70	0.48	6.0	6387.24	6386.85	0.39	4.5
33+00	6386.88	6386.36	0.52	6.0	6387.64	6387.29	0.35	4.0
34+00	6386.50	6385.95	0.55	6.5	6386.97	6386.53	0.44	5.5
35+00	6386.23	6385.59	0.64	7.5	6386.14	6385.52	0.62	7.5

THICKNESSES AT TOP (continued)

	LEFT				RIGHT			
	Filter I	Borrow soil	Thickness*		Filter I	Borrow soil	Thickness*	
Station	top elevation	toe elevation	(ft)	(in)	top elevation	toe elevation	(ft)	(in)
36+00	6385.81	6385.08	0.73	9.0	6385.64	6385.19	0.45	5.5
37+00	6385.19	6384.70	0.49	6.0	6385.21	6384.72	0.49	6.0
38+00	6384.87	6384.32	0.55	6.5	6384.91	6384.36	0.55	6.5
39+00	6384.35	6383.92	0.43	5.0	6384.60	6383.94	0.66	8.0
40+00	6384.13	6383.29	0.84	10.0	6383.73	6383.20	0.53	6.5
41+00	6383.68	6383.01	0.67	8.0	6383.67	6383.13	0.54	6.5
42+00	6383.14	6382.18	0.96	11.5	6383.11	6382.70	0.41	5.0
43+00	6382.85	6382.15	0.70	8.5	6382.78	6382.11	0.67	8.0
44+00	6382.43	6381.96	0.47	5.5	6382.35	6381.84	0.51	6.0
45+00	6381.18	6380.63	0.55	6.5	6380.38	6380.01	0.37	4.5
46+00	6377.98	6377.54	0.44	5.5	6378.19	6377.55	0.64	7.5
47+00	6375.44	6374.96	0.48	6.0	6375.53	6374.97	0.56	6.5
48+00	6372.95	6372.44	0.51	6.0	6372.96	6372.44	0.52	6.0
49+00	6372.85	6372.33	0.52	6.0	6372.91	6372.40	0.51	6.0
50+00	6367.59	6367.02	0.57	7.0	6371.11	6370.62	0.49	6.0
51+00	confluence				6371.09	6370.58	0.51	6.0
52+00	confluence				6370.65	6370.20	0.45	5.5
53+00	6367.65	6367.10	0.55	6.5	6368.32	6367.74	0.58	7.0
54+00	6363.88	6363.35	0.53	6.5	6366.30	6365.78	0.52	6.0
55+00	6360.68	6360.16	0.52	6.0	6359.81	6359.34	0.47	5.5
56+00	6357.48	6356.90	0.58	7.0	6357.05	6356.52	0.53	6.5
57+00	6355.19	6354.68	0.51	6.0	6355.08	6354.51	0.57	7.0
58+00	6352.78	6352.33	0.45	5.5	6352.36	6351.75	0.61	7.5
59+00	6353.40	6352.82	0.58	7.0	6350.39	6349.95	0.44	5.5
60+00	6355.98	6355.48	0.50	6.0	6347.35	6346.83	0.52	6.0
61+00	6355.37	6354.72	0.65	8.0	6345.15	6344.53	0.62	7.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Measurement				t4				t5

AVERAGE THICKNESSES (BY STATION)

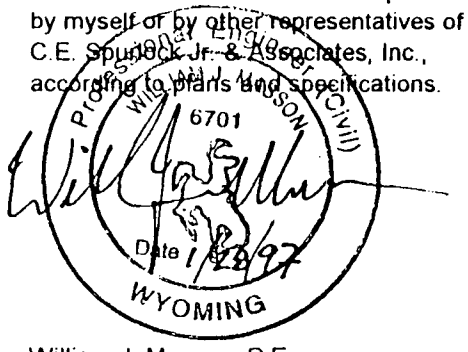
	Measurement					Average Thickness
Station	t1(in)	t2 (in)	t3 (in)	t4 (in)	t5 (in)	(in)
0+00	4.5	7.0	5.0	6.5	6.5	6.0
1+00	5.0	5.5	6.0	6.5	6.5	6.0
2+00	7.0	6.0	5.5	7.0	6.5	6.5
3+00	6.0	6.5	7.0	6.5	5.5	6.5
4+00	5.0	7.0	5.0	7.0	6.5	6.0
5+00	5.0	5.0	6.5	7.0	6.5	6.0
6+00	6.0	5.5	5.0		7.5	6.0
7+00	5.0	6.0	6.0	6.5	7.0	6.0
8+00	5.5	5.5	5.5	6.5	7.0	6.0
9+00	6.0	4.5	5.5	6.5	6.5	6.0
10+00	5.5	5.0	5.0	6.0	8.0	6.0
11+00	6.0	5.0	8.0	7.0	6.5	6.5
12+00	5.5	5.5	6.0	6.5	7.0	6.0
13+00	4.0	7.0	6.0	6.0	7.0	6.0
14+00	5.5	6.0	5.5	7.0	7.0	6.0
15+00	4.5	6.0	5.5	6.5	7.0	6.0
16+00	6.0	6.0	5.0	6.5	6.5	6.0
17+00	5.5	6.0	6.0	6.0	7.0	6.0
18+00	6.5	6.0	5.5	5.0	6.5	6.0
19+00	7.0	5.5	4.0	7.0	7.5	6.0
20+00	8.0	5.5	4.5	6.5	7.0	6.5
21+00	5.5	6.0	6.0	6.5	7.5	6.5
22+00	8.0	7.0	7.0	6.0	7.0	7.0
23+00	7.5	7.5	7.0	7.0	7.0	7.0
24+00	5.5	6.0	6.5		6.5	6.0
25+00	6.5	6.0	7.5	7.5	3.5	6.0
26+00	6.5	7.0	6.0	8.0	3.0	6.0
27+00	7.5	5.0	6.5	6.0	7.0	6.5
28+00	6.5	7.0	6.0	9.5	4.0	6.5
29+00	5.5	7.0	6.5	7.0	7.0	6.5
30+00	7.0	7.0	7.0	6.5	4.0	6.5
31+00	6.0	5.5	5.0		7.0	6.0
32+00	6.5	6.5	7.0	6.0	4.5	6.0
33+00	6.0	8.0	7.5	6.0	4.0	6.5
34+00	6.5	7.5	5.0	6.5	5.5	6.0
35+00	6.5	6.5	7.0	7.5	7.5	7.0
36+00	6.5	6.5	6.5	9.0	5.5	7.0

AVERAGE THICKNESSES (continued)

Station	Measurement t1(in)	t2 (in)	t3 (in)	t4 (in)	t5 (in)	Average Thickness (in)
37+00	6.0	6.0	5.0	6.0	6.0	6.0
38+00	6.0	6.0	6.0	6.5	6.5	6.0
39+00	6.0	6.5	6.5	5.0	8.0	6.5
40+00	6.0	5.5	6.0	10.0	6.5	7.0
41+00	5.5	5.0	6.0	8.0	6.5	6.0
42+00	6.5	4.0	5.0	11.5	5.0	6.5
43+00	6.0	6.0	5.0	8.5	8.0	6.5
44+00	6.0	6.0	6.0	5.5	6.0	6.0
45+00	6.5	5.5	6.0	6.5	4.5	6.0
46+00	5.0	7.0	5.0	5.5	7.5	6.0
47+00	4.5	8.5	8.0	6.0	6.5	6.5
48+00	5.0	6.5	6.0	6.0	6.0	6.0
49+00	6.5	8.5	6.0	6.0	6.0	6.5
50+00	6.5	5.5	5.0	7.0	6.0	6.0
51+00	5.5	4.5	7.0	[illegible]	6.0	6.0
52+00	7.5	6.0	6.0	[illegible]	5.5	6.5
53+00	5.5	5.5	6.0	6.5	7.0	6.0
54+00	6.5	5.0	6.5	6.5	6.0	6.0
55+00	5.5	6.0	6.0	6.0	5.5	6.0
56+00	6.0	8.0	7.5	7.0	6.5	7.0
57+00	6.5	8.0	7.0	6.0	7.0	7.0
58+00	7.0	6.5	7.5	5.5	7.5	7.0
59+00	8.0	7.0	6.5	7.0	5.5	7.0
60+00	7.0	7.0	7.0	6.0	6.0	6.5
61+00	7.0	5.0	6.0	8.0	7.5	6.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] = not included in average (confluence at this slope)

Measurements and calculations performed by myself or by other representatives of C.E. Spurlock Jr. & Associates, Inc., according to plans and specifications.



William J. Masson, P.E.
C.E. Spurlock Jr. & Associates, Inc.

South Diversion Ditch
Filter II Thickness Verification

1/29/97

TOE THICKNESSES

	Left				Centerline				Right			
	Filter II	Filter I	Thickness		Filter II	Filter I	Thickness		Filter II	Filter I	Thickness	
Station	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)
6+00	6388.30	6387.75	0.55	6.5	6388.33	6387.76	0.57	7.0	6388.41	6387.82	0.59	7.0
7+00	6387.48	6386.90	0.58	7.0	6387.52	6387.04	0.48	6.0	6387.46	6386.85	0.61	7.5
23+00	6379.02	6378.56	0.46	5.5	6379.04	6378.56	0.48	6.0	6379.09	6378.54	0.55	6.5
24+00	6378.08	6377.61	0.47	5.5	6378.19	6377.72	0.47	5.5	6378.25	6377.77	0.48	6.0
31+00	6376.01	6375.53	0.48	5.5	6376.09	6375.61	0.48	6.0	6376.07	6375.54	0.53	6.5
32+00	6375.66	6375.22	0.44	5.5	6375.67	6375.19	0.48	6.0	6375.75	6375.28	0.47	5.5
33+00	6376.60	6376.15	0.45	5.5	6376.67	6376.19	0.48	6.0	6376.72	6376.21	0.51	6.0
45+00	6369.70	6369.09	0.61	7.5	6369.58	6369.06	0.52	6.0	6369.63	6369.08	0.55	6.5
46+00	6367.41	6366.79	0.62	7.5	6367.37	6366.73	0.64	7.5	6367.45	6366.79	0.66	8.0
47+00	6365.13	6364.47	0.66	8.0	6365.11	6364.48	0.63	7.5	6365.03	6364.44	0.59	7.0
48+00	6362.86	6362.24	0.62	7.5	6362.87	6362.20	0.67	8.0	6362.83	6362.22	0.61	7.5
49+00	6360.44	6359.89	0.55	6.5	6360.47	6359.83	0.64	7.5	6360.50	6359.86	0.64	7.5
50+00	6358.19	6357.59	0.60	7.0	6358.18	6357.60	0.58	7.0	6358.18	6357.58	0.60	7.0
51+00	6355.83	6355.31	0.52	6.0	6355.83	6355.26	0.57	7.0	6355.88	6355.39	0.49	6.0
52+00	6353.63	6353.08	0.55	6.5	6353.59	6353.08	0.51	6.0	6353.46	6353.02	0.44	5.5
53+00	6351.17	6350.70	0.47	5.5	6351.23	6350.68	0.55	6.5	6351.27	6350.71	0.56	6.5
54+00	6348.93	6348.47	0.46	5.5	6348.89	6348.33	0.56	6.5	6348.86	6348.47	0.39	4.5
55+00	6346.62	6346.07	0.55	6.5	6346.61	6346.04	0.57	7.0	6346.50	6346.05	0.45	5.5
56+00	6344.25	6343.78	0.47	5.5	6344.18	6343.82	0.36	4.5	6344.34	6343.86	0.48	6.0
57+00	6341.99	6341.48	0.51	6.0	6342.01	6341.54	0.47	5.5	6342.04	6341.54	0.50	6.0
58+00	6339.76	6339.21	0.55	6.5	6339.76	6339.22	0.54	6.5	6339.75	6339.23	0.52	6.0
59+00	6337.36	6336.91	0.45	5.5	6337.45	6336.91	0.54	6.5	6337.38	6336.93	0.45	5.5
60+00	6335.03	6334.65	0.38	4.5	6335.07	6334.63	0.44	5.5	6335.00	6334.59	0.41	5.0
61+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
62+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
63+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
64+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
65+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Measurement				t1				t2				t3

THICKNESSES AT TOP

	LEFT				RIGHT			
	Filter II	Filter I	Thickness*		Filter II	Filter I	Thickness*	
Station	top elevation	toe elevation	(ft)	(in)	top elevation	toe elevation	(ft)	(in)
6+00	confluence				6395.36	6394.77	0.59	7.0
7+00	6395.02	6394.59	0.43	5.0	6395.04	6394.54	0.50	6.0
23+00	6396.85	6396.30	0.55	6.5	6395.52	6394.94	0.58	7.0
24+00	confluence				6395.35	6394.79	0.56	6.5
31+00	confluence				6388.47	6387.89	0.58	7.0
32+00	6390.79	6390.18	0.61	7.5	6387.74	6387.24	0.50	6.0
33+00	6387.35	6386.88	0.47	5.5	6388.18	6387.64	0.54	6.5
45+00	6381.71	6381.18	0.53	6.5	6380.92	6380.38	0.54	6.5
46+00	6378.62	6377.98	0.64	7.5	6378.66	6378.19	0.47	5.5
47+00	6375.98	6375.44	0.54	6.5	6376.08	6375.53	0.55	6.5
48+00	6373.46	6372.95	0.51	6.0	6373.44	6372.96	0.48	6.0
49+00	6373.36	6372.85	0.51	6.0	6373.40	6372.91	0.49	6.0
50+00	6370.69	6370.19	0.50	6.0	6370.68	6370.11	0.57	7.0
51+00	confluence				6368.49	6367.92	0.57	7.0
52+00	confluence				6365.97	6365.54	0.43	5.0
53+00	6363.80	6363.25	0.55	6.5	6363.83	6363.31	0.52	6.0
54+00	6361.50	6361.02	0.48	6.0	6361.55	6361.00	0.55	6.5
55+00	6361.17	6360.68	0.49	6.0	6360.39	6359.81	0.58	7.0
56+00	6357.97	6357.48	0.49	6.0	6357.64	6357.05	0.59	7.0
57+00	6355.67	6355.19	0.48	6.0	6355.64	6355.08	0.56	6.5
58+00	6353.21	6352.78	0.43	5.0	6352.87	6352.36	0.51	6.0
59+00	6353.92	6353.40	0.52	6.0	6350.95	6350.39	0.56	6.5
60+00	6356.60	6355.98	0.62	7.5	6347.90	6347.35	0.55	6.5
61+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
62+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
63+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
64+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
65+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Measurement				t4				t5

AVERAGE THICKNESSES (BY STATION)

Station	Measurement t1(in)	t2 (in)	t3 (in)	t4 (in)	t5 (in)	Average Thickness (in)
6+00	6.5	7.0	7.0		7.0	7.0
7+00	7.0	6.0	7.5	5.0	6.0	6.5
23+00	5.5	6.0	6.5	6.5	7.0	6.5
24+00	5.5	5.5	6.0		6.5	6.0
31+00	5.5	6.0	6.5		7.0	6.5
32+00	5.5	6.0	5.5	7.5	6.0	6.0
33+00	5.5	6.0	6.0	5.5	6.5	6.0
45+00	7.5	6.0	6.5	6.5	6.5	6.5
46+00	7.5	7.5	8.0	7.5	5.5	7.0
47+00	8.0	7.5	7.0	6.5	6.5	7.0
48+00	7.5	8.0	7.5	6.0	6.0	7.0
49+00	6.5	7.5	7.5	6.0	6.0	6.5
50+00	7.0	7.0	7.0	6.0	7.0	7.0
51+00	6.0	7.0	6.0		7.0	6.5
52+00	6.5	6.0	5.5		5.0	6.0
53+00	5.5	6.5	6.5	6.5	6.0	6.0
54+00	5.5	6.5	4.5	6.0	6.5	6.0
55+00	6.5	7.0	5.5	6.0	7.0	6.5
56+00	5.5	4.5	6.0	6.0	7.0	6.0
57+00	6.0	5.5	6.0	6.0	6.5	6.0
58+00	6.5	6.5	6.0	5.0	6.0	6.0
59+00	5.5	6.5	5.5	6.0	6.5	6.0
60+00	4.5	5.5	5.0	7.5	6.5	6.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

= not included in average (confluence at this slope)

Measurements and calculations performed by myself or by other representatives of C.E. Spurlock Jr. & Associates, Inc., according to plans and specifications.

Professional Engineer (Civil) WILLIAM J. MASSON 6701 Date 1/29/97 WYOMING

William J. Masson, P.E.
C.E. Spurlock Jr. & Associates, Inc.

South Diversion Ditch
Measured Riprap Thicknesses

4/15/97

Station	Left top Measured Thickness	Left toe Measured Thickness	Centerline Measured Thickness	Right toe Measured Thickness	Right top Measured Thickness	Average Measured Thickness	Riprap D50 (inches)	Design Thickness (inches)
0+00	6.5	6.0	6.5	7.5	6.0	6.5	3	6
1+00	6.0	7.5	7.5	6.5	6.0	6.5	3	6
2+00	6.0	5.5	7.0	6.0	6.0	6.0	3	6
3+00	6.5	6.0	6.5	6.0	6.5	6.5	3	6
4+00	6.0	7.0	6.0	7.0	6.0	6.5	3	6
5+00	6.0	6.0	5.5	7.0	5.5	6.0	3	6
6+00	confluence	17.5	18.0	18.5	18.5	18.0	12	18
7+00	17.5	19.0	18.5	19.0	17.5	18.5	12	18
8+00	6.0	6.5	7.0	7.5	6.5	6.5	3	6
9+00	6.0	7.0	5.5	6.0	6.5	6.0	3	6
10+00	6.5	6.5	7.0	6.0	6.0	6.5	3	6
11+00	6.0	6.5	5.5	5.5	6.5	6.0	3	6
12+00	6.0	5.5	6.5	6.5	6.0	6.0	3	6
13+00	6.0	9.0	6.0	6.0	6.0	6.5	3	6
14+00	6.0	8.0	5.0	6.5	6.5	6.5	3	6
15+00	5.5	6.0	6.0	7.5	6.0	6.0	3	6
16+00	6.5	6.0	5.5	7.5	6.5	6.5	3	6
17+00	6.5	5.5	6.0	6.0	6.5	6.0	3	6
18+00	6.0	7.0	5.0	6.0	5.5	6.0	3	6
19+00	6.0	7.5	5.5	8.0	6.0	6.5	3	6
20+00	6.0	6.5	7.0	7.5	6.0	6.5	3	6
21+00	6.5	5.0	7.0	7.5	6.0	6.5	3	6
22+00	6.0	5.0	6.5	6.0	6.0	6.0	3	6
23+00	27.5	26.5	27.0	27.5	27.5	27.0	18	27
24+00	confluence	27.5	26.5	27.5	27.5	27.5	18	27
25+00	6.5	5.5	5.0	6.0	7.0	6.0	3	6
26+00	6.0	6.0	5.5	6.5	6.0	6.0	3	6
27+00	6.0	6.5	6.0	5.5	6.5	6.0	3	6
28+00	6.5	6.5	5.5	6.5	6.5	6.5	3	6
29+00	6.5	6.0	5.0	7.0	6.0	6.0	3	6
30+00	6.5	5.5	6.0	6.5	6.0	6.0	3	6
31+00	confluence	19.0	18.5	18.5	18.0	18.5	12	18
32+00	17.5	17.5	18.0	18.0	18.0	18.0	12	18
33+00	17.0	19.0	18.0	17.5	18.5	18.0	12	18
34+00	6.0	6.5	5.5	7.0	6.5	6.5	3	6
35+00	6.5	6.5	6.0	6.0	7.0	6.5	3	6
36+00	6.5	7.0	6.0	7.0	7.0	6.5	3	6
37+00	6.0	7.0	7.0	6.5	7.0	6.5	3	6
38+00	6.5	6.5	7.5	6.0	6.0	6.5	3	6
39+00	6.5	7.0	6.5	7.0	6.5	6.5	3	6
40+00	5.5	7.5	7.5	7.5	7.5	7.0	3	6
41+00	6.0	8.0	7.0	6.5	6.0	6.5	3	6

South Diversion Ditch
Measured Riprap Thicknesses

4/15/97

Station	Left top Measured Thickness	Left toe Measured Thickness	Centerline Measured Thickness	Right toe Measured Thickness	Right top Measured Thickness	Average Measured Thickness	Riprap D50 (inches)	Design Thickness (inches)
42+00	6.5	8.5	5.5	8.0	6.0	7.0	3	6
43+00	5.5	7.0	9.0	7.0	6.5	7.0	3	6
44+00	6.0	7.5	4.5	5.5	5.5	6.0	3	6
45+00	28.0	26.5	26.5	25.5	28.0	27.0	18	27
46+00	27.5	26.5	26.0	26.5	29.0	27.0	18	27
47+00	28.5	26.0	25.0	26.0	28.5	27.0	18	27
48+00	29.5	25.5	26.0	25.0	28.5	27.0	18	27
49+00	29.0	26.5	25.5	25.0	28.0	27.0	18	27
50+00	27.0	25.5	27.0	26.0	29.0	27.0	18	27
51+00	confluence	27.0	26.5	25.5	28.5	27.0	18	27
52+00	confluence	26.0	26.0	27.0	28.5	27.0	18	27
53+00	29.0	26.5	25.5	26.0	29.0	27.0	18	27
54+00	28.5	25.5	26.0	27.0	29.5	27.5	18	27
55+00	28.0	27.5	26.0	27.0	27.5	27.0	18	27
56+00	27.0	27.5	27.5	26.5	28.0	27.5	18	27
57+00	28.5	26.0	25.5	26.0	28.5	27.0	18	27
58+00	29.0	25.0	24.5	26.5	29.5	27.0	18	27
59+00	28.0	27.0	25.5	26.0	29.5	27.0	18	27
60+00	27.0	26.5	26.5	26.5	27.5	27.0	18	27
61+00	not yet constructed						18	27
62+00							18	27
63+00							18	27
64+00							18	27
65+00							18	27

Measurements and calculations performed
by myself or by other representatives of
C.E. Spurlock Jr. & Associates, Inc.,
according to plans and specifications.

William J. Masson, P.E.
C.E. Spurlock Jr. & Associates, Inc.

ma Roske 2/18/98 Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: NORTH CENTRAL Measurement Method: Scale 1997 WORK

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
2/5/98	11+56		7.0		6.0	12	18.0
2/5/98	12+56		7.0			3	6.0
2/5/98	13+56		7.0			3	6.0
2/5/98	14+56		6.0			3	6.5
	14+81		6.0			3	6.0
FROM 1996 WORK:							
	0+00		6.0			3	6.0
	1+00		6.0			3	6.5
	2+00		6.0			3	6.0
	3+00		6.0			3	6.0
	4+00		6.0			3	6.5
	5+00		6.0		6.5	12	18.0
	6+00		6.0		6.0	18	27.0
	7+00		6.0		6.0	18	27.0
	8+00		6.0		6.0	18	27.0
	9+00		6.0		6.5	12	18.0
	10+00		6.0		6.5	12	18.0
	10+56		6.0		6.5	12	18.0

Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: SOUTH CENTRAL

Measurement Method: Scale

Audited & Verified MaBerke 2/18/98

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
2/15/98	1+00					6	12.5
2/15/98	2+00					6	12.0
2/15/98	3+00					6	12.0
2/15/98	4+00					6	12.5
2/15/98	5+00					6	12.5
2/15/98	6+00					6	12.0
2/15/98	7+00					12	18.0
2/15/98	8+00					12	18.0
	9+00					6	12.5
4/14/97	9+70					6	12.5
4/14/97	10+70					6	12.5
4/14/97	11+70					6	12.5
4/14/97	12+70					6	12.5
4/14/97	13+70					6	12.5
4/14/97	14+70					6	12.5
4/14/97	15+70					6	12.5
4/14/97	16+70					6	12.0
4/14/97	17+70					6	13.0
4/14/97	18+70					6	13.0
4/15/98	19+70					6	12.5
4/15/98	20+70					6	12.5
4/15/98	21+70					6	12.0
4/15/98	22+70					6	12.0
4/15/98	23+20					6	12.0

Revised May 1996

WESTERN NUCLEAR, INC. – SPLIT ROCK MILLSITE
QUALITY COMPLIANCE REPORT

Diversion Ditch Filter and Riprap Thickness Measurement Log

Diversion Ditch: South Central

Measurement Method: Scale

Audited & Verified
M. Parks
3/26/97

Required Minimum Thickness:

Borrow Soil Pre–Filter = 6"
Filter I = 6"
Filter II = 6"

	FILTER II D_{50}	RIPRAP D_{50}			
	3"	3"	6"	12"	18"
Required Minimum Thickness (in inches)	6	6	12	18	27

Date & Initial	Station No.	Pre–Filter Thickness	Filter I Thickness	Filter II D_{50}	Filter II Thickness	RIPRAP D_{50}	RIPRAP Thickness
1/27/97 MM	1+00		6.0				
1/27/97 MM	2+00		6.0				
1/27/97 MM	3+00		6.0				
1/27/97 MM	4+00		7.0				
1/27/97 MM	5+00		6.5				
1/27/97 MM	6+00		6.0				
1/27/97 MM	7+00		6.5		6.0		
1/27/97 MM	8+00		6.5		6.5		
1/27/97 MM	9+00		6.0			6"	12.5
1/27/97 MM	9+70		7.0			6"	12.5
1/27/97 MM	10+70		6.5			6"	12.5
1/27/97 MM	11+70		6.5			6"	12.5
1/27/97 MM	12+70		6.0			6"	12.5
1/27/97 MM	13+70		6.0			6"	12.5
1/27/97 MM	14+70		6.0			6"	12.5
1/27/97 MM	15+70		6.5			6"	12.5
1/27/97 MM	16+70		7.0			6"	12.0
1/27/97 MM	17+70		6.5			6"	13.0
1/27/97 MM	18+70		6.0			6"	13.0
1/27/97 MM	19+70		6.0				
1/27/97 MM	20+70		6.0				
1/27/97 MM	21+70		6.5				
1/27/97 MM	22+70		6.5				

Note: Riprap not placed inside the South Central Diversion Ditch from Station No. 1+00 to 8+00 and from Station No. 19+70 to 22+70, during 1996.

South Central Diversion Ditch
Filter I Verification

1/27/97

TOE THICKNESSES

	Left				Centerline				Right			
	Filter I	Subgrade	Thickness		Filter I	Subgrade	Thickness		Filter I	Subgrade	Thickness	
Station	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)
0+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1+00	6344.58	6344.04	0.54	6.5	6344.54	6344.02	0.52	6.0	6344.40	6343.97	0.43	5.0
2+00	6343.86	6343.26	0.60	7.0	6343.88	6343.30	0.58	7.0	6343.73	6343.34	0.39	4.5
3+00	6342.54	6341.98	0.56	6.5	6342.46	6341.96	0.50	6.0	6342.32	6341.93	0.39	4.5
4+00	6341.66	6341.17	0.49	6.0	6341.83	6341.30	0.53	6.5	6341.87	6341.36	0.51	6.0
5+00	6341.07	6340.47	0.60	7.0	6340.88	6340.46	0.42	5.0	6341.07	6340.50	0.57	7.0
6+00	6340.31	6339.79	0.52	6.0	6340.30	6339.85	0.45	5.5	6340.31	6339.76	0.55	6.5
7+00	6337.28	6336.79	0.49	6.0	6337.33	6336.74	0.59	7.0	6337.22	6336.72	0.50	6.0
8+00	6333.89	6333.39	0.50	6.0	6333.89	6333.34	0.55	6.5	6333.85	6333.35	0.50	6.0
9+00	6333.25	6332.83	0.42	5.0	6333.24	6332.77	0.47	5.5	6333.27	6332.78	0.49	6.0
9+70	6332.25	6331.67	0.58	7.0	6332.25	6331.62	0.63	7.5	6332.19	6331.64	0.55	6.5
10+70	6330.63	6330.15	0.48	6.0	6330.63	6330.07	0.56	6.5	6330.59	6330.05	0.54	6.5
11+70	6329.10	6328.65	0.45	5.5	6329.17	6328.55	0.62	7.5	6329.11	6328.62	0.49	6.0
12+70	6327.56	6327.07	0.49	6.0	6327.56	6327.09	0.47	5.5	6327.62	6327.08	0.54	6.5
13+70	6326.06	6325.53	0.53	6.5	6326.07	6325.60	0.47	5.5	6326.05	6325.58	0.47	5.5
14+70	6324.46	6324.03	0.43	5.0	6324.52	6324.04	0.48	6.0	6324.54	6324.01	0.53	6.5
15+70	6323.20	6322.58	0.62	7.5	6323.16	6322.69	0.47	5.5	6323.19	6322.66	0.53	6.5
16+70	6322.25	6321.60	0.65	8.0	6322.29	6321.61	0.68	8.0	6322.25	6321.78	0.47	5.5
17+70	6321.32	6320.78	0.54	6.5	6321.36	6320.79	0.57	7.0	6321.30	6320.79	0.51	6.0
18+70	6320.36	6319.95	0.41	5.0	6320.46	6319.96	0.50	6.0	6320.47	6319.94	0.53	6.5
19+70	6319.58	6319.09	0.49	6.0	6319.50	6319.05	0.45	5.5	6319.55	6318.92	0.63	7.5
20+70	6318.70	6318.14	0.56	6.5	6318.57	6318.16	0.41	5.0	6318.56	6318.14	0.42	5.0
21+70	6317.79	6317.24	0.55	6.5	6317.82	6317.22	0.60	7.0	6317.76	6317.21	0.55	6.5
22+70	6317.01	6316.50	0.51	6.0	6316.96	6316.41	0.55	6.5	6316.91	6316.38	0.53	6.5
Measurement				t1				t2				t3

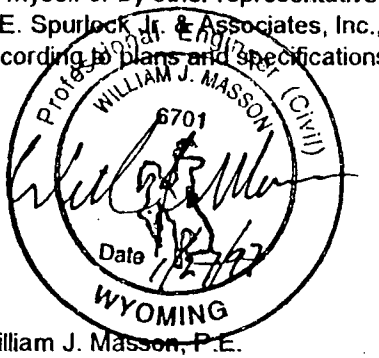
TOP THICKNESSES

	LEFT				RIGHT			
	Subgrade	Filter I	Thickness		Subgrade	Filter I	Thickness	
Station	top elevation	elevation	(ft)	(in)	top elevation	elevation	(ft)	(in)
1+00	6353.80	6354.58	0.78	9.5	6348.57	6348.91	0.34	4.0
2+00	6358.45	6358.96	0.51	6.0	6347.76	6348.22	0.46	5.5
3+00	6358.72	6359.40	0.68	8.0	6346.48	6346.96	0.48	6.0
4+00	6358.12	6358.85	0.73	9.0	6345.66	6346.25	0.59	7.0
5+00	6351.11	6351.65	0.54	6.5	6347.21	6347.76	0.55	6.5
6+00	6348.88	6349.35	0.47	5.5	6346.63	6347.15	0.52	6.0
7+00	6350.67	6351.19	0.52	6.0	6343.86	6344.39	0.53	6.5
8+00	6340.75	6341.33	0.58	7.0	6340.76	6341.27	0.51	6.0
9+00	6339.56	6340.11	0.55	6.5	6339.21	6339.75	0.54	6.5
9+70	6338.10	6338.66	0.56	6.5	6338.36	6338.91	0.55	6.5
10+70	6337.41	6337.97	0.56	6.5	6337.07	6337.59	0.52	6.0
11+70	6335.94	6336.48	0.54	6.5	6335.92	6336.46	0.54	6.5
12+70	6334.69	6335.22	0.53	6.5	6334.82	6335.36	0.54	6.5
13+70	6333.46	6334.07	0.61	7.5	6333.37	6333.88	0.51	6.0
14+70	6332.16	6332.71	0.55	6.5	6332.15	6332.64	0.49	6.0
15+70	6330.67	6331.22	0.55	6.5	6329.76	6330.31	0.55	6.5
16+70	6330.49	6330.97	0.48	6.0	6329.86	6330.39	0.53	6.5
17+70	6329.85	6330.45	0.60	7.0	6330.53	6331.05	0.52	6.0
18+70	6330.64	6331.21	0.57	7.0	6329.19	6329.67	0.48	6.0
19+70	6329.87	6330.27	0.40	5.0	6327.99	6328.55	0.56	6.5
20+70	6327.39	6327.96	0.57	7.0	6326.73	6327.21	0.48	6.0
21+70	6327.65	6328.22	0.57	7.0	6326.26	6326.78	0.52	6.0
22+70	6324.43	6324.94	0.51	6.0	6324.43	6324.97	0.54	6.5
Measurement				t4				t5

AVERAGE THICKNESSES (BY STATION)

Station	Measurement t1(in)	t2 (in)	t3 (in)	t4 (in)	t5 (in)	Average Thickness (in)
0+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1+00	6.5	6.0	5.0	9.5	4.0	6.0
2+00	7.0	7.0	4.5	6.0	5.5	6.0
3+00	6.5	6.0	4.5	8.0	6.0	6.0
4+00	6.0	6.5	6.0	9.0	7.0	7.0
5+00	7.0	5.0	7.0	6.5	6.5	6.5
6+00	6.0	5.5	6.5	5.5	6.0	6.0
7+00	6.0	7.0	6.0	6.0	6.5	6.5
8+00	6.0	6.5	6.0	7.0	6.0	6.5
9+00	5.0	5.5	6.0	6.5	6.5	6.0
9+70	7.0	7.5	6.5	6.5	6.5	7.0
10+70	6.0	6.5	6.5	6.5	6.0	6.5
11+70	5.5	7.5	6.0	6.5	6.5	6.5
12+70	6.0	5.5	6.5	6.5	6.5	6.0
13+70	6.5	5.5	5.5	7.5	6.0	6.0
14+70	5.0	6.0	6.5	6.5	6.0	6.0
15+70	7.5	5.5	6.5	6.5	6.5	6.5
16+70	8.0	8.0	5.5	6.0	6.5	7.0
17+70	6.5	7.0	6.0	7.0	6.0	6.5
18+70	5.0	6.0	6.5	7.0	6.0	6.0
19+70	6.0	5.5	7.5	5.0	6.5	6.0
20+70	6.5	5.0	5.0	7.0	6.0	6.0
21+70	6.5	7.0	6.5	7.0	6.0	6.5
22+70	6.0	6.5	6.5	6.0	6.5	6.5

Measurements and calculations performed by myself or by other representatives of C.E. Spurlock Jr. & Associates, Inc., according to plans and specifications.



William J. Masson, P.E.
C.E. Spurlock Jr. & Associates, Inc.

South Central Diversion Ditch
Filter II Verification

1/27/97

TOE THICKNESSES

	Left				Centerline				Right			
	Filter II	Filter I	Thickness		Filter II	Filter I	Thickness		Filter II	Filter I	Thickness	
Station	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)	toe elevation	toe elevation	(ft)	(in)
7+00	6337.75	6337.28	0.47	5.5	6337.78	6337.33	0.45	5.5	6337.81	6337.22	0.59	7.0
8+00	6334.50	6333.89	0.61	7.5	6334.39	6333.89	0.50	6.0	6334.40	6333.85	0.55	6.5
Measurement				t1				t2				t3

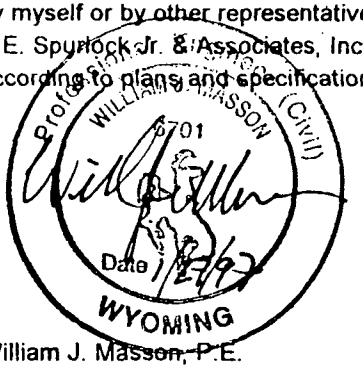
TOP THICKNESSES

	LEFT				RIGHT			
	Filter I	Filter II	Thickness		Filter I	Filter II	Thickness	
Station	top elevation	elevation	(ft)	(in)	top elevation	elevation	(ft)	(in)
7+00	6351.19	6351.78	0.59	7.0	6344.39	6344.88	0.49	6.0
8+00	6341.33	6341.81	0.48	6.0	6341.27	6341.74	0.47	5.5
Measurement				t4				t5

AVERAGE THICKNESSES (BY STATION)

	Measurement					Average Thickness
Station	t1(in)	t2 (in)	t3 (in)	t4 (in)	t5 (in)	(in)
7+00	5.5	5.5	7.0	7.0	6.0	6.0
8+00	7.5	6.0	6.5	6.0	5.5	6.5

Measurements and calculations performed by myself or by other representatives of C.E. Spurlock Jr. & Associates, Inc., according to plans and specifications.



William J. Masson, P.E.
C.E. Spurlock Jr. & Associates, Inc.

South Central Diversion Ditch
Rip-rap Measured Thicknesses

4/17/97

Station	Left top Measured Thickness	Left toe Measured Thickness	Centerline Measured Thickness	Right toe Measured Thickness	Right top Measured Thickness	Average Measured Thickness	Riprap D50 (inches)	Design Thickness (inches)
0+00	not yet constructed						6	12
1+00							6	12
2+00							6	12
3+00							6	12
4+00							6	12
5+00							6	12
6+00							6	12
7+00							12	18
8+00							12	18
9+00	12.0	12.0	13.0	12.5	12.5	12.5	6	12
9+70	12.5	11.5	14.0	11.5	12.0	12.5	6	12
10+70	13.0	13.0	11.5	12.5	12.0	12.5	6	12
11+70	13.5	12.0	12.5	12.5	12.0	12.5	6	12
12+70	12.5	12.5	13.5	12.5	12.0	12.5	6	12
13+70	13.0	12.5	12.5	13.0	11.5	12.5	6	12
14+70	12.0	12.0	13.0	12.5	12.0	12.5	6	12
15+70	12.0	12.5	13.5	12.5	11.5	12.5	6	12
16+70	11.5	12.0	12.0	12.5	12.0	12.0	6	12
17+70	13.0	14.0	13.0	12.5	11.5	13.0	6	12
18+70	14.5	12.0	14.0	12.0	12.5	13.0	6	12
19+70	not yet constructed						6	12
20+70							6	12
21+70							6	12
22+70							6	12

Measurements and calculations performed by myself or by other representatives of C.E. Spurlock Jr. & Associates, Inc., according to plans and specifications.

William J. Masson, P.E.
C.E. Spurlock Jr. & Associates, Inc.

APPENDIX X
NRC INSPECTIONS

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064
November 3, 1994

Docket: 40-1162
License: SUA-56

Western Nuclear, Inc.
ATTN: Stephanie J. Baker
Manager of Environmental Services
200 Union Boulevard
Lakewood, Colorado 80228

SUBJECT: NRC INSPECTION REPORT 40-1162/94-01

This refers to the routine, announced inspection conducted by Ms. M. Linda McLean and accompanied by Mr. Charles L. Cain of this office on September 27, 1994. The inspection included a review of activities authorized for the possession of licensed materials associated with the former Split Rock Uranium Mill, Fremont County, Wyoming, under NRC License SUA-56. At the conclusion of the inspection, the findings were discussed with members of your staff. The enclosed NRC Inspection Report 40-1162/94-01 documents this inspection.

The inspection was an examination of activities conducted under the license as they relate to radiation safety and to compliance with the Commission's rules and regulations and the conditions of the license. The inspection consisted of selective examinations of procedures and representative records, interviews of personnel, independent measurements, and observation of activities in progress.

No violations or deviations were identified; therefore, no response to this letter is required.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be placed in the NRC Public Document Room.

Should you have any questions concerning this letter, please contact the inspector identified above at (817) 860-8100.

Sincerely,

Samuel J. Collins, Director
Division of Radiation Safety
and Safeguards

cc:
Western Nuclear, Inc.
ATTN: Project Manager
P.O. Box 630
Jeffrey City, Wyoming 82310

Bureau of Land Management
ATTN: Ray Brubaker
State Director
P.O. Box 1828
Cheyenne, Wyoming 82003

Lidstone & Anderson
ATTN: Christopher D. Lidstone
736 Whalers Way, Suite F-2000
Fort Collins, Colorado 80525

Solid and Hazardous Waste Division
Department of Environmental Quality
ATTN: David Finley
122 W. 25th Street
Cheyenne, Wyoming 82002

Wyoming Department of Environmental Quality
ATTN: Land Quality Division
122 W. 25th Street
Cheyenne, Wyoming 82002

Wyoming Radiation Control Program Director

APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 40-1162/94-01

License: SUA-56

Licensee: Western Nuclear, Inc.
200 Union Boulevard
Lakewood, Colorado 80228

Facility Name: Site of Former Split Rock Uranium Mill

Inspection At: Fremont County, Wyoming

Inspection Conducted: September 27, 1994

Inspector: M. Linda McLean, Senior Health Physicist
Fuel Cycle and Decommissioning Branch

Accompanied by: Charles L. Cain, Chief
Fuel Cycle and Decommissioning Branch

Approved: Charles L. Cain 11/2/94
Charles L. Cain, Chief Date
Fuel Cycle and Decommissioning Branch

Inspection Summary

Areas Inspected: Routine, announced inspection of the licensee's mill tailings monitoring programs including management and organization controls, operations review, radiation protection, radioactive waste management, and environmental monitoring.

Results:

- The licensee's organization and management controls complied with the requirements of the license. Qualified individuals had maintained oversight of licensed activities (Section 2).
- The management of the mill tailings area had been conducted in accordance with license requirements (Section 3).
- The licensee had implemented an effective radiation protection program that was in compliance with the license and applicable portions of 10 CFR Part 20 (Section 3).

- The radioactive waste management program and environmental monitoring program had been conducted in accordance with license requirements (Section 4).

- The licensee's effluent monitoring report required by 10 CFR 40.65 was reviewed and found to be in compliance with the license and applicable portions of 10 CFR Part 40 (Section 4).

Attachment:

- Persons Contacted and Exit Meeting

DETAILS

1 SITE STATUS

The Western Nuclear, Inc. (WNI) Split Rock Mill ceased processing of uranium ore in 1981 and began decommissioning activities in April 1988. The licensee had completed interim soil cover over all of the exposed tailings and were in the process of placing the final radon barrier over areas as described in the licensee's submittal of June 14, 1994.

2 MANAGEMENT AND ORGANIZATION CONTROLS (88005)

The inspector reviewed the licensee's organizational structure and management controls to determine whether functional responsibilities and personnel qualifications had been clearly established and fulfilled and to determine what controls were in place to ensure review and compliance with requirements.

2.1 Discussion

The licensee described the organizational structure and current staffing at the Split Rock site. There were four WNI employees and approximately 45 contract workers at the facility. The contract workers were hired to work on the radon barrier installation. The Radiation Safety Officer (RSO) reported to the general manager of the facility. The RSO and assistant RSO were responsible for the implementation of the radiation safety program. Both individuals had attended a training course on revised 10 CFR Part 20 in 1994.

2.2 Conclusion

The licensee's organization and management controls met the requirements of the license. Qualified individuals had maintained oversight of licensed activities.

3 OPERATIONS REVIEW AND RADIATION PROTECTION (88020 and 83822)

The inspector reviewed licensee operations to determine compliance with applicable requirements specified in the license. Also reviewed was the licensee's program for radiation protection to determine compliance with the license application and revised 10 CFR Part 20.

3.1 Discussion

The inspector toured the mill tailings areas and observed haul trucks delivering clay from an area approximately 14 miles south of Jeffrey City, Wyoming, for placement of the final radon barrier on 3A and 3B mill tailings areas. The licensee stated that these areas should be covered with the final radon barrier within the week. License Condition 75 required placement of the barrier for these areas to be completed by December 31, 1994. All remaining tailings had been covered with a minimum of 12 inches of interim cover. The

evaporation systems were in operation at the time of the inspection. Restricted area fencing was noted to be in good condition with the appropriate postings required by License Condition 37.

Five active radiation work permits (RWPs) were reviewed by the inspector. RWP 118, dated July 18, 1994, was issued to cover the final radon barrier installation project, which included regrading and rock mulching. RWP 118 required that all workers involved with the radon barrier installation project have baseline and final bioassays for natural uranium. The inspector reviewed the baseline and four final urinalysis results. All results were less than 5 μg/l, well below the licensee's initial action level of 15 μg/l. All individuals working on the project were required to frisk with a radiation survey instrument when exiting the facility. Radiation protection training for the contract workers included information required by 10 CFR Part 19, the information on NRC Form 3, an explanation of the work to be conducted under the RWP, and a written exam.

Additionally, the licensee had performed lapel air sampling on workers involved in the radon barrier installation. Upon evaluating the lapel sampling calculations, the inspector identified errors in the calculations. However, despite the errors, exposures were determined to be less than 40 DAC-hrs per week. The licensee acknowledged the errors and committed to making the appropriate corrections.

External exposures of individuals working in the restricted areas were calculated as the product of working hours and radiation levels. Thermoluminescent dosimeters were not issued. Instrument readings were taken at each designated work area and multiplied by the amount of time spent in that area. From that data the assistant RSO assigned total exposures.

The inspector reviewed the written Standard Operating Procedures (SOPs) required by License Condition 44. The inspector noted that the SOPs contained adequate detail regarding routine site activities, and that the RSO had performed a documented review of all site procedures annually.

The inspector reviewed the annual ALARA audit report for 1993 required by License Condition 42. The ALARA audit committee was composed of four individuals: three licensee personnel and an independent contractor. The inspector concluded that the licensee had conducted a thorough ALARA audit and satisfied the condition of the license. The audit for 1994 had been completed on September 13, 1994; however, the report was unavailable for review.

3.2 Conclusion

The management of the mill tailings area had been conducted in accordance with license requirements. The licensee had implemented an effective radiation protection program that was in compliance with the license and applicable portions of 10 CFR Part 20.

4 RADIOACTIVE WASTE MANAGEMENT AND ENVIRONMENTAL MONITORING (88035 and 88045)

The inspector reviewed the licensee's radioactive waste management program and environmental monitoring program to determine compliance with applicable requirements specified in the license.

4.1 Discussion

Two environmental stations were in use by the licensee. They were located northeast of the facility and by the nearest residence. The licensee performed continuous air particulate sampling, radon monitoring, and external radiation monitoring at these two locations. Air samples had been analyzed for natural uranium, thorium-230, radium-226, and lead-210. Radon concentrations were reported at these two stations as 2.8 E-9 and 2.9 E-9 μci/ml respectively for the second quarter of 1994. 10 CFR Part 20 effluent concentration limit is 1 E-10 μci/ml. External gamma radiation was monitored by thermoluminescent dosimeters at the two stations. The average gamma level for the second quarter of 1994 was 0.931 mr/day and 0.536 mr/day respectively. The licensee evaluated the data for compliance with the 10 CFR 20.1301 limit of 100 mrem/yr to individual members of the public and determined that no member of the public would receive in excess of that limit.

The inspector reviewed the effluent monitoring report dated September 1, 1994, submitted to NRC pursuant to 10 CFR 40.65 and License Condition 24. The inspector noted that the licensee reported results for the first half of 1994 in percent of MPC rather than the new limits identified in revised 10 CFR Part 20. Revised 10 CFR Part 20 which went into effect January 1, 1994, no longer lists MPC's but effluent concentration limits. The effluent concentration limit for radon-222 is 1 E-8 μci/ml, whereas the MPC for radon-222 is 3 E-9 μci/ml. The licensee acknowledged the error and committed to correcting the data using the appropriate limit for radon-222. Despite the reported limits, the inspector verified that the effluent monitoring results were within all applicable limits.

The licensee has implemented a groundwater compliance monitoring program. Groundwater samples had been analyzed as required by License Condition 74. The licensee sampled 28 wells. Thirteen of these well samples and two point-of-compliance samples are required by license condition. The well samples were analyzed quarterly by an independent laboratory. Quality control samples were submitted with the well samples.

4.2 Conclusion

The radioactive waste management program and the environmental monitoring program had been conducted in accordance with license requirements.

ATTACHMENT

1 PERSONS CONTACTED

1.1 Licensee Personnel

*John Gearhart, Radiation Safety Officer
*Trinidad Herrera, Assistant Radiation Safety Officer

1.2 NRC Personnel

*M. Linda McLean, Senior Health Physicist, Region IV Office
*Charles L. Cain, Branch Chief, Region IV Office

*Denotes personnel that attended the exit meeting.

2 EXIT MEETING

An exit meeting was conducted at the conclusion of the inspection on September 27, 1994. During this meeting, the inspector reviewed the scope and findings of the inspection. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspector.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

June 20, 1995

Western Nuclear, Inc.
ATTN: Ms. Stephanie J. Baker
Manager of Environmental Services
Union Plaza Suite 300
200 Union Blvd.
Lakewood, Colorado 80228

SUBJECT: NRC INSPECTION REPORTS 40-1162/95-01 and 95-02

This refers to the inspections conducted by Mr. R. J. Evans of this office, and Messrs. T. Harris and M. Haque of our headquarters office, Division of Waste Management, on May 16 through 18, 1995. The inspections included a review of activities authorized for your former Split Rock Uranium Mill near Jeffrey City, Wyoming. At the conclusion of the inspections, the findings were discussed with those members of your staff identified in the enclosed reports.

Inspection 95-01 was performed by Mr. R. J. Evans while Inspection 95-02 was performed by Mr. T. Harris. Areas examined during the inspections are identified in the reports. Within these areas, the inspections consisted of selective examinations of procedures and representative records, interviews with personnel, and observation of activities in progress.

No violations or deviations were identified; therefore, no response to this letter is required.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be placed in the NRC Public Document Room.

Should you have any questions concerning these inspections, we will be pleased to discuss them with you.

Sincerely,

Charles L. Cain

for Ross A. Scarano, Acting Director
Division of Radiation Safety
and Safeguards

Docket: 40-1162
License: SUA-56

Enclosures:
1. NRC Inspection Report
   40-1162/95-01
2. NRC Inspection Report
   40-1162/95-02

cc w/enclosures:
Western Nuclear, Inc.
ATTN: John R. Gearhart
Resident Agent/Environmental Engineer
P. O. Box 630
Jeffrey City, Wyoming 82310

Bureau of Land Management
ATTN: Ray Brubaker
State Director
P. O. Box 1828
Cheyenne, Wyoming 82003

Lidstone & Anderson
ATTN: Christopher D. Lidstone
736 Whalers Way, Suite F-2000
Fort Collins, Colorado 80525

Solid and Hazardous Waste Division
Wyoming Department of Environmental Quality
ATTN: David Finley
122 W. 25th Street
Cheyenne, Wyoming 82002

Wyoming Department of Environmental Quality
ATTN: Land Quality Division
122 W. 25th Street
Cheyenne, Wyoming 82002

Wyoming Radiation Control Program Director

ENCLOSURE 1

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 40-1162/95-01

License: SUA-56

Licensee: Western Nuclear, Inc.
200 Union Blvd.
Lakewood, Colorado 80228

Facility Name: Site of Former Split Rock Uranium Mill

Inspection At: Jeffrey City, Fremont County, Utah

Inspection Conducted: May 16-18, 1995

Inspector: R. J. Evans, Health Physicist
Fuel Cycle and Decommissioning Branch

Accompanied by: M. W. Haque, Project Manager, Division of Waste Management
Office of Nuclear Materials Safety and Safeguards

T. Harris, Geotechnical Engineer, Division of Waste Management, Office of Nuclear Materials Safety and Safeguards

Approved: Charles L. Cain 6/19/95
Charles L. Cain, Chief Date
Fuel Cycle and Decommissioning Branch

Inspection Summary

Areas Inspected: Routine, announced inspection of site status, management and organization controls, radiation protection, operations review, emergency preparedness, environmental protection, and radioactive waste management.

Results:

- The onsite staffing level was appropriate for the amount of work in progress at the site (Section 2).
- The licensee has developed and implemented a radiation protection program that meets the intent of the license and regulatory requirements (Section 3).

- Facility records were thorough and complete. Procedures had been established and maintained with an adequate level of quality and detail. Errors were noted in the As Low As Reasonably Achievable (ALARA) report submitted to the NRC. A review of radiological exposure records indicated that personnel exposure rates were low (Section 3).

- The licensee was maintaining positive control of the facility. Fences and gates were installed and were properly posted. The evaporation ponds and extraction system were in service at an acceptable flow rate. Industrial-level emergency response procedures have been established (Section 4).

- Environmental and effluent monitoring was performed by the licensee in accordance with license and regulatory requirements. All routine submittals required by license conditions were submitted to the NRC in a timely manner (Section 5).

Attachment:

- Persons Contacted and Exit Meeting

DETAILS

1 SITE STATUS

The Western Nuclear, Incorporated, Split Rock Mill ceased operation in 1981. The mill processed about 7.7 million tons of uranium ore during its lifetime. Decommissioning activities began on the 267 acre site in April 1988. Since that time, the licensee has demolished and buried the former mill, evaporated a 500 million gallon tailings pond, and placed an interim cover on the 3.3 million ton tailings pile. Installation of the final tailings pile cover began in 1994 on areas 3A and 3B (the areas, consisting of 51 acres, where the former mill was previously located and eventually buried). Two evaporation ponds, each with a 16 million gallon capacity, were installed in area 2C, the 19 acre winter storage pond area in the southwest corner of the site.

At the time of the inspection, onsite activities included: (1) production of rock for inclusion into the final tailings pile cover, (2) pumping of ground water at a flow rate of 198 gallons per minute into the evaporation ponds, (3) mobilization of contractors to install the final cover on additional areas of the tailings pile, and (4) other routine activities consisting of ground water remediation, environmental monitoring, site maintenance, and activities necessary to ensure compliance with license conditions.

The licensee plans to install the final cover on areas 1C, 2A, and 2B during the summer of 1995. This area consists of 69 acres and includes the old tailings impoundment, alternate tailings, and low level radioactive waste burial areas. Other short-term future site activities planned include continuation of ground water remediation, water evaporation utilizing the two evaporation ponds, and upgrading the local road to allow easier access to the former tailings pile areas. The licensee plans to place the final cover over areas 1A, 1B, and the new tailings impoundment area (128 acres) in 1996. The licensee also plans to place the final cover over area 2C, the winter storage pond area, in 1996, depending on the effectiveness of the ground water corrective action program.

2 MANAGEMENT ORGANIZATION AND CONTROLS (88005)

The licensee's organizational structure and management controls were reviewed to determine whether the licensee had established an organization with defined responsibilities, and to determine if controls were in place to ensure compliance with license and regulatory requirements.

2.1 Discussion

The onsite organization consisted of four individuals, the resident agent/environmental engineer, the radiation safety officer/safety director, a mechanic, and an electrician. The resident agent, the highest ranking official on site, reported to the Western Nuclear Company manager. The company manager was located off site in the corporate office.

In February 1994, the onsite staff was reduced from five members to four members. The position of assistant radiation safety officer was discontinued at that time. Also, a contract work force of roughly 15 to 50 people were on site on a seasonal basis, depending on the work in progress.

The licensee stated that they routinely kept the site access gate closed during non-business hours to prevent unauthorized access to the facility. Site perimeter fences appeared to be in good condition and properly posted. The licensee did not employ a security guard to perform normal or off-hour site inspections. A licensee employee resided within the immediate vicinity of the site and could have responded to off-hour events on an as needed basis.

2.2 Conclusions

The site staffing was appropriate for the amount of work in progress at the site. A qualified radiation safety officer maintained daily oversight of the facility. Adequate levels of security were being maintained at the site.

3 RADIATION PROTECTION (83822)

The radiation protection program was inspected to determine if the licensee was complying with the regulatory requirements related to radiation protection and to evaluate the adequacy of the radiation protection program. Specific attributes inspected included program procedures, instrument use and calibration, external exposures, internal exposures, respiratory protection, and implementation of the As Low As Reasonably Achievable (ALARA) program.

3.1 Discussion

License Condition 25 requires the licensee to conduct a quality assurance program and document the results of each annual audit. The licensee's May 12, 1995, quality assurance audit was reviewed as part of the inspection and found to be in compliance with the license condition.

License Condition 41 requires all equipment or packages being released from the restricted area to be surveyed for radioactive contamination prior to release. The licensee was keeping records of surveys of equipment being moved from restricted to unrestricted areas.

License Condition 42 requires an ALARA audit report to be submitted to the NRC on an annual basis. The 1994 ALARA audit report was submitted to the NRC on January 9, 1995. As part of the inspection, the 1994 ALARA audit report was reviewed. Numerical errors were identified in the findings and recommendations section of the ALARA report. Numerous airborne particulate concentration numbers listed in the ALARA report for the first and second quarters of 1994 were either incorrect (wrong numbers transferred from the source documents into the ALARA report) or the numbers were off by a factor of 10 (decimal point in wrong location).

Licensee representatives stated that the next annual report will incorporate the correct information. The licensee was effectively analyzing and documenting compliance with each license condition in the ALARA report.

License Condition 43 states that the results of sampling, analyses, surveys, equipment calibrations, audit and inspection reports, all meetings and training courses required by this license, and subsequent reviews, investigations, and corrective actions shall be documented. Overall, the licensee's records were noted to be complete and thorough.

Written standard operating procedures are required to be established in accordance with the requirements of License Condition 44 for personnel and environmental monitoring, and survey instrument calibrations. (The licensee had established procedures for these areas as well as for others.) Also, the radiation safety officer is required to review and approve all procedures prior to implementation and whenever a change to a procedure is proposed. In addition, the radiation safety officer is required to review all procedures on an annual basis.

The current revisions of the licensee's procedures were reviewed as part of the inspection. The inspector noted that references to superseded 10 CFR 20 requirements had not been updated. Also, the procedures referenced an extraction well that had been previously abandoned. The radiation safety officer had performed an annual review of all procedures as required by License Condition 44. (However, a minor change had been made to one procedure without the radiation safety officer initialing and dating the change.)

The standard operating procedures specified daily inspections for operating wells and evaporation ponds. Also, the procedures provided instructions for recording evaporation pond inflow rates on a daily basis. A review of the licensee's records indicated that the inspections were not being performed consistently on a daily basis; however, these daily checks are not required by the license.

Quarterly radiation safety reports are required by License Condition 46. The quarterly reports for 1994 and 1995 were reviewed and were determined to be adequate and in compliance with the requirements of the license.

License Condition 53 states that the radiation detection instrumentation shall be calibrated after repair and as recommended by the manufacturer or at intervals not to exceed 6 months, whichever is sooner. Several instruments had not been calibrated within the 6 month interval; however, no out-of-date survey instrument was identified to have been used at the facility.

The bioassay program consisted primarily of urinalysis sampling for incoming personnel, outgoing personnel, and site personnel on a routine basis. During 1994, approximately 130 urine samples were taken and analyzed. The results indicated that no sample exceeded the licensee's initial action level of 15 micrograms/liter. With respect to external exposure control, personnel monitoring was not performed with the use of film badges or thermoluminescent

dosimeters. The licensee assigned doses to individuals based on the amount of time an individual spent in an area with a known exposure rate. The licensee's method of assigning doses to individual workers was conservative in nature because the amount of time an individual spent in a restricted area tended to be overestimated. A review of the dose assessment records indicated that onsite doses were small fractions of 10 CFR 20 limits.

The personnel training records were reviewed. All onsite personnel were being trained at the required frequency. The radiation safety officer received off site refresher training during calendar year 1995. Written tests were being provided for site personnel. Selected radiation work permits were reviewed and found not to specifically state that workers were required to scan themselves for radioactive contamination prior to eating or leaving the restricted area. The licensee stated that this oversight would be incorporated into future radiation work permits.

The use of respiratory protection equipment was minimal since the last inspection because of the standby status of the facility. The licensee does have a written respiratory protection program; however, the written program was noted to be out of date. For example, the program included the use of self-contained breathing apparatus, an item no longer used on site. Also, the program referenced superseded 10 CFR 20 requirements. The licensee has used lapel air samplers and half-face respirators on an "as needed" basis. The licensee did not routinely take credit for the respirator protection factors in dose assessments.

3.2 Conclusion

The licensee developed and implemented a radiation protection program that met the intent of the license and regulatory requirements. The radiation protection program was appropriate for the work in progress at the site. Facility records were complete. Minor errors were noted in the ALARA report submitted to the NRC. Procedures had been established and maintained with an adequate level of quality and detail. Daily checks of the wells and evaporation ponds were not being performed as required by procedure. A review of radiological exposure records indicated that personnel exposure rates were low.

4 OPERATIONS REVIEW (88020) EMERGENCY PREPAREDNESS (88050)

A review of plant operations was performed to determine if the conduct of operations was adequate to ensure compliance with applicable regulations and to protect the health and safety of the workers and the general public. A facility tour was performed to observe conduct of operations and to examine housekeeping and the material condition of the facility. Also, a review of the licensee's emergency preparedness program was reviewed to determine if the licensee was maintaining an adequate level of emergency readiness for fire, radiological, and personnel injury incidents.

4.1 Discussion

A tour of the facility was performed, including the tailings pile area located adjacent to the former uranium mill and the former heap leach pile located roughly 25 miles northeast of the Split Rock facility. The tour included a visit to the site of the rock mining and crushing operations, the evaporation ponds, the environmental sample stations, and Areas 3A and 3B where the final tailings pile cover had been installed. At the time of the inspection, three extraction wells, 21 monitoring wells, and one drinking water well were being used or sampled on a regular basis. Three wells had been abandoned since the last inspection.

The evaporation ponds were noted to be in service during the tour. License Condition 74.C states that between 47.3 and 66 million gallons of contaminated water shall be recovered on an annual basis as part of the ground water corrective action program. At the time of the inspection, the inflow into the evaporation ponds was 198 gallons per minute. At this flow rate, the licensee expected to exceed the 50 million gallon mark for the 1995 season.

License Condition 34 requires the licensee to protect potential cultural resources during site decommissioning activities. The licensee identified a potential cultural resource area on the northeastern corner of the site. A sturdy fence was noted to have been installed around the area to preclude accidental intrusion by vehicles or other earthmoving equipment into the area.

License Condition 64 states that the licensee shall control grazing to the north and north-northeast of the tailings impoundment by maintaining cattle guards at each end of the rock outcrops along the north side of the restricted area fence. During the site tour, the inspector noted that the licensee was complying with the intent of the license condition by controlling grazing from the northeast to northwest sides of the tailings impoundment by maintaining cattle fences along the north side of the restricted area fence. Overall, the fences around the tailings area were in good condition and were properly posted.

The licensee was previously authorized to conduct heap leaching of low-grade uranium ore at several locations, including the Day Loma site. In the heap leaching process, a sulfuric acid solution was allowed to percolate through an ore pile. The solution was then collected and processed into a slurry, which was eventually shipped to the Split Rock mill. Heap leaching operations were conducted at the Day Loma site from the late 1960's to about 1972. The site has since been remediated by the licensee. The licensee submitted a request to the NRC in 1987 to have this site removed from the license; however, unresolved issues, including long term erosion control and ownership concerns, have prevented the NRC from concurring with the licensee's request.

The Day Loma site was visited during the inspection. The site covered roughly 26 acres and was about 2600 feet long by 400 feet wide. There were no fences or signs on or adjacent to the site. Radiation exposure rates were measured during the Day Loma site tour using an NRC-issued microRoentgen/hour (μR/h)

meter. With a background of 15 μR/h (multiply the values by 0.7 to convert to values measured by a radium-226 calibrated instrument), the top of the former heap leach pile measured 50-55 μR/h, a measurement that was comparable to or slightly lower than other "piles" in the area.

The emergency response procedures in place at the Split Rock site included instructions for injury/illness and fire/evacuation. The instructions for radiological emergency responses were limited and were determined to be unnecessary for the amount of work in progress for the facility. Emergency response procedures are not required by license conditions.

4.2 Conclusions

The licensee was maintaining positive control of the facility. Fences and gates were installed and were properly posted in compliance with several license conditions. The evaporation ponds and extraction system were in service at an acceptable flow rate. Industrial-level emergency response procedures have been established.

5 ENVIRONMENTAL PROTECTION (88045) RADIOACTIVE WASTE MANAGEMENT (88035)

The objective of this portion of the inspection was to ensure that the licensee was implementing license commitments for the environmental program and was maintaining adequate control of the program. Also, the radioactive waste management program was reviewed to determine if the licensee was complying with regulations and license requirements related to the release and disposal of liquid, airborne, and solid wastes.

5.1 Discussion

Environmental monitoring requirements are established in License Condition 24. The program currently in use at the facility consisted of continuous air particulate sampling, radon sampling, measurement of direct gamma radiation, ground water sampling, and surface water sampling. Two environmental sampling stations were utilized, one at the northeastern site boundary and one at a background location roughly 8 miles west of the site. Each sample station consisted of one continuous air monitor (filters changed weekly and composited quarterly), one radon monitor (devices changed quarterly), and one thermoluminescent dosimeter (also changed quarterly) to measure direct gamma radiation levels. The two monitoring stations were visited during the inspection and appeared to be in good working order.

Semiannual effluent reports were submitted to the NRC to satisfy the requirements of License Condition 24 and 10 CFR 40.65. These semiannual reports include details of both the site effluents and the environmental monitoring programs. The report covering the January-June 1994 period was submitted to the NRC on September 1, 1994, while the report covering the July-December 1994 period was submitted on March 1, 1995. Overall, the

licensee was performing the environmental and effluent sampling at the required locations and at the required frequencies.

A review of the most recent semiannual effluent report indicated that:

- The licensee sampled for natural uranium, thorium-230, radium-226, and lead-210 particulates in air. The concentration of thorium-230 was noted to be up to 31 percent of the limits established in 10 CFR 20, Appendix B, Table 2, Column 1, at the northeast perimeter location. All other radionuclide concentrations were less than 5 percent of the limits.

- Radon-222 as a gas in air continues to be above the 10 CFR 20 limits; however, the background levels were also above the limits.

- Direct gamma radiation levels were below the 10 CFR 20.1301 limits (100 millirems per year to individual members of the public). The northeast perimeter gamma radiation levels were only about 37 millirems/year above background levels.

The licensee was no longer taking surface water samples of the tailings pond or acid plant cooling pond (previously required by reference to License Condition 24) because these bodies of water no longer exist on site.

License Condition 74 states that a ground water compliance monitoring program shall be implemented. The corrective action program commenced in 1990. In accordance with License Condition 74, an annual groundwater corrective action program review has to be submitted to the NRC. The report, last submitted to the NRC on December 15, 1994, was briefly reviewed as part of the inspection. The report appeared to be comprehensive, providing information of ground water levels and hazardous constituents in the ground water.

License Condition 74.B designates wells 4 (recently replaced by well 4R) and 21 as the point of compliance wells. A review of the ground water and surface water quality data for the last half of 1994, submitted to the NRC on March 1, 1995, was reviewed. Parameters noted to be above the ground water protection standards included nickel, selenium, uranium, thorium for well 4R, and uranium for well 21. This indicated that the licensee has not completed remediation of the ground water.

The licensee is no longer required to conduct an annual survey of land use within 5 miles of the facility; therefore, this subject area was not inspected.

5.2 Conclusions

The environmental and effluent monitoring was performed by the licensee in accordance with license and regulatory requirements. All routine submittals required by license conditions were submitted to the NRC in a timely manner.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Licensee Personnel

J. Gearhart, Resident Agent/Environmental Engineer
T. Herrera, Radiation Safety Officer

The personnel listed above attended the exit meeting.

2 EXIT MEETING

An exit meeting was conducted on May 18, 1995. During this meeting, the inspector reviewed the scope and findings of the report. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspector.

ENCLOSURE 2

THE U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF WASTE MANAGEMENT

Inspection Report:	40-1162/95-02
License:	SUA-56
Licensee:	Western Nuclear Inc. 200 Union Boulevard Denver, Colorado 80228
Facility Name:	Split Rock Mill
Inspection At:	Freemont County, Wyoming
Inspection Conducted:	May 16 and 17, 1995
Inspector:	T. E. Harris, Geotechnical Engineer Engineering and Geosciences Branch Division of Waste Management Office of Nuclear Material Safety and Safeguards

Approved: _____ 6/7/95
Mysore Nataraja, Acting Section Leader — Date
Engineering and Geosciences Branch

Inspection Summary

Areas Inspected: Routine, announced inspection of the licensee's reclamation of Areas 3A and 3B, including review of construction records.

Results:

- The licensee's construction records were complete and considered to be adequate. The required testing had been performed at the required frequency. Any non-conforming areas were reworked and retested to meet applicable specifications.
- The licensee's construction activities and programs complied with the requirements of the license and the construction specifications.
- Suggestions were made in the procedures for obtaining Proctor samples and for recording thicknesses.
- Deficiencies in the placement of rock/soil layer were noted by the inspector.

Persons Contacted

Licensee Personnel:

John Gearhart, WNI *
Trinidad Herrera, WNI
Gerald Miller, Inberg-Miller *

NRC Personnel:

T. E. Harris, NMSS *
M. W. Haque, NMSS
R. J. Evans, RIV

* Denotes persons present during exit meeting

Exit Meeting:

An exit meeting was conducted at the conclusion of the inspection on May 17, 1995. During this meeting, the inspector reviewed the scope and findings of the inspection. The licensee did not identify, as proprietary, any information provided to, or reviewed by, the inspector.

CONSTRUCTION REVIEW (88001)

The inspector reviewed the licensee's construction records to determine: 1) if reclamation activities are being accomplished in accordance with specifications and procedures; 2) whether the system for preparing and maintaining records is functioning properly; 3) whether records reflect work accomplished; and 4) if the records and/or work activities indicate any generic problems, inadequacies, or other weaknesses that could impact the acceptability of the reclamation activities.

Discussion:

The construction quality control testing is being performed by a third party consultant, Inberg-Miller of Riverton, Wyoming. The records are reviewed by WNI's on-site environmental engineer. In addition, WNI corporate personnel perform periodic audits of the construction records. The records reviewed were for work performed in 1994 in Sections 3A and 3B, which included placement of radon barrier, placement of borrow soil, and placement of rock/soil layer.

The records were divided into the following: 1) Daily Summary Reports; 2) Daily Production Reports; 3) Weekly Reports; 4) Rock Durability Tests; 5) Subgrade Inspection Reports; 6) Cody Shale Gradation Tests; 7) Cody Shale Placement Reports; 8) Borrow Soil Layer Report; 9) Thickness Measurement Log; 10) Rip Rap Swale Report; and 11) Soil/Rock Placement Reports.

The sand-cone density method was used as the primary acceptance method, although, the nuclear density method was used to identify potential problem areas and for contractor convenience. An on-site laboratory facility was established to perform Proctor testing and some gradation testing. Additional testing, such as rock durability, was performed at Inberg-Miller's laboratory in Riverton, Wyoming.

The on-site laboratory facility was inspected for conformance with applicable ASTM standards. Staff determined that adequate quality assurance measures appeared to be implemented.

The field density records noted a significant percentage of tests with compaction percentages in excess of 100 percent. Staff believes this resulted from the use of single Proctor value for a block of 10 field density tests and from sampling the Proctor material from the borrow source.

The thickness measurements for the differing materials, in particular the radon layer (Cody Shale), were recorded as the required thickness. The licensee was questioned about uniformity of the measurements. It was stated that the measurements represented minimum thicknesses.

Staff noted significant unevenness in the placement of the rock/soil layer. One large area of ponding water was noted in Area 3B. In many areas, soil material had been eroded and deposited in low areas of the rock/soil layer. Staff believes the unevenness results from a combination of the relatively thin layer of rock material and the lack of cohesion of the borrow soil layer, which was visually classified as poorly-graded sand (SP). This problem could potentially impact the acceptability of the construction.

Conclusion:

In general, the records were well maintained, complete and in accordance with the Reclamation Plan. Non-conforming tests were tracked for cause of non-conformance, remedial action taken and verification of conformance.

While the staff concern regarding the causes for reporting compaction percentages in excess of 100 percent will not impact the acceptability of the reclamation, it is recommended that Proctor samples be obtained from the in-place fill. In the recording of layer thicknesses, staff suggested recording the actual thickness to the nearest 1/2 inch.

The problems associated with the unevenness of the rock/soil layer could be significant. It is recommended that a follow-up inspection be conducted by an NRC surface water hydrologist.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

June 23, 1995

Western Nuclear, Inc.
ATTN: Ms. Stephanie J. Baker
Manager of Environmental Services
Union Plaza Suite 300
200 Union Blvd.
Lakewood, Colorado 80228

SUBJECT: PHOTOGRAPHS TAKEN AT WESTERN NUCLEAR-SPLIT ROCK

Attached are copies of photographs recently taken at the former Western Nuclear-Split Rock mill. The photographs were taken during the inspection conducted on May 16-18, 1995, and documented in NRC Inspection Report 40-1162/95-01.

The photographs are of substandard quality, most likely because of heat damage to the original film.

Should you have any questions concerning this letter, we will be pleased to discuss them with you.

Sincerely,

Charles L. Cain

Charles L. Cain, Acting Deputy Director
Division of Radiation Safety
and Safeguards

Docket: 40-1162
License: SUA-56

Enclosure:
Photos Taken at Western Nuclear-Split Rock

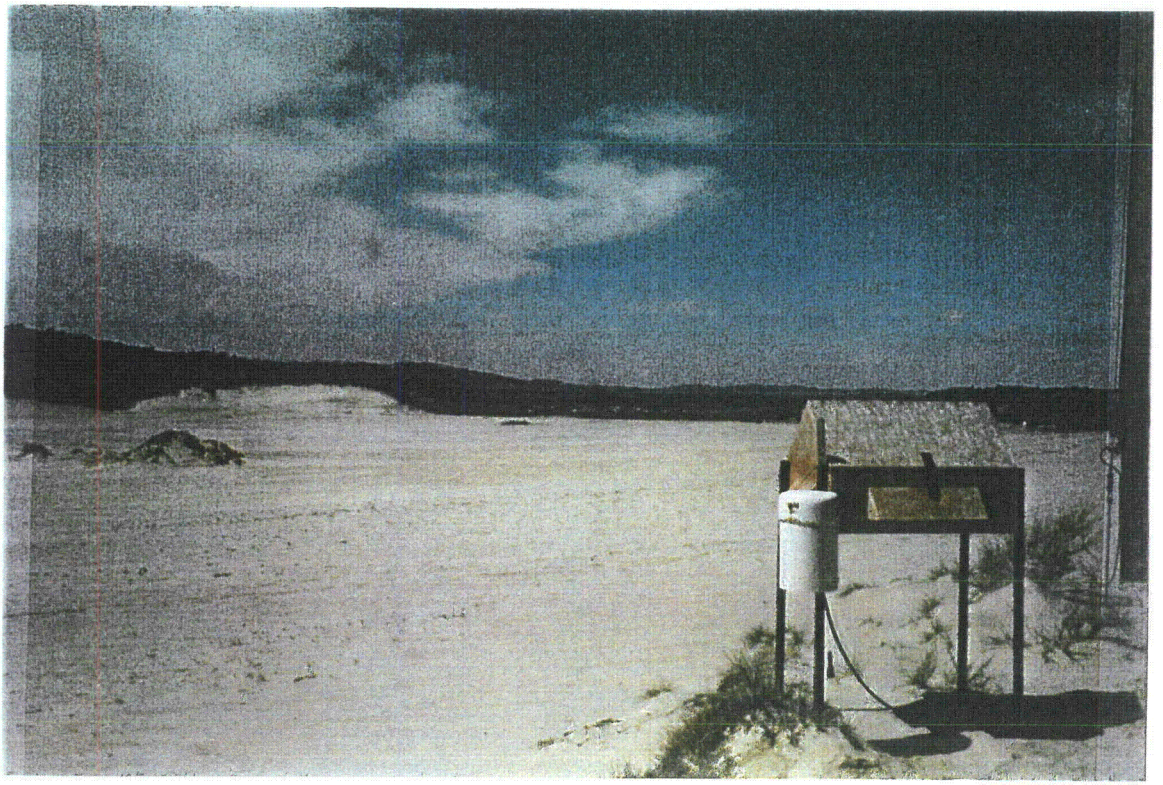
PHO[redacted] TAKEN AT WESTERN NUCLEAR-SPLI[redacted]OCK

Photograph 1: Entrance to Western Nuclear, near Jeffrey City, Wyoming

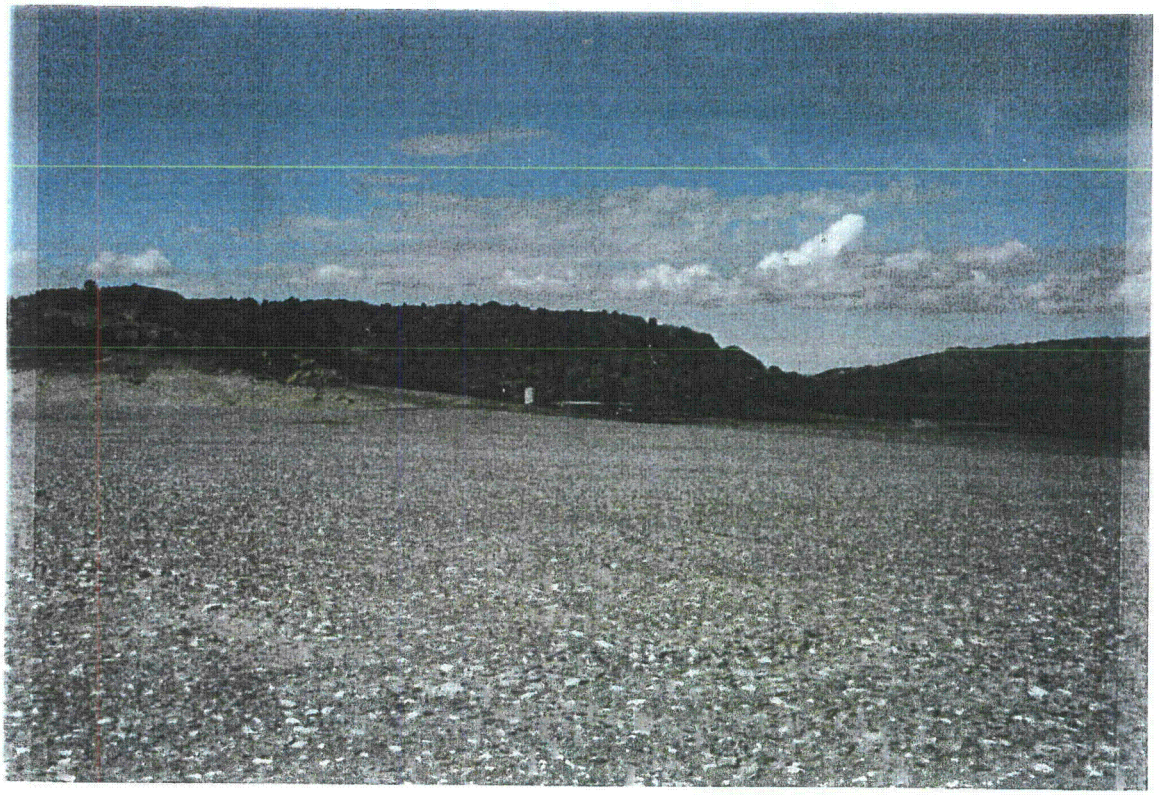
Photograph 2: Rock quarry (background), Area 3A (foreground)

Photograph 3: Idle construction equipment (contractor gearing up for 1995 season)

Photograph 4: Area 3B (area where mill was buried)

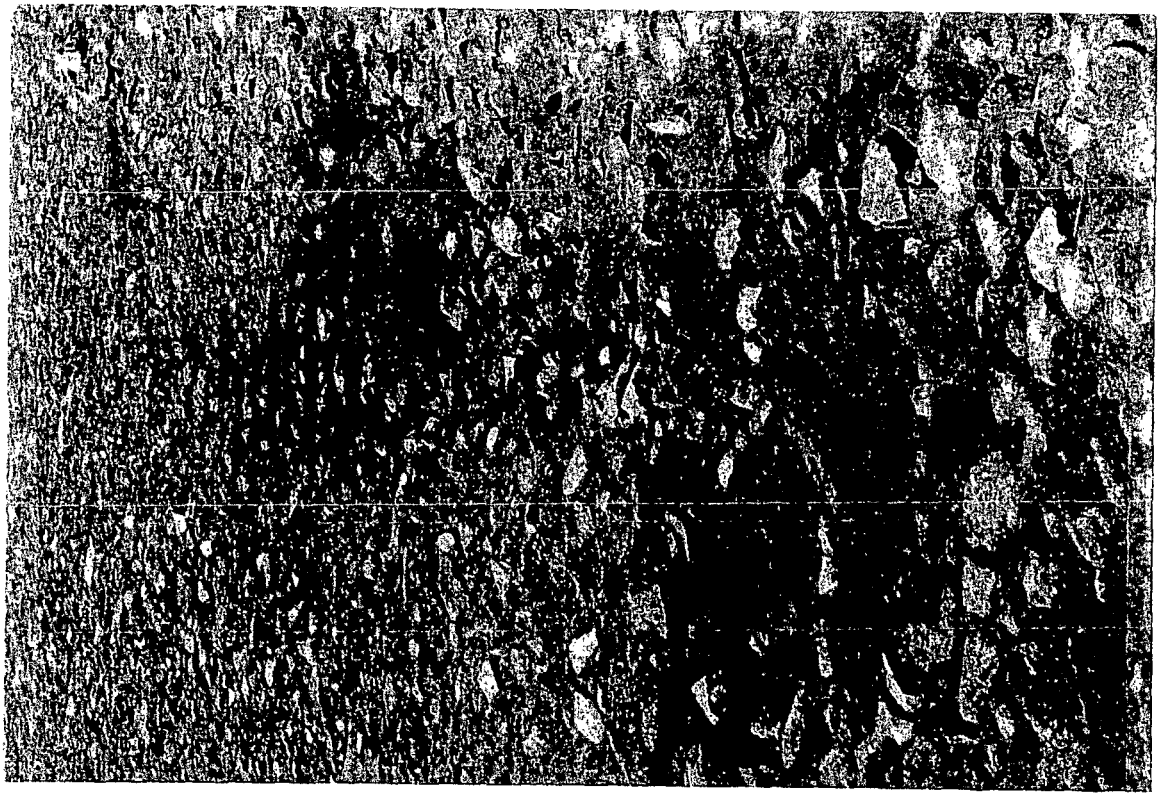


Photograph 5: Environmental monitoring sample station with Areas 1A and 1B in background (looking west)



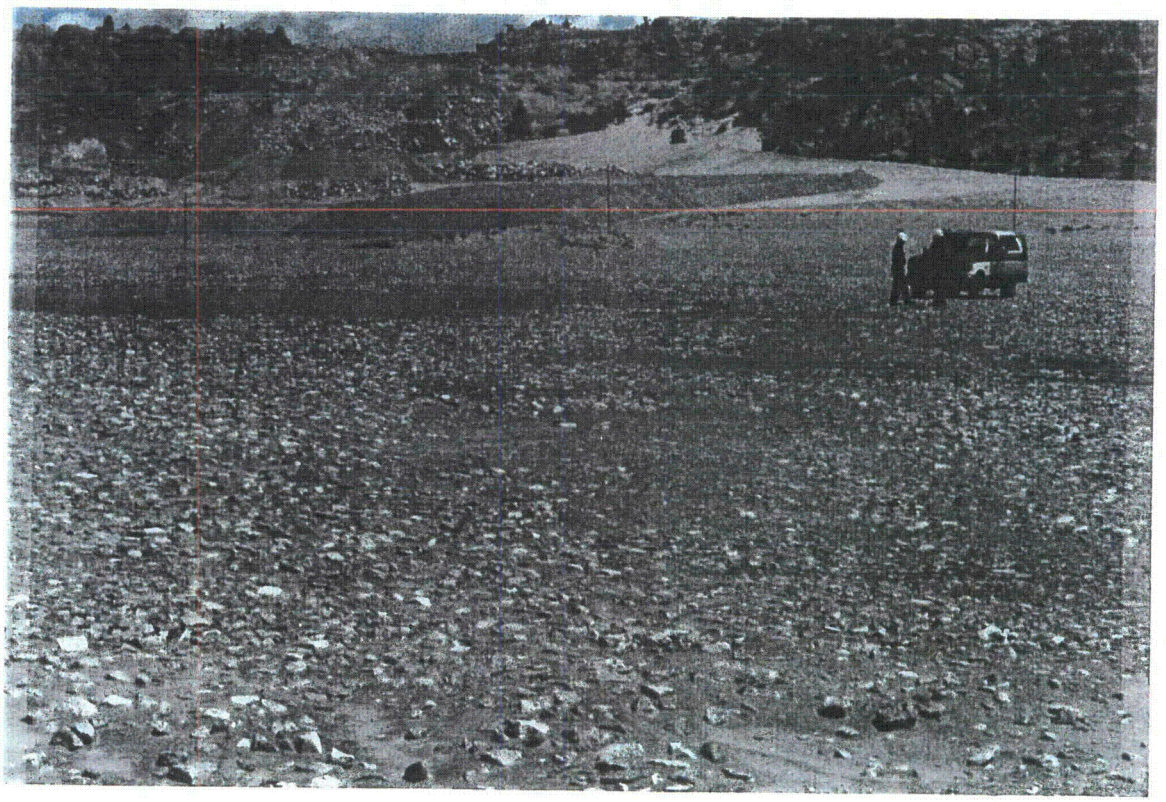
Photograph 6: Area 3A with Western Nuclear office in background

Photograph 7: Composition of final cover on Area 3A



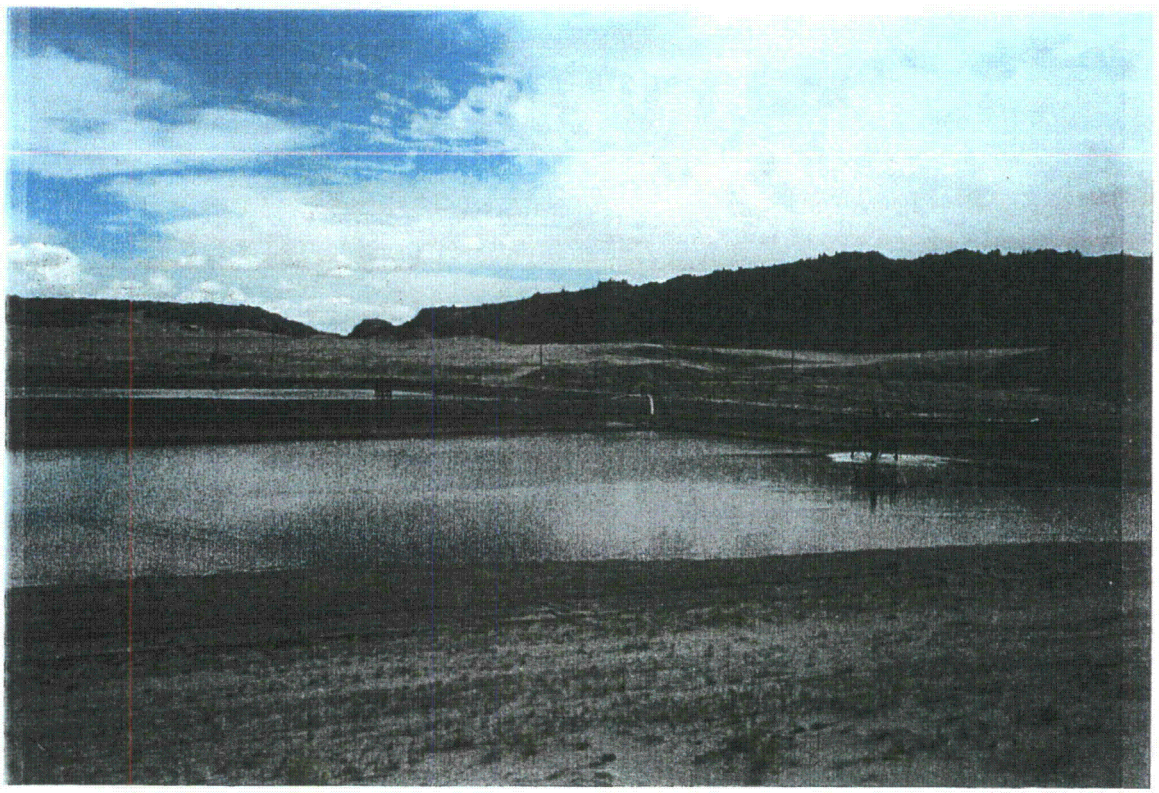
Photograph 8: Mild erosion noted in final cover of Area 3A (photograph

Photograph 9: NRC Project Manager inspecting Area 3B



Photograph 10: Final cover on Area 3B

Photograph 11: Western Nuclear employee in Area 3B (minor erosion noted in this area)



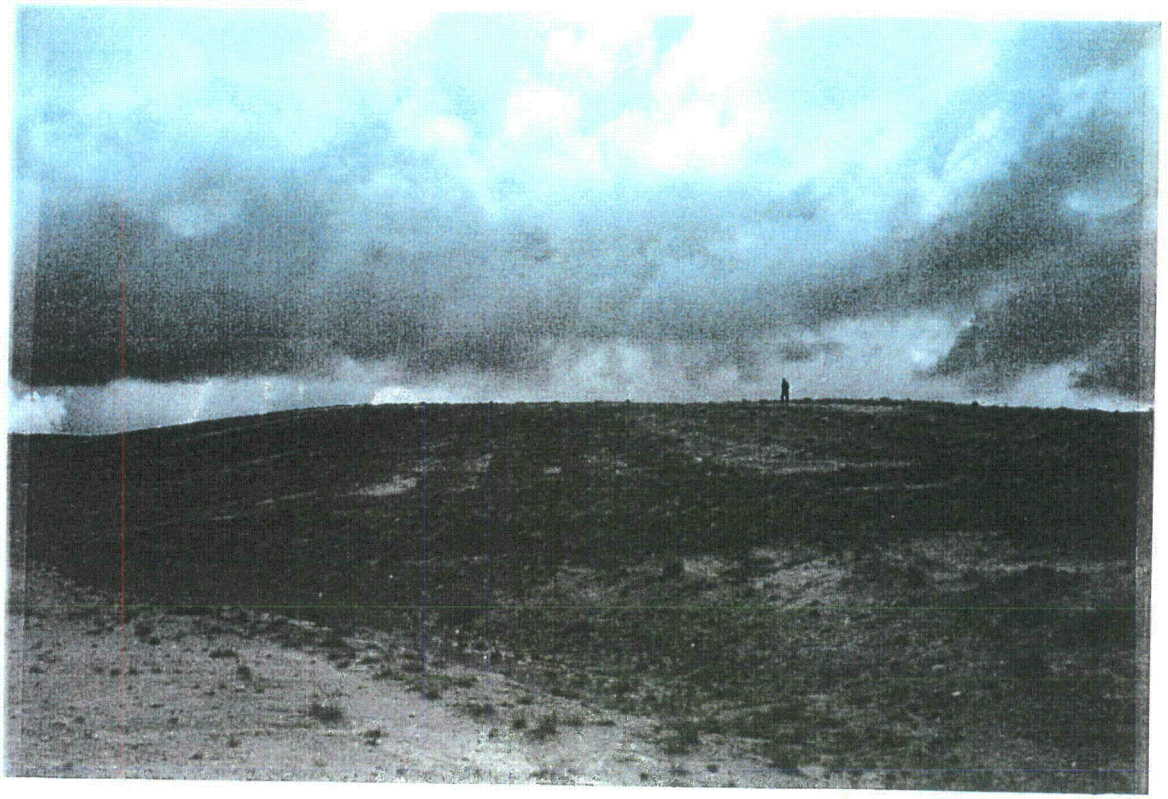
Photograph 12: Evaporation Ponds

Photograph 13: Rock quarry drilling

Photograph 14: Rock crusher operations

Photograph 15: Sorted rock piles near rock quarry operations

Photograph 16: Entrance sign to former Day Loma Mines



Photograph 17: NRC Project Manager on top of Day Loma Heap Leach pile

Photograph 18: Day Loma Heap Leach pile (open pit mine located on right side of photograph)

Photograph 19: Day Loma Heap Leach pile; open mine pit on far left side of photograph (a long term erosion control concern)

Photograph 20: Top of Day Loma Heap Leach pile

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

July 24, 1996

Ms. Stephanie J. Baker, Manager of
Environmental Services
Western Nuclear, Inc.
Union Plaza Suite 300
200 Union Boulevard
Lakewood, Colorado 80228

SUBJECT: NRC INSPECTION REPORT 40-1162/96-01

Dear Ms. Baker:

On June 5, 1996, the NRC completed an inspection of your former Split Rock uranium milling facility. The enclosed report presents the results of that inspection.

The inspection disclosed that you are making progress in remediating the site and appropriately controlling activities in accordance with NRC license conditions and regulations with some minor exceptions.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact Mr. Robert Evans at (817) 860-8234 or Mr. Charles L. Cain at (817) 860-8186.

Sincerely,

Dwight D. Chamberlain

for Ross A. Scarano, Director
Division of Nuclear Materials Safety

Docket No.: 40-1162
License No.: SUA-56

Enclosure:
NRC Inspection Report 40-1162/96-01

cc w/enclosure:
Project Manager
Western Nuclear, Inc.
P.O. Box 630
Jeffrey City, Wyoming 82310

Mr. Christopher D. Lidstone
Lidstone & Anderson
736 Whalers Way, Suite F-2000
Fort Collins, Colorado 80525

Mr. David Finley
Department of Environmental Quality
Solid and Hazardous Waste Division
122 W. 25th Street
Cheyenne, Wyoming 82002

Land Quality Division
Wyoming Department of Environmental Quality
122 W. 25th Street
Cheyenne, Wyoming 82002

Wyoming Radiation Control Program Director

ENCLOSURE

U. S. NUCLEAR REGULATORY COMMISSION

REGION IV

Docket No.: 40-1162
License No.: SUA-56

Report No.: 40-1162/96-01

Licensee: Western Nuclear, Inc.

Facility: Split Rock Mill

Location: Jeffery City, Wyoming

Dates: May 13-15 and June 5, 1996

Inspectors: Robert J. Evans, P.E., Health Physicist
Nuclear Materials Inspection and
Fuel Cycle/Decommissioning Branch
Division of Nuclear Materials Safety
Region IV Office

Dan S. Rom, Geotechnical Engineer
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Materials Safety and Safeguards

Approved By: Charles L. Cain, Technical Assistant
Division of Nuclear Materials Safety
Region IV

Attachments:
- Partial List of Persons Contacted; Items Opened, Closed and Discussed; List of Acronyms Used
- Radiological Survey Results
- Photographs Taken at the Split Rock Facility

EXECUTIVE SUMMARY

Western Nuclear's Split Rock Facility
NRC Inspection Report 40-1162/96-01

This inspection included a review of site status; management organization and controls; site operations; and the licensee's radiation protection, waste management and environmental programs.

Management Organization and Controls

- The licensee's organizational structure and level of security were consistent with previous inspections, and it appeared that adequate oversight had been provided for site activities (Section 2).

- In general, all procedures required by the license had been developed and were technically adequate. However, the licensee had failed to adhere to the guidance provided in two site procedures. Also, the licensee failed to perform the annual procedure review during 1995. These failures were considered minor and were identified as a non-cited violation of the license (Section 2).

Operations Review

- Site reclamation activities appeared to have been conducted in accordance with the applicable license and regulatory requirements. Site fences were in good condition, and perimeter postings were appropriate (Section 3).

Radiation Protection

- The licensee had implemented a radiation protection program that met the requirements established in 10 CFR Part 20 and the license (Section 4).

- Occupational doses appeared consistent with the level of activity in progress at the site, and no individual exceeded the limits established in 10 CFR Part 20 during 1995 (Section 4).

- Soil samples were taken by the NRC during the inspection. The sample results indicated that additional remediation may be appropriate in some areas downwind of the site's restricted area (Section 4).

Radioactive Waste Management/Environmental Protection

- A review of the licensee's environmental and groundwater monitoring programs indicated that the licensee was appropriately controlling activities and was in compliance with license requirements with the minor exception of a non-cited violation identified involving the licensee's failure to utilize multi-chip thermoluminescent dosimeters as stipulated by the license (Section 5).

Report Details

1 SITE STATUS

Decommissioning activities at Western Nuclear's Split Rock facility began in 1988. Since that time, the licensee has demolished and buried the former mill and performed reclamation work on the tailings piles. Installation of the final tailings pile cover was completed in 1994 on tailings Areas 3A and 3B (51 acres total), the location where the former mill was previously situated and eventually buried. During 1995, the radon barrier and erosion protection were installed on Areas 1C, 2B, and most of Area 2A (65 acres). Diversion ditch excavation work was started during 1995, but this activity was not completed by the end of the year. The production of cover rock was in progress during the previous inspection and was completed in December 1995. The licensee has stockpiled enough rock onsite for the final cover and erosion control projects.

During this inspection, activities in progress included continuation of the ditch excavation work and grading of tailings Areas 1A and 1B (60 of 129 acres planned for 1996). In addition, the licensee's contractors were hauling clay from a mine located south of the facility to the site. The clay will be utilized as a radon barrier on Areas 1A, 1B, 2C, and the remainder of Area 2A. Also, the licensee was in the process of picking up windblown material. The licensee started by picking up windblown material on the northwest side of the property. The licensee planned to work their way across the site to the northeast corner. In addition, an evaluation of the site's groundwater characteristics was in progress.

Future activities planned at the site included startup of the enhanced evaporation system. At the time of this inspection, the licensee was awaiting NRC approval to reduce the annual flow rate requirements for the evaporation system. Also, the final cover was expected to be installed on Area 2C, the area that contains the winter storage evaporation ponds, during the 1997 or 1998 season, depending on the effectiveness of the groundwater corrective action program.

2 MANAGEMENT ORGANIZATION AND CONTROLS (88005)

2.1 Management Organization

a. Inspection Scope

The organizational structure was reviewed to ensure that the licensee had established an organization with defined responsibilities and functions.

b. Observations and Findings

The onsite staff consisted of four individuals, the resident agent/environmental engineer, the safety director/radiation safety officer (RSO), a mechanic, and an electrician. The licensee's organizational structure was found to be essentially the same as the structure that was in place during the previous inspection. Almost 70 contractors were onsite during the inspection. Most contractors were performing reclamation-related work. Other consultants were being used for the groundwater protection studies, onsite drilling, materials testing, and site surveying.

Security was provided by locked access gates, and a fence was installed around the site property to keep intruders out. The licensee no longer maintained a radiological emergency response preparedness program at the site.

2.2 Management Controls

a. Inspection Scope

The inspector reviewed the licensee's implementation of procedures and analyses related to site reclamation, as specified in license conditions, to evaluate the effectiveness of the licensee's control of site activities.

b. Observations and Findings

As specified in License Condition 44, the licensee is required to establish written procedures for site reclamation activities, including personnel and environmental monitoring and survey instrument calibrations. Site procedures were reviewed to determine whether procedures had been established for the program areas referenced in the license and to evaluate the procedures for their technical adequacy. The procedures that were required by the license had been developed and were considered technically adequate for the work being performed.

Two instances of failure to comply with issued procedures were identified. First of all, the Procedure Manual Section H, "Routine Operation Procedures," listed the licensee's daily, weekly, monthly, and quarterly site inspection requirements. The licensee was noted to be performing the daily inspections on a weekly basis. The daily activities that were being performed essentially on a weekly basis included inspecting the evaporation ponds, monitoring the pond inflow meters, and checking the pond leak detection probes for pond leakage.

Also, Section B, Part 6.0, "Contamination Control," stated that contamination control of the contractor's office area, eating area, wash area, and toilet will be accomplished by weekly cleaning and by performing weekly radiation surveys for gross alpha contamination.

Documentation presented by the licensee indicated that not all areas had been surveyed on a weekly basis. Records were missing for several weeks within the May-July 1995 and April-May 1996 time frames, suggesting that the required surveys had not been performed on a weekly basis. The licensee's failure to comply with the guidance provided in these two procedures was determined to not be a significant safety concern because of the low radiological risks currently present at the site.

License Condition 44 also states that the site RSO shall perform a documented review of all existing site procedures at least annually. A review of the licensee's procedure manual revealed that the site procedures had been reviewed and approved for use during June 1994 and March 1996; however, the licensee missed the 1995 review. Although the licensee failed to perform a review during 1995, the procedures had been reviewed during the previous (1994) and subsequent (1996) years. Site status had not changed significantly since 1994; therefore, the missed procedure review did not appear to have a negative impact on the reclamation activities.

The failures described above constitute a violation of minor significance. This violation is being treated as a non-cited violation of License Condition 44, consistent with Section IV of the NRC Enforcement Policy.

2.3 Conclusions

The licensee's organizational structure was consistent with structures in place during previous inspections, and it appeared that adequate oversight had been provided for site activities. In general, the procedures that were required by the license had been developed and were technically adequate. However, the licensee failed to adhere to the guidance provided in approved procedures in two areas. Also, the licensee failed to perform the annual procedure review during 1995. These failures were considered minor and were identified as a non-cited violation of License Condition 44.

3 OPERATIONS REVIEW (88020)

3.1 Site Tour

a. Inspection Scope

A site tour was performed on May 13-15, 1996, to verify that site activities were being conducted in accordance with applicable regulations and the conditions of the license, and to ensure that operational controls were adequate to protect the health and safety of the workers and members of the general public.

b. Observations and Findings

At the time of the inspection, site structures consisted of one office building and several trailers. Reclamation activities were in progress, including the scraping of windblown material and the transfer of clay material to the site from a nearby mine. Heavy equipment was in the process of scraping potentially contaminated soil from the northwest corner of the site and transferring the material to tailings Area 1A.

Also, clay material was being transferred onsite from a mine located approximately 10 miles south of the site. Once delivered onsite, the clay was being prepared in a laydown area called the "Pug Mill." The clay was being mixed with water to ensure proper consistency prior to placement on the former tailings areas. The clay material will eventually be used during the construction of the tailings pile radon barriers.

During the plant tour, site buildings, fences, gates, and operating equipment were observed. Site fences were in good condition and were properly posted although some sections of the fence were temporarily removed to allow for reclamation work to continue unimpeded.

Gamma exposure rate measurements were obtained at several locations on and around the site property (the survey results are attached to this inspection report). As expected, slightly elevated exposure rate readings were identified onsite when compared to the offsite exposure rate. The elevated survey results are expected to be reduced to background levels as the remediation of the site continues.

3.2 Construction Review (June 5, 1996)

a. Inspection Scope

A construction review was performed during a site tour on June 5, 1996, to verify that site construction activities were being conducted in accordance with applicable regulations and the conditions of the license.

b. Observations and Findings

A construction review for reclamation activities at the Western Nuclear Split Rock site was conducted. In addition to reviewing pertinent records of construction, the NRC conducted a walking and driving tour of the disposal and borrow sites. The tour was led by a licensee representative. After returning to the site office, summary results of construction activity involving the moving, placement, and testing of soil materials were reviewed. Also, laboratory operations were observed, and laboratory testing procedures were discussed.

In general, the construction and testing records were found to be in order. Based on the records review, discussions with the licensee, and NRC observations, the construction operations were judged to have been in conformance with the reclamation plan, and work practices were generally consistent with industry standards.

3.3 Conclusions

Site activities generally appeared to have been conducted in accordance with applicable license and regulatory requirements. Site fences were in good condition and perimeter postings were appropriate.

4 RADIATION PROTECTION (83822)

4.1 Radiation Safety Program

a. Inspection Scope

The purpose of this portion of the inspection effort was to determine if the licensee's radiation safety program was in compliance with requirements established in the license and 10 CFR Part 20 regulations. Areas inspected included personnel exposures, equipment releases, annual As Low As Reasonably Achievable (ALARA) reports, instrument calibrations, and radiation protection training records.

b. Observations and Findings

License Condition 43 specifies various documents relating to the radiation protection program which must be maintained. A review of records relating to instrument calibrations, radiation work permits, personnel training, employee exposures, and equipment releases was performed, and no oversights in documentation were noted. In addition, License Condition 46 requires the licensee to develop quarterly reports of radiation protection-related activities. The quarterly reports for 1995 were reviewed and were found to be satisfactory.

Air sampler calibration records were reviewed. The licensee was noted to have been calibrating personnel air samplers with the same procedure used for radon daughter samplers. The two calibration methods were similar; however, the inspector suggested that the development of a procedure specific for personnel air samplers could prove beneficial.

License Condition 53 states that radiation detection instruments shall be calibrated after repair and as recommended by the manufacturer or at intervals not to exceed 6 months, whichever is sooner. No survey instrument was identified as having been used by the licensee past its respective calibration due date.

License Condition 42 states that a copy of the annual ALARA report containing the results of the annual audit and recommendations by the

ALARA committee shall be submitted to the NRC. The licensee's annual ALARA report, submitted to the NRC on November 30, 1995, was reviewed. The report provided clear and concise discussions of the licensee's compliance with the license conditions. However, the report appeared to be lacking detailed information about trends, such as whether employee exposures were increasing or decreasing. In addition, the licensee's documentation did not clearly identify, by name or by title, which site individuals were designated members of the ALARA committee. Also, the chairman of the committee had not been designated by the licensee.

During 1995, site workers' exposures to radioactive materials had been calculated by the licensee based on the amount of time a worker spent in a particular area. The licensee did not use thermoluminescent dosimeters (TLDs) to monitor site personnel for external exposures. According to the licensee's data, the highest exposure, calculated for a contractor foreman, was 55 millirems, which was well below the annual limit of 5000 millirems that had been established in 10 CFR Part 20.1201. The second highest worker exposure was calculated to be 47 millirems. In addition, approximately 120 bioassays were collected and sampled during 1995, down slightly from the previous year. None of the samples exceeded 5 micrograms per liter for natural uranium. In summary, site exposures were small fractions of the annual limits established in 10 CFR 20.

4.2 Radiological Verification Program

a. Inspection Scope

The purpose of this portion of the inspection effort was to review with staff from the Oak Ridge Institute for Science and Education (ORISE) the verification survey program associated with site remediation.

b. Observations and Findings

On December 15, 1995, the licensee submitted a proposed final radiological verification program for the Split Rock site to the NRC for review and approval. (At the time of this inspection, the program had not been approved by the NRC.) During the inspection, selected portions of the program were briefly reviewed by the NRC inspector and a representative from the Oak Ridge Institute for Science and Education. Comments regarding the program were verbally presented to the licensee. Also, soil samples were taken by the inspector in select areas of the site to independently ascertain whether cleanup may be necessary in those areas. (The soil sample results are attached to this inspection report.) The areas visited and sampled included:

- The Graham Ranch sample station (This location was the site background location for environmental monitoring.)

- Bureau of Land Management (BLM) property located downwind of the site
- The archeological site located in the northeastern portion of the property
- A gap between rock formations in the northeastern corner of the property downwind of the restricted area
- A spot in the northeastern corner of the site near Stake 388 which had been previously remediated

In accordance with 10 CFR 40, Appendix A, Criterion 6, the acceptance criteria for the radium-226 concentration in the first 15 centimeters of soil is 5 picocuries per gram above the background level, averaged over an area of 100 square meters. The soil sample results indicated that slightly elevated levels of radium-226 were identified in the BLM, the rock gap, and Stake 388 areas. Two of these areas, the rock gap and Stake 388, may require additional remediation depending on whether or not these locations would pass or fail the averaging criteria test (which was not performed during this inspection).

In summary, based on limited sample results, the archeological site appeared to be free of windblown material while the areas downwind of the site appeared to still contain windblown material. The elevated soil sample readings were not a short-term concern because the licensee planned to continue site remediation, including the northeastern portion of the site, in the foreseeable future. During an April 25, 1996, teleconference call with the NRC, the licensee stated that they would perform additional radiological scoping studies to further delineate areas impacted by windblown tailings.

4.3 Conclusions

The licensee had implemented a radiation protection program that met requirements established in 10 CFR Part 20 and the conditions of the license. Occupational doses for site personnel during calendar year 1995 appeared consistent with the scope of work activities ongoing at the site and were only a small fraction of the occupational dose limits established in 10 CFR Part 20.

Soil samples were taken during the inspection. In general, the sample results indicated that additional remediation may be appropriate in the areas downwind of the site's restricted area.

5 RADIOACTIVE WASTE MANAGEMENT (88035) AND ENVIRONMENTAL PROTECTION (88045)

5.1 Environmental Protection

a. Inspection Scope

The environmental monitoring program at the site was reviewed to assess the effectiveness of the licensee's program and to evaluate the effects, if any, of site reclamation activities on the local environment.

b. Observations and Findings

Environmental monitoring program requirements are identified in License Condition 24. At the time of the inspection, the environmental monitoring program in place at the site consisted of air particulate, radon, direct radiation, and surface water sampling. The licensee used two sample stations. One sample station was located at the northeastern corner of the site, while the second station was located offsite at the Graham Ranch. Continuous air samplers, radon canisters, and TLDs were deployed at each station.

During the inspection, the two semi-annual effluent reports and supporting data for 1995 were reviewed. Overall, the licensee's semi-annual reports were noted to be thorough and complete. All environmental monitoring samples required by the license were obtained and were documented in the semi-annual effluent reports, with one exception. Surface water samples were not taken at the two tailings and acid plant cooling ponds because these ponds no longer existed at the site.

Surface water samples were obtained at the three remaining locations on a quarterly basis. The samples were analyzed for several chemical constituents, including radium-226, radium-228, thorium-230 and natural uranium. The surface water sample results were small fractions of the effluent release limits established in 10 CFR 20, Appendix B, and no upward trends were identified involving radionuclides.

Air samples were taken at the two sample stations and analyzed for lead-210, radium-226, thorium-230, and natural uranium on a quarterly basis. According to information provided in the semi-annual effluent reports, the highest value measured was for thorium-230 in the fourth quarter of 1995. This radionuclide, measured at the northeast corner location, reached 29 percent of the effluent concentration limit specified in 10 CFR 20, Appendix B. The next highest value that was measured for thorium-230, obtained in the third quarter of 1995, was almost one-fourth of that value. All other sample results were below 5 percent of the annual limits.

Radon samples were continuously taken at the two sample stations. The samples were analyzed quarterly. The highest measured value (2.4 picocuries per liter) was obtained at the northeastern corner station in the fourth quarter of 1995. This value is 24 percent of the effluent concentration limit listed in 10 CFR 20, Appendix B, for radon-222 with daughters removed. The second highest value (0.61 picocuries per liter) was measured at the northeast corner site during the third quarter of 1995. The licensee speculated that the higher than anticipated air sample and radon sample results for the fourth quarter may have been the result of dry, windy weather and/or the result of reclamation activities in progress at the time.

Ambient gamma exposures were measured using environmental TLDs. The sample results indicated that the northeastern corner boundary location was nearly 70 millirems per year above the background location (Graham Ranch) during 1995. The difference in ambient exposure rate between the two sample stations increased in 1995 when compared to the 1994 results. The difference in the ambient exposure rates between the two sample stations was 37 millirems during 1994.

License Condition 24 states that the licensee shall implement the environmental monitoring program outlined in Tables 1 and 2 of the previously provided guidance entitled "Current Environmental Monitoring Program." Table 1 states that the direct radiation shall be obtained using a continuous passive integrating device (TLD) or sensitive gamma radiation survey instrument. In addition, Table 1 has a footnote that states that when TLDs are used, they (will) provide for two or more readings of exposure from each dosimeter. The licensee has been using TLDs instead of meters to obtain the exposure rates. However, the licensee has been using single-chip TLDs, not multi-chip TLDs.

Multi-chip TLDs provide for multiple readings of the exposure rates and typically provide a more accurate measurement of actual exposure rates than single-chip TLDs because an average value is normally calculated and reported. The licensee's failure to use multi-chip TLDs as required by Table 1 constitutes a violation of minor significance and is being treated as a non-cited violation of License Condition 24 consistent with Section IV of the NRC Enforcement Policy. Although the licensee did not use multi-chip TLDs, the licensee did meet the intent of Table 1 by obtaining an exposure rate at each sample station.

5.2 Groundwater Corrective Action Program

a. Inspection Scope

The groundwater compliance monitoring program was reviewed to verify that the program was consistent with the requirements specified in the license.

b. Observations and Findings

A groundwater compliance monitoring program is required to be implemented by License Condition 74. The groundwater sample results were submitted to the NRC in the 1995 semi-annual effluent reports. No missed samples were identified during the review of the reports. The chemical constituents still above the groundwater protection standards included uranium in the Well No. 21 samples and nickel, cadmium, selenium, and uranium in Well No. 4R samples.

Also, the licensee is required by Condition 74.D to submit an annual program review to the NRC. The 1995 annual groundwater monitoring report, submitted to the NRC on December 15, 1995, was briefly reviewed during the inspection and was found to be thorough. The report clearly and concisely explained the trends associated with the groundwater, tailings fluid, and the chemical constituents in the groundwater and tailings fluid.

License Condition 74 listed Well No. 4 as one of two point-of-compliance wells. This well was no longer operable and has since been replaced with Well No. 4R. The licensee was advised to include a revision request to change the compliance well from No. 4 to No. 4R during future written communications with the NRC's program office.

License Condition 74.C states that the licensee shall annually recover and evaporate between 47.3 and 66 million gallons of water. According to information provided by the licensee, the licensee extracted 51 million gallons of groundwater during the 1995 season. However, the licensee wants to eliminate the enhanced evaporation system (the spray misters) because they plan to reclaim the area where the system was previously located. Since the evaporation rate will be significantly reduced if the enhanced evaporation system is eliminated, the licensee expects a corresponding reduction in the annual recovery rate. The licensee has submitted a request to the NRC to reduce the recovery rate that is listed in the license. At the time of the inspection, the licensee had not yet activated the groundwater recovery and evaporation equipment pending a response from the NRC. License Condition 74.C does not specify the time interval (such as April to November of each year) that the groundwater recovery equipment is required to be in operation.

During the inspection, the licensee's contractors were performing an extensive review of the hydrogeology in and around the site property. The review included the installation of additional pizeometers as well as drilling and sampling the soil and groundwater at various locations and depths. The licensee plans to include the data in a groundwater protection plan to be submitted to the NRC at a later date. The goal of the hydrogeology studies was to develop long-term alternatives to the remediation process. These alternatives may include expanding the surface area of the evaporation ponds in place at the site, installation

of additional cleanup equipment, or changing to different point-of-compliance wells.

5.3 Conclusions

A review of the licensee's environmental monitoring program indicated that the licensee was appropriately controlling activities and was in compliance with the license requirements with a minor exception as noted below. The inspector noted that the licensee had initiated investigations of the tailings pile in an attempt to gather more information about the hydrogeology of the pile.

A non-cited violation was identified involving the licensee's failure to utilize multi-chip TLDs as required by the license.

EXIT MEETING SUMMARY

The inspector from Region IV presented the inspection results to the representatives of the licensee at the conclusion of the inspection on May 15, 1996. Also, immediately after the June 5, 1996, inspection, the findings identified by the NRC Geotechnical Engineer were discussed with the licensee. Licensee representatives acknowledged the findings as presented.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

J. Gearhart, Resident Agent/Environmental Engineer
T. Herrera, Safety Director/RSO

NRC

M. W. Haque, Project Manager, High Level Waste and Uranium Recovery Projects Branch, Division of Waste Management, Office of Nuclear Materials Safety and Safeguards

Oak Ridge Institute for Science and Education

W. C. Adams, Project Leader/Health Physicist, Environmental Survey and Site Assessment Program

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

40-1162/9601-01	NCV	Failure to adhere to procedures in two instances and failure to perform an annual review of site procedures during 1995 as required by License Condition 44
40-1162/9601-02	NCV	Failure to utilize multi-chip TLDs as required by License Condition 24

Closed

40-1162/9601-01	NCV	Failure to adhere to procedures in two instances and failure to perform an annual review of site procedures during 1995 as required by License Condition 44
40-1162/9601-02	NCV	Failure to utilize multi-chip TLDs as required by License Condition 24

Discussed

None

LIST OF ACRONYMS USED

ALARA	As Low As Reasonably Achievable
BLM	Bureau of Land Management
μR/hr	Microroentgen per hour
pci/g	Picocuries per gram
RSO	Radiation Safety Officer
SCBA	Self-contained Breathing Apparatus
TLD	Thermoluminescent Dosimeters

RADIOLOGICAL SURVEY RESULTS

Radium-226 Soil Sample Results (obtained by NRC and analyzed in Region III):

Designator	Location	Result in pci/g
	Background[1]	1.4 ± 0.5
SS-1	Graham Ranch (Background Station)	2.1 ± 1.0
SS-2	BLM Property (Downwind of Site)	4.8 ± 1.6
SS-3	Archeological Site	0.7 ± 0.1
SS-4	"The Gap" Downwind of Site	35.0 ± 4.0
SS-5	At Stake 388 Northeast Area	11.0 ± 2.0

NOTE: In accordance with 10 CFR 40, Appendix A, Criterion 6, the acceptance criteria for the radium-226 concentration in the first 15 centimeters of soil is 5 picocuries per gram above the background level averaged over areas of 100 square meters. The samples taken were not composite samples and should not be compared directly to the 10 CFR 40 acceptance criteria.

[1]The Background value was previously determined during a pre-reclamation radiological survey that was performed in September 1987; the results of that survey were attached to the licensee's revised reclamation plan dated March 1, 1988.

Comparison of Gamma Exposure Rate Readings During Site Tours:

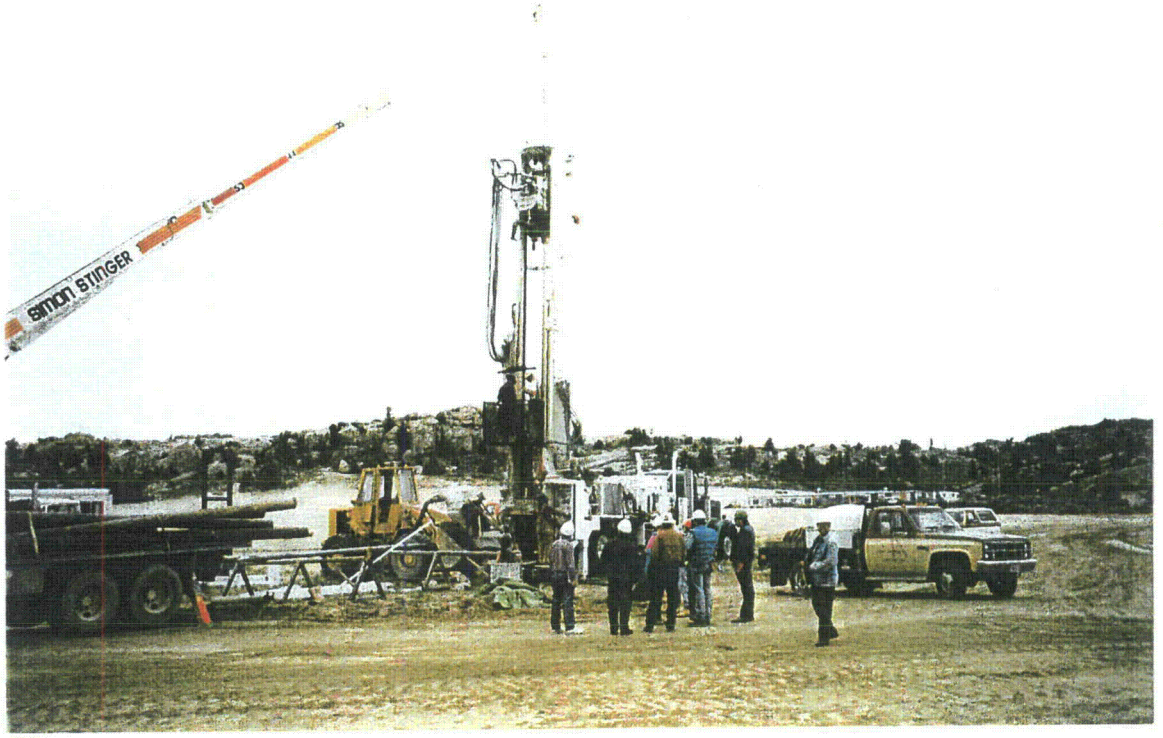
Location	NRC	Licensee	TLD[1]
Graham Ranch Sample Station (Background)	15	6	9.4
Onsite Station (Northeast Corner)	32	12	17.4
Location of SS-2 (BLM land)	30	11	
Location of SS-3 (Archeological Site)	26	10	
Location of SS-4 (The gap in rocks)	85	40	
Location of SS-5 (Northeast area near Stake 388)	43	17	
Northwestern Corner (following cleanup of windblown material)	25	10	

NOTE: All readings were in microroentgen per hour (μR/hr). The NRC inspector used a Ludlum Model 19 meter while the licensee used an Eberline PRM-7 meter.

Although the values measured by each survey meter were not identical in each case, the survey readings were consistent when compared to background values. For example, the survey readings obtained at the onsite sample station by each meter (as well as the TLD) were about twice the exposure rate measured at the background station.

[1]The TLD readings were the average values for 1995 at the two environmental monitoring sample stations.

PHOTOGRAPHS TAKEN AT THE SPLIT ROCK FACILITY



Photograph 1 - Drilling rig in northwest corner of site; area in foreground had been previously scraped for windblown material.

Photograph 2 - Unauthorized "visitors" in the restricted area. The cattle

Photograph 3 - Scraping of windblown material in northwest portion of the site.

Photograph 4 - Scraping of windblown material in northwest portion of the

Photograph 5 - Laydown of scraped windblown material in Area 1A.

Photograph 6 - "Pug Mill" clay soil stockpile being mixed with water

Photograph 7 - "The Gap," area in northeastern corner of the site; one soil sample was obtained from this location.

[illegible] soil sample at the Graham Ranch

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

June 19, 1997

Ms. Stephanie J. Baker, Manager of
Environmental Services
Western Nuclear, Inc.
Union Plaza Suite 300
200 Union Boulevard
Lakewood, Colorado 80228

SUBJECT: NRC INSPECTION REPORT 40-1162/97-01

Dear Ms. Baker:

On May 14, 1997, the NRC completed an inspection of your former Split Rock uranium milling facility. The enclosed report presents the results of that inspection. The inspection disclosed that the site was in an active state of reclamation and that site activities appeared to be progressing in accordance with NRC and license requirements.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact Mr. Robert Evans at (817) 860-8234 or Mr. Charles L. Cain at (817) 860-8186.

Sincerely,

Charles L. Cain

for Ross A. Scarano, Director
Division of Nuclear Materials Safety

Docket No.: 40-1162
License No.: SUA-56

Enclosure:
NRC Inspection Report 40-1162/97-01

cc w/enclosure:
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Wyoming Radiation Control Program Director

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ENCLOSURE

U. S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.:	40-1162
License No.:	SUA-56
Report No.:	40-1162/97-01
Licensee:	Western Nuclear, Inc.
Facility:	Split Rock Mill
Location:	Jeffrey City, Wyoming
Dates:	May 13-14, 1997
Inspector:	Robert J. Evans, P.E., Health Physicist Nuclear Materials Inspection Branch Division of Nuclear Materials Safety
Approved By:	Charles L. Cain, Chief Nuclear Materials Licensing Branch Division of Nuclear Materials Safety
Attachments:	Partial List of Persons Contacted Items Opened, Closed and Discussed List of Acronyms Used Photographs Taken at the Split Rock Facility

EXECUTIVE SUMMARY

Western Nuclear's Split Rock Facility
NRC Inspection Report 40-1162/97-01

This inspection included a review of site status; management organization and controls; site operations; and the licensee's radiation protection, waste management and environmental programs.

Management Organization and Controls

- The licensee's organizational structure and level of security were consistent with previous inspections, and it appeared that adequate oversight had been provided for site activities (Section 2).

- All procedures required by the license had been developed and were technically adequate (Section 2).

Operations Review

- Site reclamation activities appeared to have been conducted in accordance with the applicable license and regulatory requirements. Site fences were in good condition, and perimeter postings were appropriate (Section 3).

Radiation Protection

- The licensee had implemented a radiation protection program that met the requirements established in 10 CFR Part 20 and the license, with one minor exception. A Non-Cited Violation was identified related to the licensee's failure to maintain all radiological survey meters adequately calibrated (Section 4).

- Occupational doses appeared consistent with the level of activity in progress at the site, and no individual exceeded the occupational exposure limits established in 10 CFR Part 20 during 1996 (Section 4).

- The licensee's implementation of the radiological verification program was reviewed, and the licensee was observed to be performing site activities in accordance with the conditions of the license. Additionally, the licensee had implemented a quality assurance program that will help ensure that the radiological verification program has been properly implemented (Section 4).

Radioactive Waste Management/Environmental Protection

- A review of the licensee's environmental and groundwater monitoring programs indicated that the licensee was appropriately controlling these activities and was in compliance with license requirements (Section 5).

Report Details

1 SITE STATUS

Decommissioning activities began at Western Nuclear's Split Rock facility in 1988. Since that time, the licensee has demolished and buried the former mill and performed reclamation work on the tailings piles. Installation of the final cover was completed in 1994 on tailings impoundment areas 3A and 3B (51 acres total), the location where the former mill was previously situated and eventually buried. During 1995, the radon barrier and erosion protection were installed on areas 1C, 2B, and most of area 2A (65 acres).

During the 1996 construction season, the radon barrier and associated rock cover were installed over portions of tailings areas 1A and 1B (70 acres). Other activities completed during 1996 included installation of radon barrier material and erosion protection material in local drainage ditches. (Site ditches occasionally traversed through the tailings areas; therefore, radon barrier material was required to be installed in these areas of the site.) The licensee still must install the radon barrier on the remaining 62 acres of the tailings impoundment (areas 1A, 1B, and 2A). Much of this work is planned for the 1997 construction season.

During this inspection, activities in progress included cleanup of contaminated windblown material. Windblown tailings and other contaminated soils were being identified and were being collected from around the site. The contaminated soil was being discarded in a disposal cell located in the northern portions of areas 1A and 1B.

2 MANAGEMENT ORGANIZATION AND CONTROLS (88005)

2.1 Management Organization

a. Inspection Scope

The organizational structure was reviewed to ensure that the licensee had established an organization with defined responsibilities and functions.

b. Observations and Findings

The onsite staff consisted of five individuals, the resident agent/environmental engineer, the safety director/radiation safety officer, a mechanic, an electrician, and a receptionist. The licensee's organizational structure was essentially the same as the structure that was in place during the previous inspection.

About 50 contractors were onsite during the inspection. Most contractors were performing reclamation-related work. Other consultants were being used for the groundwater protection studies, onsite drilling, materials testing, and site surveying.

Security was provided by locked access gates, and a fence was installed around the site property to keep intruders out. Site offices had been relocated since the last inspection to a new site situated outside of the restricted area. The onsite office was demolished during the inspection. No permanent structures remained onsite at the end of the inspection although several contractor trailers were still stationed inside of the restricted area.

2.2 Management Controls

a. Inspection Scope

The inspector reviewed the licensee's implementation of procedures and analyses related to site reclamation as specified in license conditions to evaluate the effectiveness of the licensee's control of site activities.

b. Observations and Findings

As specified in License Condition 44, the licensee is required to establish written procedures for site reclamation activities, including personnel and environmental monitoring and survey instrument calibrations. Site procedures were reviewed to determine whether procedures had been established for the program areas referenced in the license and to evaluate the procedures for their technical adequacy. In summary, the procedures that were required by the license had been developed and were considered technically adequate for the work being performed.

License Condition 44 also states that the site RSO shall perform a documented review of all existing site procedures at least annually. A review of the licensee's procedure manual revealed that site procedures had been reviewed twice during 1996. However, the licensee had not updated the operations procedures to take into account the recent changes in their groundwater corrective action program. Specific changes that have occurred at the site that were not incorporated into the site procedures included deletion of one extraction well and relocation of the enhanced evaporation system.

2.3 Conclusions

The licensee's organizational structure was consistent with structures in place during previous inspections, and it appeared that adequate oversight had been provided for site activities. In general, the procedures that were required by the license had been developed and were technically adequate.

3 OPERATIONS REVIEW (88020)

3.1 Inspection Scope

A site tour was performed to verify that site activities were being conducted in accordance with applicable regulations and the conditions of the license, and to ensure that operational controls were adequate to protect the health and safety of the workers and members of the general public.

3.2 Observations and Findings

At the time of the inspection, reclamation activities were in progress, including the collection and disposal of windblown material. The work appeared to be progressing in a safe, orderly fashion. Also, site buildings, fences, gates, and operating equipment were observed. Site fences were noted to be in good condition and were properly posted. Employee postings, required by 10 CFR 19, were identified in the licensee's offsite offices and some, but not all, of the onsite trailers. Furthermore, the postings that were located in the trailers were noted to be out-of-date. This subject area was pointed out to the licensee for correction.

The licensee's site inspection records were reviewed. In accordance with the licensee's procedures, an inspection of the winter storage ponds was required to be performed on a routine basis. (The frequency of the inspection depended on the work in progress.) A review of the licensee's "Routine Evaporation Pond Inspection" Log and discussions with the licensee revealed that the licensee continued to perform the inspections of the pond on a routine basis; however, the licensee stopped documenting these inspections in mid-January 1997 because they ran out of blank inspection forms. The licensee was reminded of their responsibility to perform and document these inspections in accordance with the instructions provided in their site operating procedures. (This issue was not considered a violation of NRC standards because the pond inspection is not specifically required by the license.)

3.3 Conclusions

Site activities generally appeared to have been conducted in accordance with applicable license and regulatory requirements.

4 RADIATION PROTECTION (83822)

4.1 Radiation Safety Program

a. Inspection Scope

The purpose of this portion of the inspection effort was to determine if the licensee's radiation safety program was in compliance with requirements established in the license and 10 CFR Part 20 regulations.

b. Observations and Findings

License Condition 43 specifies various documents relating to the radiation protection program which must be maintained. A review of records relating to instrument calibrations, radiation work permits, personnel training, employee exposures, and equipment releases was performed, and no oversights in documentation (as required by the license) were noted. For example, License Condition 46 requires the licensee to develop quarterly reports of radiation protection-related activities. The quarterly reports for 1996 were reviewed and were found to be satisfactory.

License Condition 53 states that radiation detection instruments shall be calibrated after repair and as recommended by the manufacturer or at intervals not to exceed 6 months, whichever is sooner. At the time of the inspection, the licensee was using a personnel contamination monitor to allow site workers to scan themselves prior to eating or leaving the restricted area. The requirements for the personnel scan were specified in two radiation work permits. However, the calibration of the personnel contamination survey instrument in use during the inspection expired on May 7, 1997. A calibrated replacement meter was not available for onsite use until May 13, 1997.

The licensee's failure to maintain the calibration of the personnel survey meter up-to-date was identified as a violation of License Condition 53 (40-1162/9701-01). This failure constitutes a violation of minor significance and is being treated as a Non-Cited Violation, consistent with Section IV of NUREG-1600, General Statement of Policy and Procedures for NRC Enforcement Actions.

Although the instrument's calibration had expired, the licensee performed an instrument response check on this survey meter on a daily basis. If the meter had malfunctioned, the daily check should have revealed that the instrument reading was erroneous. Therefore, the instrument appeared to function correctly during the time frame that the survey meter had to be used at the site but was out of calibration. Therefore, this violation was not considered safety significant because the survey meter appeared to be operating properly during the May 7-13, 1997, time frame.

One of the contributing factors to the out-of-calibration instrument problem appeared to be related to the licensee's failure to rotate instruments. The licensee normally had more than one personnel contamination survey meter available onsite; however, the licensee did not routinely rotate the instruments to ensure that a calibrated instrument was always available at the site.

License Condition 42 states that a copy of the As Low As Reasonably Achievable (ALARA) report containing the results of the annual audit and recommendations by the ALARA committee shall be submitted to the NRC. The licensee's annual ALARA report dated November 14, 1996, was reviewed. The report provided clear and concise discussions of the licensee's compliance with the license conditions.

Although the license does not specify a particular deadline for submittal of this report to the NRC, the licensee had not submitted the ALARA report to the NRC at the time of the inspection. The inspector considered the licensee's failure to submit the ALARA report to the NRC in a timely manner a weakness in the licensee's document distribution program. The licensee submitted the report to the NRC immediately after the end of the inspection.

During 1996, site workers' exposures to radioactive materials had been monitored and documented by the licensee. Site exposures were essentially a summation of internal doses based on airborne particulate sample results and external doses based on the time workers spent in areas with known ambient gamma exposure rates. The licensee did not use thermoluminescent dosimeters to monitor site personnel for external exposures.

The licensee monitored 39 site workers during 1996 for exposure to radioactive materials. According to the licensee's data, the highest exposure to one site worker, a construction worker, was 283 millirems. This exposure was up significantly from 1995 when the highest individual exposure recorded for that year was 55 millirems. The second highest worker exposure for 1996 was calculated to be 274 millirems. Regardless, the exposures for 1996 were well below the annual limit of 5000 millirems established in 10 CFR Part 20.1201.

During a review of the licensee's exposure calculations, an error was identified in their "Annual Employee Exposure Summary" documentation. The error involved the licensee's conversion of rems to millirems. This error impacted the calculated total effective dose equivalent exposures assigned to site workers for 1996. The licensee implemented corrective actions during the inspection that include recalculation of the workers' assigned exposures.

Approximately 200 urine bioassay samples were collected during 1996, a number that was up from the previous year. (About 120 samples were collected during 1995.) None of the samples exceeded the action level of 15 micrograms per liter of natural uranium.

The licensee had a written respiratory protection program in place at the site, and the licensee's staff maintained their medical qualifications up-to-date in case respirators had to be used. In addition, the licensee had respirators available for use at the site although the respirators were being used predominately for industrial reasons only.

A review of the licensee's air sampling records was performed. The records indicate that the licensee had measured one airborne concentration that exceeded the derived air concentration (DAC) limit for thorium-230 during 1996. (The licensee used the DAC value for thorium-230 instead of natural uranium because of conservatism.)

On April 24, 1996, the licensee obtained a routine air sample for workers assigned to a location in the vicinity of tailings impoundment area 1A. The sample results for that day revealed a DAC of 103 percent of the thorium-230 occupational inhalation limit listed in 10 CFR 20, Appendix B. The licensee routinely resampled the airborne thorium-230 concentrations in this area of the site on May 3, 1996. The sample result was only 4 percent of the thorium-230 DAC limit. The licensee concluded, based on previous experience, that the elevated DAC sample result obtained on April 24, 1996, was caused by blowing winds that were prevalent in the area on that day. The licensee has previously observed elevated airborne sample results on windy days, and conversely, lower airborne concentrations on calm days. (The winds were calm on May 3, 1996).

The licensee decided not to obtain a special sample between April 24 and May 3, 1996, to ensure that the airborne concentrations were below the DAC limit because the weather conditions changed on April 25, 1996, from windy to calm. As a conservative measure, the licensee assigned doses to site workers for April 24, 1996, based on the 103 percent DAC measurement. As mentioned above, no site worker received an assigned dose for 1996 that exceeded 10 percent of the NRC limits for occupational workers.

4.2 Radiological Verification Program

a. Inspection Scope

The purpose of this portion of the inspection effort was to review the licensee's implementation of the verification survey program associated with site remediation.

b. Observations and Findings

License Condition 33.A states in part that the cleanup of soil contamination will be verified in accordance with the Radiological Verification Program, a plan that was previously submitted to the NRC and approved by the NRC. A review of the windblown cleanup and radiological sampling activities, in progress during the

inspection, was performed to ascertain whether the activities were being conducted in accordance with Condition 33.A of the license.

In accordance with the Radiological Verification Program, the site (and selected areas adjacent to the site) was divided up into three basic areas (Primary-1, Primary-2, and Secondary). The grid system dimensions, the cleanup compliance criteria, and soil sampling requirements varied for each of these three areas. Overall, around 200-250 acres of land will have to be cleaned and/or verified clean of radioactive contamination. The licensee speculated that roughly 10,000 grids will have to be established to implement the soil verification program. Furthermore, the soil acceptance criteria included not only radium-226 to ensure compliance with 10 CFR 40 requirements, but also included natural uranium and thorium-230 restrictions.

The licensee previously submitted supplemental standards to the NRC for several areas of the site that have been determined to be difficult, if not impossible, to remediate. These problem areas included rocky sections which have limited public access, the area under the current rock stockpiles (the rock stockpiles includes rejected material that will not be used), certain access roads, and areas along former ore hauling roads. As of the date of the inspection, the NRC had not approved the licensee's request for the supplemental standards.

To save time in the implementation of the soil verification program, the licensee performed scoping surveys in select areas of the site. If the scoping surveys indicated that the area would fail the acceptance criteria, then the licensee performed reclamation (scraping of the topsoil) with heavy construction equipment. In accordance with the licensee's program, the results of this preliminary construction survey (if performed) was not documented.

With respect to backfilling of areas that have been remediated, the licensee planned to backfill only the access roads as needed to support current construction traffic. (If the licensee backfilled an area, confirmatory sampling by the NRC in that area would be more difficult to accomplish.) The licensee does not plan to backfill most areas of the site until completion of the NRC's confirmatory survey (scheduled for 1998).

At the time of the inspection, the licensee's contractor was in the process of performing ambient gamma surveys to locate the areas with elevated soil contamination. The contractor utilized 22 sets of survey instruments although the actual number of instruments in use depended on the number of personnel available each day. The survey equipment consisted of Ludlum Model 2350 meters with 44-10 probes, an assembly that has been successfully used by licensees at other sites. The probe was attached to a backpack assembly which included a 3-inch lead shield to eliminate radiation "shine" from all directions other than the direction of the ground.

Once a technician had been equipped with a survey instrument assembly, the technician was assigned to survey scan a pre-determined number of 10 meter by 10 meter grids. According to the licensee's procedures, the technician was required to walk the grid in a predetermined sequence within a 150-second time interval. If the survey meter recorded less than 2274 total counts within the 150-second time interval, the grid was assumed to contain an acceptable amount of contaminated soil. If the total count was greater than 2274 counts, then the grid was assumed to need remediation.

To ensure that the instruments were operating correctly, the licensee performed calibrations of the instrument assemblies daily as well as instrument checks three times per day. Correction factors were used to correlate an instrument to a predetermined correlation mean value in counts-per-minute. This correction was necessary to ensure that all 22 instrument assemblies were operating in unison.

Once a technician performed the gamma survey scans, the information stored in the survey meter was then downloaded into a desktop computer workstation. According to information provided by the licensee, one technician could perform a scan of 80-100 grids per day. Furthermore, the licensee was performing gamma scans of roughly 400-600 grids per day. The actual number of grids completed in a day depended on factors such as the number of technicians available and weather conditions.

At the time of the site tour, surveyors were using a global positioning system to stake out the 10 meter by 10 meter grids with wooden lathes. The surveyors stated that they were staking out about 300-500 grids per day. The surveyors were staking grids at a rate necessary to ensure that they remained ahead of the technicians that were performing the gamma scan surveys.

In accordance with the Radiological Verification Program, soil samples were required to be obtained on a minimum of 10 percent of the grids. The locations for the soil samples were typically chosen based on the highest gamma survey readings obtained during a certain time frame, such as per shift or per day. Once a grid was chosen, the licensee obtained 11 cores per grid. The soil samples were not dried during the mixing/splitting process because the ground was already dry enough. Following collection, portions of the samples were bagged for laboratory analysis and for storage (in case it's needed for future use).

The license utilized a slightly different approach for quality control of the soil sample results. Instead of using a third-party laboratory to perform confirmatory analyses on a certain number of samples (such as 5 percent of the samples), the licensee typically included a spiked blind sample with every 19 soil samples sent to their contract laboratory. If the blind sample's results were within a predetermined range, then the licensee assumed that the results for the remaining 19 samples were acceptable. The licensee firmly believed that this process resulted in reliable, reproducible sample results. At the time of the inspection, the licensee noted that

none of the blank sample results had failed to meet the acceptance criteria established for the samples.

One minor observation was reported to the licensee. The inspector noted that the licensee was required to obtain 1000-gram samples for laboratory analysis; however, the licensee did not weigh the samples during the mixing/splitting process. The licensee acknowledged that they did not weigh the samples, but noted that the laboratory rarely, if ever, had notified them that they had not submitted enough soil in a sample for laboratory use.

As part of the Radiological Verification Program, one individual performed quality control/quality assurance activities to help ensure proper implementation of the program. For example, the quality assurance inspector performed an audit on May 4, 1997. The most common problem identified during the audit was that the wrong high voltage setpoint had been selected on the survey instruments, or that the wrong high voltage setpoint had been documented for the instrument. Overall, the actions of this quality assurance representative will help ensure that the licensee's radiological verification program has been properly implemented.

4.3 Conclusions

The licensee had implemented a radiation protection program that met requirements established in 10 CFR Part 20 and the conditions of the license, with one exception. A Non-Cited Violation was identified related to the licensee's failure to keep calibrated survey meters onsite and available for use.

Occupational doses for site personnel during calendar year 1996 appeared consistent with the scope of work activities ongoing at the site and were only a small fraction of the dose limits established in 10 CFR Part 20.

The licensee's implementation of the radiological verification program was reviewed. The licensee was performing site activities in accordance with the reference documents listed in the license. Additionally, the licensee had implemented an active quality assurance program that should help ensure that the program had been properly implemented.

5 RADIOACTIVE WASTE MANAGEMENT (88035) AND ENVIRONMENTAL PROTECTION (88045)

5.1 Environmental Protection

a. Inspection Scope

The environmental monitoring program at the site was reviewed to assess the effectiveness of the licensee's program and to evaluate the effects, if any, of site reclamation activities on the local environment.

b. Observations and Findings

Environmental monitoring program requirements are identified in License Condition 24. At the time of the inspection, the environmental monitoring program in place at the site consisted of air particulate, radon, direct radiation, and surface water sampling. The licensee utilized two sample stations. One sample station was located at the northeastern corner of the site, while the second station was located offsite at the Graham Ranch. Continuous air samplers, radon canisters, and environmental thermoluminescent dosimeters (TLDs) were deployed at each of the two sample stations.

During the inspection, the two semi-annual effluent reports and supporting data for 1996 were reviewed. Overall, the licensee's semi-annual reports were noted to be thorough and complete. All environmental monitoring samples required by the license had been obtained and were documented in the semi-annual effluent reports, with two exceptions. Surface water samples were not being taken at the tailings and acid plant cooling ponds because these two ponds no longer existed at the site.

Surface water samples were obtained at three locations on a quarterly basis. The water samples were analyzed for a number of chemical constituents as well as radium-226, radium-228, thorium-230, and natural uranium. The radionuclide concentrations in the surface water samples were 2 percent or less of the respective effluent concentration release limits established in 10 CFR 20, Appendix B.

Air samples were taken at the two sample stations and analyzed for lead-210, radium-226, thorium-230, and natural uranium concentrations on a quarterly basis. According to information provided in the semi-annual effluent reports, the thorium-230 concentration peaked at 26 percent of the effluent concentration limit listed in 10 CFR 20 during the second quarter of 1996 at the northeast sample station. The concentrations for all other radionuclides were under 5 percent of the respective effluent concentration limits specified in 10 CFR 20, Appendix B.

Radon samples were continuously taken at the two sample stations. The samples were analyzed quarterly. The highest measured value (1.2 picocuries per liter) was obtained at the northeastern corner station in the second quarter of 1996. This value was 12 percent of the effluent concentration limit listed in 10 CFR 20, Appendix B, for radon-222 with daughters removed. All other sample results were less than 8.5 percent of the limit.

Ambient gamma exposures were measured using environmental TLDs. A total of 140.4 millirems was measured at the northeast perimeter sample station during 1996, while 84.8 millirems was measured at the background station during the same time frame. The northeastern corner boundary location was nearly 56 millirems per year above the background location (Graham Ranch) during 1996. The difference in ambient exposure rates between the two sample stations

decreased in 1996 when compared to the 1995 sample results (70 millirems difference in 1995).

During the previous NRC inspection (documented in NRC Inspection Report 40-1162/96-01), a Non-Cited Violation of License Condition 24 was identified related to the licensee's apparent failure to utilize multi-chip environmental TLDs. During the current inspection, the licensee's laboratory documentation related to the environmental TLDs was reviewed. The documentation for the fourth quarter of 1996 clearly indicated that the reported exposure rate was an average of four readings, suggesting that the licensee had used multi-chip TLDs during late-1996.

Furthermore, the licensee speculated that they had been using multi-chip TLDs in the past (but the licensee was not positive of this assertion during the inspection) although their laboratory documentation for early-1996 and previous quarters implied that the TLDs being used at the site were single-chip TLDs. In summary, the licensee was noted to be using multi-chip TLDs during the inspection that met the intent of License Condition 24.

5.2 Groundwater Corrective Action Program

a. Inspection Scope

The groundwater compliance monitoring program was reviewed to verify that the program was consistent with the requirements specified in the license.

b. Observations and Findings

A groundwater compliance monitoring program is required to be implemented by License Condition 74. The groundwater sample results were submitted to the NRC in the two semi-annual effluent reports for 1996. No missed samples were identified during the review of these reports.

The groundwater protection standard limits are listed in License Condition 74.B for the point-of-compliance Wells No. 4 and 21. The chemical and radiological constituents still above the groundwater protection standards during 1996 included uranium in the Well No. 21 samples and nickel, selenium, and uranium in the Well No. 4R samples. (The licensee replaced Well 4 with Well 4R during 1994 because Well 4 had collapsed and could not be salvaged.)

Also, the licensee is required by Condition 74.D to submit an annual program review to the NRC. The 1996 annual groundwater monitoring report, submitted to the NRC on December 16, 1996, was briefly reviewed during the inspection and was found to be thorough. The report clearly and concisely explained the trends associated with the groundwater, tailings fluid, and the chemical constituents in the fluid.

License Condition 74.C states that the licensee shall annually recover and evaporate between 6 and 15 million gallons of water. (On April 28, 1997, License Amendment No. 79 was issued by the NRC which reduced the annual recovery rate from 47.3-66 million gallons to 6-15 million gallons.) According to information provided by the licensee, the licensee extracted slightly over 18 million gallons of groundwater during 1996. This recovery rate was down significantly from 1995 when 51 million gallons of fluid was recovered.

The reason for the decrease in the recovery rate was related in part to the licensee's decision to modify their enhanced evaporation system to support reclamation. The licensee eliminated the spray misters because they needed to reclaim the area where the misters had been previously located. For the 1996 evaporation season, the enhanced evaporation system was relocated from the tailings area to the evaporation pond area. The new enhanced evaporation system was modified to moisten the side slopes of the two lined evaporation ponds versus use of a spray mister system. The licensee estimated that 8.36 million gallons of water (of 18.1 million gallons collected) was evaporated during 1996.

At the time of the inspection, the licensee had two extraction wells that were used to recover groundwater. The operation of a third well, 5E, was no longer required when Amendment 79 of the license was issued by the NRC on April 28, 1997. Of the remaining two wells, 4E and B, neither were in operation during the inspection. Well 4E was inoperative because the water discharge line had been disconnected to allow for reclamation of the office area. Well B was inoperative because it had no power. The well's power line was down for reclamation work. The licensee planned to return both extraction pumps to operation during June 1997.

During the inspection, the semi-annual effluent and environmental monitoring and the annual groundwater corrective action program review reports were evaluated. All three reports were noted to have been submitted to the NRC several days late. The licensee was reminded of their responsibility to submit the reports in a timely manner or to obtain NRC permission prior to submitting the reports after the respective deadlines.

5.3 Conclusions

A review of the licensee's environmental monitoring program indicated that the licensee was appropriately controlling activities and was in compliance with the license requirements of the license and 10 CFR Part 20 and Part 40.

EXIT MEETING SUMMARY

The inspector presented the inspection results to the representatives of the licensee at the conclusion of the inspection on May 14, 1997. Licensee representatives acknowledged the findings as presented.

Attachment

PARTIAL LIST OF PERSONS CONTACTED

Licensee

S. Baker, Manager of Environmental Services
L. Fiske, Civil Engineer/Radiation Specialist, Shepherd Miller, Inc.
J. Gearhart, Resident Agent/Environmental Engineer
T. Herrera, Safety Director/RSO
L. Miller, Vice President, Shepherd Miller, Inc.

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

40-1162/9701-01	NCV	Failure to maintain calibrated radiological survey instruments available for use as required by License Condition 53.

Closed

40-1162/9701-01	NCV	Failure to maintain calibrated radiological survey instruments available for use as required by License Condition 53.

Discussed

None

LIST OF ACRONYMS USED

ALARA	As Low As Reasonably Achievable
DAC	Derived Air Concentration
TLD	Thermoluminescent Dosimeters

Attachment 2
PHOTOGRAPHS TAKEN AT THE SPLIT ROCK FACILITY

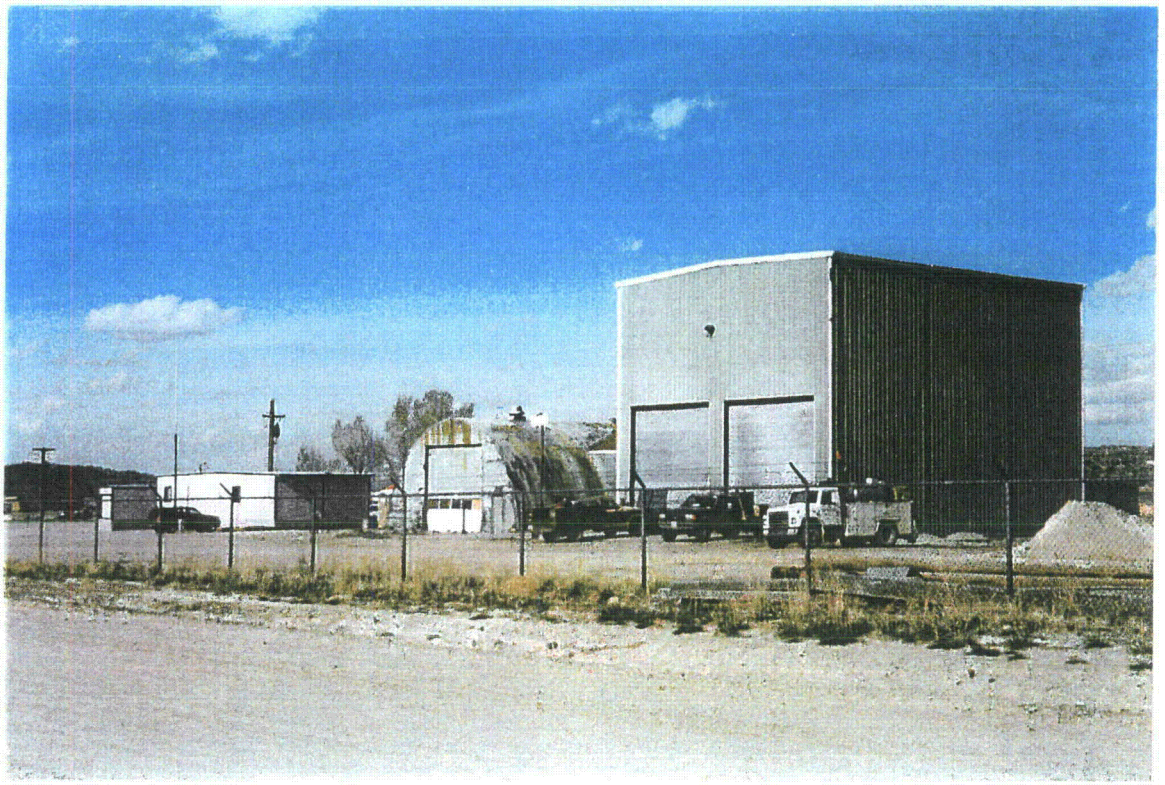

Photo 1 - Current Western Nuclear facility offices located outside of the restricted area.

Photo 2 - Demolition of former office building inside of restricted area.

Photo 3 - Demolition of former office building.

Photo 4 - Disposal of former office building debris in the area 1A burial pit.

Photo 5 - Area P-2 being remediated; rock stockpiles in background.

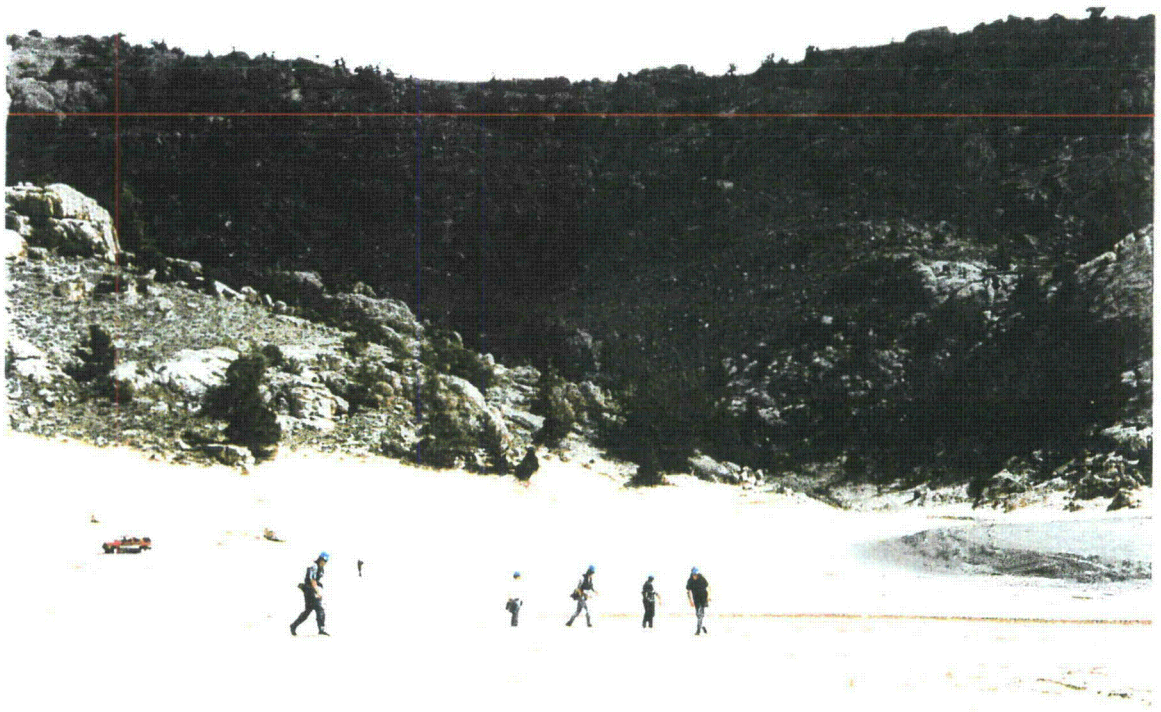

Photo 6 - Gamma radiation survey scanning in progress (four technicians and one supervisor).

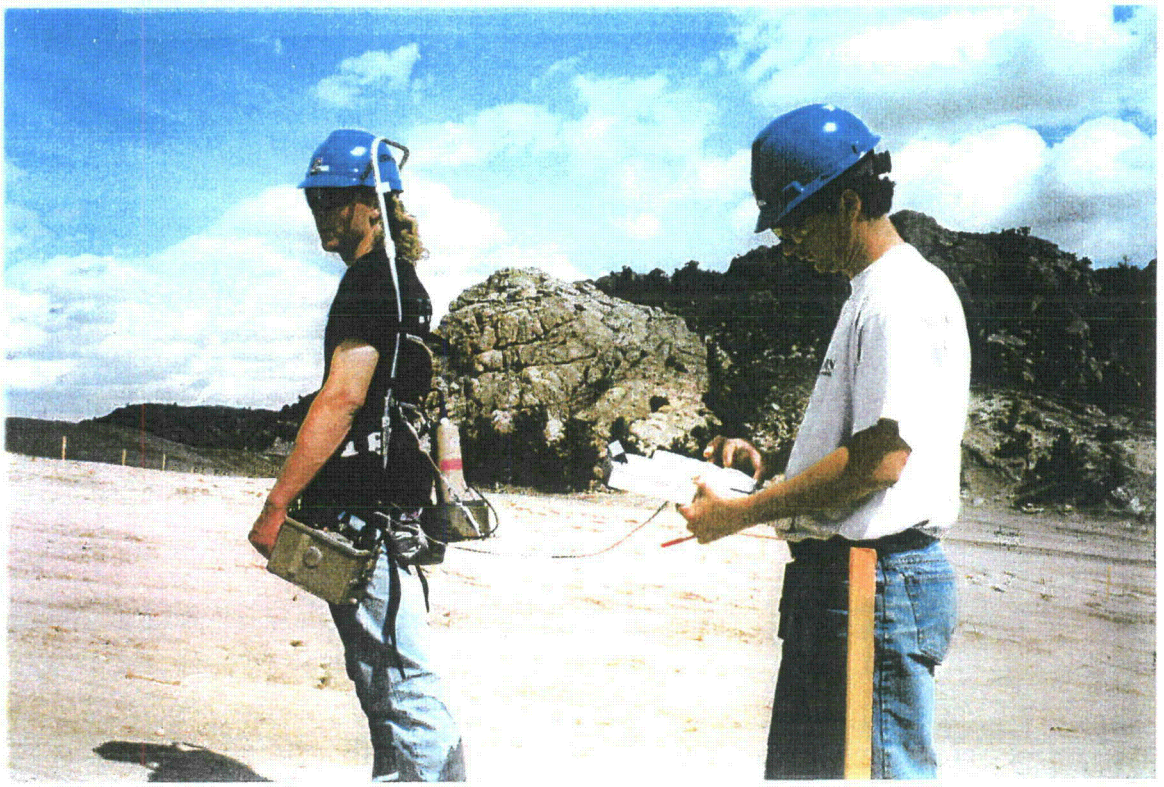

Photo 7 - Gamma survey meter assembly as seen on one representative technician.

Photo 8 - Instrument calibration trailer, location where gamma survey instruments were being controlled.

Photo 9 - Soil sample splitting area (samples were split prior to analysis for radionuclide content).

Photo 10 - Use of global positioning system to accurately pinpoint the location where grid corner stakes were to be installed.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 29, 1997

Ms. Stephanie J. Baker, Manager of
Environmental Services
Western Nuclear, Inc.
Union Plaza Suite 300
200 Union Boulevard
Lakewood, CO 80228

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION INSPECTION REPORT 40-1162/97201

Dear Ms. Baker:

On July 22, 1997, the Nuclear Regulatory Commission completed an inspection of the Western Nuclear, Inc. (WNI) Split Rock Uranium Mill site located in Fremont County, Wyoming. The enclosed report presents the results of that inspection.

The inspection examined activities conducted under Source Material License SUA-56 as they relate to surface reclamation and geotechnical engineering activities. The inspection consisted of observation of ongoing and completed site reclamation activities, geotechnical testing, review of construction records and laboratory facilities, and interviews with WNI personnel and subcontractors. No violations or deviations were identified; therefore, no response to this letter is required.

In accordance with 10 CFR 2.790 of the NRC "Rules of Practice," a copy of this letter and its enclosures will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact Mr. Ken Hooks, the inspection team leader, at (301) 415-7777.

Sincerely,

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material
Safety and Safeguards

Docket Number: 40-1162
License No. SUA-56

Enclosure: NRC Inspection
Report 40-1162/97201

cc: J. Virgona, DOE-Grand Junction
D. Finley, WDEQ

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF WASTE MANAGEMENT

Docket No.:	40-1162
License No.:	SUA-56
Report No.:	40-1162/97201
Licensee:	Western Nuclear, Inc. (WNI)
Facility:	Split Rock Mill
Location:	Fremont County, Wyoming (near Jeffrey City)
Date:	July 22, 1997
Inspectors:	Kenneth R. Hooks, Project Manager and Team Leader Division of Waste Management, Uranium Recovery Branch Mikko P. Ahola, Geotechnical Engineer Center for Nuclear Waste Regulatory Analyses
Approved by:	Joseph J. Holonich, Chief Uranium Recovery Branch, Division of Waste Management
Attachment:	Partial List of Persons Contacted List of Items Opened, Closed, and Discussed List of Acronyms Partial List of References

Enclosure

Report Details

On-Site Construction (88001)

Inspection Scope

The inspectors conducted a routine, announced geotechnical engineering inspection of the WNI Split Rock uranium mill tailings site in Fremont County, Wyoming. The purpose of the inspection was to observe surface reclamation activities at the site and to review construction records to determine if activities met license conditions and the NRC-approved reclamation design (License Condition No. 27).

Observations and Findings

Following a brief entrance meeting to define the inspection scope and to obtain site background information, the site tour began with an inspection of the Cody Shale source deposit for the radon barrier cover layer, located a short distance offsite. The deposit was previously drilled and tested on a uniform grid and to necessary depths for the amount of cover material needed for the 1997 construction season. The gradation testing requirement for the Cody Shale radon barrier was that at least 90 percent of the material must pass a #200 sieve. Based on the sieve testing of drill hole material, color coded stakes were placed outlining the portion of the clay deposit to be utilized for the radon barrier. Excavated Cody Shale material identified not to pass the gradation tests was set aside in separate piles to be utilized for construction purposes other than the construction of radon barrier. An adequate amount of Cody Shale passing the sieve test requirements was identified in the source deposit for the 1997 construction season.

The excavated Cody Shale radon barrier material was transported to an onsite pug mill for mixing with water to the desired moisture content for the cover placement. It was stated that while there were other methods for mixing water with the dry clay, the pug mill provided the most consistent control of water content in the clay. The site construction manager stated that the pug mill was operated to condition the clay to a slightly higher moisture content (i.e., 20-22 percent) than the optimum moisture content (approximately 18 percent), because some drying takes place before the clay can be compacted over the tailings. At the time of the inspection, the pug mill was not in operation, and it was not possible to observe this process.

The inspectors observed the condition of the south central and south diversion ditches. These two ditches were either at or near completion, and no construction activities were ongoing. The rock mulch in the ditches appeared to be uniformly placed and no erosion was observed. The ditches were lined and compacted with clay, on top of which was placed a fine rock filter (i.e., less than 1 in.), followed by rock mulch with a D_{50} of 3, 6, 12, or 18 in., depending on the steepness of the slope. Six inch rock mulch was placed well

up the opposite slope from the tailings pile to minimize erosion of soil from drainage of the Granite Mountains. Other inlet drainages into the south diversion ditch were protected by rock mulch. These drainage ditches were stated by the licensee to be designed to accommodate any expected flash flooding.

The completed cover (i.e., 2 in. D_{50} rock mulch) was observed over areas 2A, 2B, 1C, and the south portions of areas 1A and 1B. The cover appeared in good condition with some vegetation growth. The only construction activity observed during the inspection was the placement/compaction of windblown tailings in the north end of areas 1A and 1B. No placement of the radon barrier cover (i.e., Cody Shale) or density testing was ongoing or inspected. The construction manager stated that the windblown tailings were placed in loose lifts of 8 in. and rolled more than once with a smooth vibratory compactor. Only one pass with the vibratory compactor is required in the construction specifications.

The subsidence within the tailings has reached 90 percent of the maximum, and no additional subsidence monitoring was deemed necessary since the windblown tailings were placed and compacted in short lifts. Adequate moisture appeared to be added to the windblown tailings during their placement. The construction manager stated that the radon cover placement would begin soon, and if necessary, additional water would be added to the windblown tailings to create a good interface with the Cody Shale radon barrier. The 16 in. Cody Shale radon barrier will be placed in 3 lifts, with the first 6 in. compacted to 90 percent of maximum dry density and the subsequent two 5 in. lifts compacted to 95 percent of the maximum dry density. Density tests will be performed in accorance with American Standards for Testing and Materials (ASTM) requirements. The swale across areas 1A and 1B appeared to be well constructed and in good condition.

The last area inspected was the rock stockpile where variously sized rock filter material was stored for use in the diversion ditches and the final cover. The process for extracting material from the rock stockpiles to maintain the proper gradation of material was discussed.

The laboratory trailer where soil density and Proctor tests were performed was inspected and was found to be in good working condition, although no soil testing was ongoing. All equipment (e.g., laboratory scales) was in compliance with calibration requirements as evidenced by the calibration stickers on the equipment. The technician stated that only the sand cone method (ASTM D-698) was currently being used for the density testing of the radon cover material.

Upon completing the site tour, the inspectors reviewed the construction records covering the period March 1996 through December 1996. These records included the daily summary reports; corrective action reports; and construction records covering the subgrade material, Cody Shale gradation tests, radon barrier layer, borrow soil layer, erosion protection placement, and rock durability tests. Verification of the required test frequency was performed (License Condition No. 27, and the approved site reclamation plan) based on daily as well as cumulative volumes of material placed. The

inspectors concluded that the frequency of testing was in compliance with license requirements. The inspectors examined several corrective action reports (i.e., failure of an in-place density test) at random to assure that followup construction activities and testing took place to achieve satisfactory results. All construction documentation records were complete.

Conclusions

Surface reclamation appeared to have been conducted in accordance with the the NRC-approved design, and construction appeared adequate based on the condition of the diversion ditches and the portion of the cover completed to date. It should be noted, however, that the inspection did not include the observation of any geotechnical testing or placement of the Cody Shale radon barrier. Future geotechnical inspections should be scheduled when these activities are in progress.

Construction tests were being properly documented and records properly maintained. Special forms developed to document the construction activities with regard to the various placement materials facilitated the records review and the resolution of corrective action requests. WNI also has a staff engineer to periodically audit the construction activities and records, giving additional assurance of compliance with the design and the license conditions.

The previous geotechnical inspection report (IR) of the WNI Split Rock site (IR40-1162/95-02), identified a deficiency in the placement of the top 4 in. rock/soil layer; specifically unevenness or non-uniformity of the rock/soil mix. Since that time, the soil component has been eliminated from the top 4-in. rock layer as required by License Condition No. 27E, and the non-uniformity has been corrected.

No violations were identified.

Exit Meeting

An exit meeting was conducted at the conclusion of the inspection on July 22, 1997. During this meeting, the inspectors reviewed the scope and findings from the inspection. The licensee did not identify any information provided to, or reviewed by, the inspectors, as proprietary.

PARTIAL LIST OF PERSONS COTACTED

Licensee:

John R. Gearhart (WNI)
Moe A. Pasha (WNI)
Stephanie J. Baker (WNI)
Louis L. Miller (Shepherd Miller, Inc.)
William Ray (Inberg-Miller)

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None were opened in this report.

Closed

None

Discussed

None

LIST OF ACRONYMS USED

ASTM	American Society for Testing and Materials
IR	Inspection report
WNI	Western Nuclear, Inc.

PARTIAL LIST OF REFERENCES

NRC Inspection Manual Chapter 2620, "On-Site Construction Reviews of Remedial Action at Inactive Uranium Mill Tailings Sites", February 11, 1993.

NRC Inspection Manual Inspection Procedure 88001, "On-Site Construction", April 15, 1994.

NRC "Staff Technical Position on Testing and Inspection Plans During Construction of DOE's Remedial Action at Inactive Uranium Mill Tailings Sites", January 1989.

Attachment

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

June 30, 1998

Ms. Stephanie J. Baker, Manager of
Environmental Services
Western Nuclear, Inc.
Union Plaza Suite 300
200 Union Boulevard
Lakewood, Colorado 80228

SUBJECT: NRC INSPECTION REPORT 40-1162/98-01

Dear Ms. Baker:

On May 14, 1998, the NRC completed a team inspection at the site of your former Split Rock uranium milling facility. The final results of this inspection were presented to your organization during a telephone call held on June 19, 1998, following NRC analysis of 21 soil samples obtained during the inspection. The inspection disclosed that site activities appeared to be progressing in accordance with NRC regulations and license requirements. The enclosed report presents the results of that inspection.

Based on the results of this inspection, no violations or deviations were identified; therefore, no response to this letter is required.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact Mr. Robert Evans at (817) 860-8234 or Mr. Charles L. Cain at (817) 860-8186.

Sincerely,

Charles L. Cain

Charles L. Cain, Chief
Nuclear Materials Safety Branch - 1
Division of Nuclear Materials Safety

Docket No. 40-1162
License No. SUA-56

Enclosure:
NRC Inspection Report 40-1162/98-01

cc w/enclosure:
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Wyoming Radiation Control Program Director

ENCLOSURE

U. S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.	40-1162
License No.	SUA-56
Report No.	40-1162/98-01
Licensee:	Western Nuclear, Inc.
Facility:	Site of former Split Rock Mill
Location:	Jeffrey City, Wyoming
Dates:	May 11-14, 1998
Inspectors:	Robert J. Evans, P.E., Health Physicist Nuclear Materials Safety Branch 1 Division of Nuclear Materials Safety Region IV Michael C. Layton, Hydrogeologist Uranium Recovery Branch Division of Waste Management Office of Nuclear Material Safety and Safeguards
Accompanied by:	Robert D. Carlson, Project Manager Uranium Recovery Branch Division of Waste Management Office of Nuclear Material Safety and Safeguards
Approved By:	Charles L. Cain, Chief Nuclear Materials Licensing Branch Division of Nuclear Materials Safety Region IV
Attachments:	Supplemental Inspection Information Photographs Taken at the Split Rock Facility

EXECUTIVE SUMMARY

Site of Former Western Nuclear Split Rock Mill
NRC Inspection Report 40-1162/98-01

This inspection included a review of site status; management organization and controls; site operations; and the licensee's radiation protection, waste management and environmental monitoring programs. Special emphasis was placed on the licensee's recent remediation activities, including cleanup of ground water and windblown material. Also reviewed were the licensee's actions taken in response to a recent NRC Information Notice related to the Year 2000 computer issues.

Management Organization and Controls

- The licensee's organizational structure and level of security were consistent with previous inspections, and it appeared that adequate oversight had been provided for site activities (Section 2).

- All procedures required by the license had been developed, reviewed by the responsible parties, and were technically adequate for the tasks being performed (Section 2).

Operations Review

- Site activities appeared to have been conducted in accordance with the applicable license and regulatory requirements. Site fences were in good condition, and perimeter postings were appropriate (Section 3).

Radiation Protection

- The licensee had implemented a radiation protection program that met the requirements established in 10 CFR Part 20 and the license (Section 4).

- Occupational doses appeared consistent with the level of activity in progress at the site, and none exceeded 10 percent of the occupational exposure limits established in 10 CFR Part 20 (Section 4).

- The licensee's implementation of the radiological verification program was reviewed, and the licensee appeared to have performed surface reclamation activities in accordance with the conditions of the license. Soil samples were obtained to ascertain whether the licensee had performed cleanup of potentially contaminated windblown material in accordance with the limitations specified in 10 CFR Part 40, Appendix A. The NRC's laboratory results revealed that the samples were within the radium-226 limitations specified in Appendix A, suggesting that the licensee had adequately cleaned up the windblown material (Section 4).

Radioactive Waste Management/Environmental Protection

- A review of the licensee's environmental and ground water monitoring programs indicated that the licensee was appropriately controlling these activities and was in compliance with license requirements (Section 5).

- A review of the environmental monitoring program revealed that the licensee had collected and reported all samples required by the license. None of the sample results exceeded the regulatory limits specified in 10 CFR Part 20, Appendix B (Section 5).

- The ground water concentration limits established in the license to monitor cleanup for various constituents had been exceeded in samples obtained from three wells. The licensee was aware of this situation and had taken some corrective actions in response to the exceedances (Section 5).

Report Details

1 Site Status

Decommissioning activities began at Western Nuclear's Split Rock facility during 1988. Since that time, the licensee has demolished and buried the former mill structures and has performed extensive reclamation work on the tailings impoundment. Since the last inspection (conducted during May 1997), the licensee has installed the radon cover and erosion protection on tailings impoundment areas 1A, 1B, and portions of 2A. Installation of the final radon cover and erosion barrier has now been completed on the entire tailings impoundment and all diversion ditches. Also completed since the last inspection was the cleanup of contaminated windblown material. According to the licensee, the only onsite surface areas left to be remediated are the two evaporation ponds and the borrow area (the area where clean, uncontaminated soil was borrowed for other onsite uses).

Work in progress included ground water remediation. The licensee was operating two extraction wells which pumped ground water into two evaporation ponds. The pumps operated at a combined flowrate of 116 gallons per minute. To assist in the disposal of ground water, enhanced evaporation systems were in service in each of the two 8-acre evaporation ponds. The operation of the enhanced evaporation system was seasonal. The licensee secured the system during October 1997 but restarted the system during April 1998.

Activities planned for the near future included radon flux testing of the final 58 acres of the tailings impoundment, including portions of areas 1A, 1B, 2A, and the diversion ditches. The licensee also planned to reseed and recontour the topsoil in off-tailings areas such as the borrow area and to reclaim the "Cody Shale" pit, the offsite location where tailings impoundment radon barrier material was obtained.

2 Management Organization and Controls (88005)

2.1 Inspection Scope

The organizational structure was reviewed to ensure that the licensee had established an organization with defined responsibilities and functions. The inspectors also reviewed the licensee's implementation of procedures and analyses related to site reclamation as specified in the license to evaluate the effectiveness of the licensee's control of site activities.

2.2 Observations and Findings

The onsite staff consisted of five individuals, the resident agent/environmental specialist, the safety director/radiation safety officer, a mechanic, an electrician, and a receptionist. Contractors were used on an as-needed basis, including construction workers and site

surveyors. In summary, the licensee's onsite organizational structure was the same as the structure that was in place during the previous inspection.

As specified in License Condition 44, the licensee is required to establish written procedures for site reclamation activities, including personnel and environmental monitoring and survey instrument calibrations. The NRC inspectors noted that procedures had been developed and were technically adequate for the work being performed. License Condition 44 also states that the site radiation safety officer shall perform a documented review of all existing site procedures at least annually. A review of the licensee's procedure manual revealed that site procedures had been reviewed by the radiation safety officer during April 1997 and January 1998.

In accordance with the licensee's procedures, an inspection of the winter storage ponds was required to be performed on a routine basis. (The frequency of the inspection depended on the work in progress.) A review of the licensee's "Routine Evaporation Pond Inspection Log" and discussions with the licensee revealed that the licensee continued to perform the pond inspections on a routine basis.

2.3 Conclusions

The licensee's organizational structure was consistent with structures in place during previous inspections, and it appeared that adequate oversight had been provided for site activities. In general, the procedures that were required by the license had been developed and were technically adequate.

3 Operations Review (88020)

3.1 Inspection Scope

The NRC inspectors performed a site tour to verify that site activities were being conducted in accordance with applicable regulations and the conditions of the license, and to ensure that operational controls were adequate to protect the health and safety of the workers and members of the general public.

3.2 Observations and Findings

The inspectors observed offsite buildings, fences, gates, and operating equipment. Site fences were noted to be in good condition and were properly posted. Employee postings, required by 10 CFR 19, were identified in the licensee's main office. The inspectors noted that the tailings impoundment areas appeared to be adequately covered with erosion protection. No construction activities were in progress during the inspection.

Security was provided by locked access gates, and a fence was installed around the site property to keep intruders out. No permanent structures remained onsite, although several contractor trailers were stationed just outside of the restricted area. (The site

offices were moved to an offsite location prior to the May 1997 inspection.) In summary, the inspectors identified no health or safety hazard during the site tour.

3.3 Conclusions

Site activities generally appeared to have been conducted in accordance with applicable license and regulatory requirements. No health or safety concern was identified during the site tours.

4 Radiation Protection (83822)

4.1 Radiation Safety Program

a. Inspection Scope

The purpose of this portion of the inspection effort was to determine if the licensee's radiation safety program was in compliance with requirements established in the license and 10 CFR Part 20 regulations.

b. Observations and Findings

During 1997, the licensee monitored two site workers for exposure to radioactive materials. These two individuals were the workers most likely to receive an occupational dose during construction activities. The workers were the operators of a tailings impoundment compaction machine and a dirt scraper. According to the licensee's data, the two workers were assigned doses of 31 and 29 millirems for the year, primarily from internal exposures to radioactive materials. These assigned doses were down significantly from 1996, but were comparable with 1995 dose assessments.

All site workers were assigned an occupational dose of 30 millirems, the average dose of the two monitored workers. The exposures assigned to site workers for 1997 were well below the annual limit of 5000 millirems established in 10 CFR 20.1201. The licensee did not report these doses to site workers because the doses were well below 10 percent of the total effective dose equivalent limit established in the NRC regulations. Reporting is not required unless the doses exceed 10 percent of either the external or internal regulatory limits.

A review of the licensee's air sampling records was performed. The records indicated that during 1997 the licensee measured one airborne concentration of 4.30 E-13 microcuries per milliliter, which was 7 percent of the thorium-230 derived air concentration specified in Appendix B of 10 CFR Part 20. (The licensee used the derived air concentration value for thorium-230 instead of natural uranium because it was viewed as a more conservative value.) All other 1997 sample results were less than 7 percent of the thorium-230 limit.

Approximately 100 urine bioassay samples were collected during 1997. The number of bioassay samples collected during 1997 was down significantly from the previous year because of a reduction in onsite reclamation activities. (About 200 samples were collected during 1996.) One sample result exceeded the lowest action level of 15 micrograms per liter. This sample (19 micrograms of natural uranium per liter of urine) was an initial bioassay sample for a truck driver who previously worked for another NRC licensee prior to working at this site. Followup sampling revealed measurable amounts of uranium below the lowest action level. The initial sample result was inconclusive because the elevated sample may have been the result of an intake that occurred at another site or the result of medications being taken by that particular individual at the time of testing.

The release of equipment from the restricted area is governed by License Condition 41. The licensee's equipment release records were reviewed to ensure that no material had been inappropriately released from the site with residual radioactive contamination above the release limits. Construction equipment was released during July-August 1997. The licensee's records revealed that all equipment was released with removable contamination levels well below the action level of 1000 disintegrations per minute per 100 square centimeters. The licensee also maintained records of alpha radiation contamination checks of site employees. The licensee's records indicated that no individual was identified with contamination above the site action level.

License Condition 43 specifies various documents relating to the radiation protection program which must be maintained. The inspectors reviewed records relating to instrument calibrations, radiation work permits, personnel training, employee exposures, and equipment releases, and no oversights in documentation were noted. For example, License Condition 46 requires the licensee to develop quarterly reports of radiation protection-related activities. The quarterly reports for 1997 and 1998 were found to be satisfactory.

License Condition 42 states that a copy of the As Low As Reasonably Achievable (ALARA) report containing the results of the annual audit and recommendations by the ALARA committee shall be submitted to the NRC. The inspectors reviewed the licensee's annual ALARA report dated August 28, 1997. The report provided clear and concise discussions of the licensee's compliance with all license conditions.

License Condition 53 states that radiation detection instruments shall be calibrated after repair and as recommended by the manufacturer or at intervals not to exceed 6 months, whichever is sooner. A review of the licensee's calibration records revealed that equipment with up-to-date calibrations was available at the time of the inspection.

In summary, the licensee's radiation protection program was in compliance with the conditions of the license, and occupation exposures were small fractions of the total effective dose equivalent limit specified in the 10 CFR Part 20.

4.2 Radiological Verification Program

a. Inspection Scope

The purpose of this portion of the inspection effort was to review the licensee's implementation of the verification survey program associated with site remediation.

b. Observations and Findings

License Condition 33.A states that the cleanup of soil contamination will be verified in accordance with the Radiological Verification Program, a plan that was previously submitted to and approved by the NRC. The inspectors performed confirmatory sampling to ascertain whether the licensee had performed adequate remediation of the areas containing windblown radioactive materials. The confirmatory sampling included ambient gamma surveys and soil sampling. The gamma surveys were performed outside of the restricted area to locate "hot spots," areas with elevated ambient gamma readings. Soil samples were obtained from the areas identified with elevated gamma readings.

During the inspection, soil samples were obtained by the licensee at the request of the NRC from three different locations: 10 samples were obtained from inside of the area previously remediated or radiologically surveyed by the licensee for windblown materials, 5 samples were obtained from the areas surrounding the windblown cleanup area, and 4 samples were obtained from the licensee's sample archives. The samples were sent to the NRC Region III laboratory for analysis. At the request of the NRC laboratory, a background sample was obtained and submitted with the remainder of the soil samples.

The licensee utilized a slightly different approach for quality control of the soil sample results. Instead of using a third-party laboratory to perform confirmatory analyses on a certain number of samples (such as 5 percent of the samples), the licensee typically included a spiked blind sample with every 19 soil samples being sent to their contract laboratory. If the blind sample's results were within a predetermined range, then the licensee assumed that the results for the remaining 19 samples were acceptable. As a quality control check of the NRC's laboratory, a portion of the performance evaluation standard was randomly submitted with the 20 soil samples. The NRC's analysis result for this sample was within the predetermined range for the standard; therefore, the NRC inspectors concluded that the NRC's sample results were reliable.

Appendix A to 10 CFR Part 40, Criterion 6, lists the acceptance criteria for cleanup of windblown material. According to Criterion 6, the allowable concentration of radium-226 in land, averaged over 100 square meters, which, as a result of byproduct material, does not exceed the background level by more than 5 picocuries per gram (pCi/g) of radium-226 averaged over the first 15 centimeters (roughly 6 inches) below the surface and 15 pCi/g of radium-226 averaged over 15-centimeter thick layers more than 15 centimeters below the surface. The samples that were collected were samples obtained from the first 15 centimeters of soil, averaged over a 100 square meter grid.

With an NRC-approved background level of 1 pCi/g, the acceptance criteria for all soil samples obtained from the site was 6 pCi/g.

The soil sample results listed in the table below include the results of all samples except the four obtained from the licensee's archives. All samples results listed are for radium-226 in units of pCi/g:

SAMPLE ID	DESCRIPTION	LICENSEE'S SAMPLE RESULTS	NRC SAMPLE RESULTS
S6073123	Performance Evaluation Standard	4.75 - 9.30	5.85 ± 0.39
W3507617	Background sample		1.33 ± 0.16
C2217281	Inside windblown cleanup area		3.32 ± 0.26
C3106121	Inside windblown cleanup area	NOT	1.89 ± 0.22
E5310416	Inside windblown cleanup area	AVAILABLE	2.91 ± 0.24
E6672707	Inside windblown cleanup area	AT	2.06 ± 0.27
N1468497	Inside windblown cleanup area	TIME	4.75 ± 0.31
N1858898	Inside windblown cleanup area	OF	1.47 ± 0.33
S1260278	Inside windblown cleanup area	INSPECTION	1.61 ± 0.16
S3105111	Inside windblown cleanup area		5.29 ± 0.46
W1116127	Inside windblown cleanup area		3.93 ± 0.36
W3501611	Inside windblown cleanup area		3.25 ± 0.22
R1001004	Outside of windblown cleanup area		1.70 ± 0.17
R1005008	Outside of windblown cleanup area		2.39 ± 0.22
R1013016	Outside of windblown cleanup area		2.36 ± 0.29
R1009012	Outside of windblown cleanup area		2.33 ± 0.24
R1017020	Outside of windblown cleanup area		2.09 ± 0.31

The NRC's sample results indicate that no sample exceeded the acceptance criteria limit of 6 pCi/g, suggesting that the licensee has adequately remediated the site of all loose, windblown material.

The soil sample results were split with the licensee. The licensee's sample results were not available at the end of the inspection period; therefore, this subject area will be reviewed during a future NRC inspection (Inspection Followup Item 40-1162/9801-01).

As a quality control check of the licensee's previous laboratory results, the NRC inspectors obtained four randomly selected samples from the licensee's soil archives. (The licensee had roughly 3000 samples in storage.) The samples were analyzed by the NRC for their radium-226 content and were compared to the licensee's sample results previously published in their December 1997completion report. The results are as follows:

SAMPLE ID	NRC's SAMPLE RESULTS	LICENSEE's SAMPLE RESULTS
W1662715	3.85 ± 0.99 pCi/g	1.96 ± 0.113 pCi/g
C3402426	1.82 ± 0.26 pCi/g	2.03 ± 0.131 pCi/g
S2284309	1.25 ± 0.18 pCi/g	1.055 ± 0.099 pCi/g
E4747827	1.07 ± 0.20 pCi/g	1.097 ± 0.095 pCi/g

The NRC inspectors concluded that the sample results were acceptable because all sample results contained background, or near background, levels of radium-226, and none of the sample results exceeded the acceptance criteria limit of 6 pCi/g.

In summary, the sample results suggest that the licensee had adequately performed cleanup of the windblown material because none of the sample results exceeded the acceptance criteria limit specified in 10 CFR Part 40, Appendix A.

4.3 Conclusions

The licensee had implemented a radiation protection program that met requirements established in 10 CFR Part 20 and the conditions of the license. Occupational doses for site personnel during calendar year 1997 appeared consistent with the scope of work ongoing at the site, and occupational doses were only a small fraction of the dose limits established in 10 CFR Part 20.

The licensee's implementation of the radiological verification program was reviewed. The licensee appeared to have performed cleanup of the windblown material in such a manner as to be in compliance with the criteria specified in 10 CFR Part 40, Appendix A.

An Inspection Followup Item was issued to perform a correlation comparison of the licensee's soil sample results to the NRC's sample results. The licensee's soil sample results were not available at the end of the inspection period and will be reviewed during a future inspection.

5 Radioactive Waste Management (88035) Environmental Protection (88045)

5.1 Environmental Protection

a. Inspection Scope

The environmental monitoring program at the site was reviewed to assess the effectiveness of the licensee's program and to evaluate the effects, if any, of site reclamation activities on the local environment.

b. Observations and Findings

Environmental monitoring program requirements are identified in License Condition 24. At the time of the inspection, the environmental monitoring program in place at the site consisted of air particulate, radon, direct radiation, and surface water sampling. The licensee utilized two sample stations. One sample station was located at the northeastern corner of the site, while the second station was located offsite at the Graham Ranch. Continuous air samplers, radon canisters, and environmental thermoluminescent dosimeters were deployed at each of the two sample stations.

During the inspection, the inspectors reviewed the two semi-annual effluent reports and supporting data for 1997. Overall, the licensee's semi-annual reports were noted to be thorough and complete. All environmental monitoring samples required by the license had been obtained and were documented in the semi-annual effluent reports, with two exceptions. Surface water samples were no longer being taken from the tailings and acid plant cooling ponds because these two ponds no longer existed at the site.

Surface water samples were obtained on a quarterly basis at three locations from a local stream. The water samples were analyzed for a number of chemical constituents as well as radium-226, radium-228, thorium-230, and natural uranium. The radionuclide concentrations in the surface water samples were under 3 percent of the respective effluent concentration release limits established in 10 CFR Part 20, Appendix B.

Air samples were continuously collected at the two sample stations and analyzed for lead-210, radium-226, thorium-230, and natural uranium concentrations on a quarterly basis. The concentrations for all radionuclides were under 4 percent of the respective effluent concentration limits specified in Appendix B.

Radon samples were also continuously collected at the two sample stations. The samples were analyzed quarterly. The highest measured value (1.3 picocuries per liter) was obtained at the northeastern corner station during the fourth quarter of 1997. This value was 13 percent of the effluent concentration limit listed in 10 CFR Part 20, Appendix B, for radon-222 with daughters removed. All other sample results were less than 4 percent of the limit.

Ambient gamma radiation levels were measured using environmental thermoluminescent dosimeters. A total of 124 millirems was measured at the northeast perimeter sample station during 1997, while 84.8 millirems was measured at the background station (Graham Ranch) during the same time frame. The northeastern corner boundary location was therefore 39.2 millirems per year above the background location during 1997. The difference in ambient exposure rates between the two sample stations decreased during 1997 when compared to the 1995 (70 millirems) and 1996 (56 millirems) sample results.

An NRC inspector compared the 1997 results with the 1995 and 1996 sample results. The sample results for 1997 were either comparable to, or lower than, the 1995-1996 environmental monitoring sample results.

In response to the NRC's new constraint rule listed in 10 CFR 20.1101(d), the licensee performed a dose assessment for air particulate releases using the sum of fractions method. The licensee concluded that the airborne releases could have resulted in 3.4 millirems of exposure to an offsite individual. (The NRC inspectors noted that the nearest resident lived over one mile from the site.) Since the result was less than 10 millirems, the licensee was not required to formally report this assessment, or report any proposed corrective actions to reduce the releases, to the NRC. An NRC inspector reviewed the licensee's report and determined that the licensee's assessment was technically acceptable.

5.2 Ground water Monitoring Program

Ground water compliance monitoring program requirements are specified in License Condition 74.A, and the corrective action program monitoring requirements are specified in License Condition 74.C. Details of the sampling frequency and concentration limits are specified in the licensee's amendment request submittal dated April 18, 1997. During the inspection, an NRC inspector visually examined the physical condition of the majority of the monitoring wells in the licensee's monitoring network, examined the surface impoundments, reviewed the monitoring well sampling standard operating procedure, and reviewed the laboratory reports for the corrective action monitoring program.

a. Monitoring Well and Evaporation Impoundment Conditions

The inspector visually examined the physical condition of all monitoring wells listed in the license, with two exceptions. Each observed well was completed with a steel protective casing set in a concrete pad, labeled, and secured with a locking cover. Each of the well casings were fitted with a dedicated submersible pump for well purging and sampling, and an electrical connection for a portable generator was provided to supply pumping power. The inspector noted that the soil surrounding two monitoring wells within the site boundary had been removed during windblown cleanup to the degree that the concrete casings were fully exposed. However, the inspector determined that this condition did not adversely impact the performance of the monitoring wells.

Well WN-23 also exhibited complete exposure of the concrete well pad. The licensee stated that this condition was the result of frost heaving moving the concrete pad over a period of several years. The inspector visually verified that movement of the concrete pad and the protective casing had not caused a separation in the well casing. The inspector concluded that all wells examined were in good condition, with no irregularities that would adversely impact the monitoring well's performance.

The two evaporation pond impoundments used to dispose of water collected from the corrective action program were inspected. The inspector visually examined the berms of each impoundment and the access ports of the leak detection systems. No irregularities were noted. A system of spray misters situated along the sides of the impoundments were operating during the inspection.

Each impoundment is reported to be approximately eight acres in surface area, totaling sixteen acres of aerial coverage. The licensee indicated that the operating depth for each impoundment could potentially produce a capacity of 50 acre-feet for each impoundment. The inspector inquired whether all of the 50 acre-feet capacity was retained behind the berm or if a portion of the capacity was retained below grade. The licensee indicated that some capacity was below grade and that a calculation was being performed to assess this situation and determine whether the impoundments should be included in NRC's Dam Safety Program. The licensee stated that the results of this calculation would be forwarded to NRC Headquarters at a later date.

b. Standard Operating Procedure and Ground-Water Sampling

Ground-water sampling was not being performed during this inspection, but the inspector reviewed the written procedure for ground-water sampling and compared the information from the field sampling log sheets with the sampling procedure. The procedure was currently being revised to incorporate field filtration of the collected samples. (Samples are currently filtered by the laboratory before analysis.) The inspector reviewed the procedure and determined that it adequately addressed all aspects of water-level measurement, well purging, sample collection, sample handing, and chain-of-custody protocols. The inspector also reviewed field sampling records for the period covering the previous year and found no discrepancies in the records. The records showed the licensee was performing ground-water sampling in accordance with the established procedure.

c. Corrective Action Program

An inspector reviewed the results of laboratory analyses for the wells listed in License Condition 74 and the wells used to monitor the performance of the corrective action program, as required by License Condition 74.C and described in the licensee's submittal dated April 18, 1997. The records showed that for the second quarterly (June) sampling of 1997, monitoring Well WN-3 exceeded the established concentration limits for total dissolved solids (TDS) and sulfate (SO_4), while monitoring Well WN-24 exceeded the concentration limit for nitrate (NO_3) established in the April 18, 1997, submittal.

These wells continued to exceed the established limits for these and other indicator constituents in the subsequent quarterly samplings. Monitoring well WN-18 exceed the established concentration limits for chloride (Cl) in the third quarterly (August) sampling of 1997, and this well exceeded TDS, SO_4, NO_3, and Cl limits in the subsequent quarterly samplings.

The April 18, 1997, submittal requires resampling of a well that exceeds the indicator concentration limits within 10 days of receipt of the laboratory results. Resampling of Wells WN-3 and WN-24 were not initiated until after the third quarterly sampling results were received. Resampling of Well WN-18 was performed after the third quarterly sampling results were received. If the results of the resampling confirm the exceedance, then the sampling frequency for those wells would increase from quarterly to monthly. Monthly sampling of Wells WN-3, WN-18, and WN-24 was initiated after the exceedances were confirmed by the resampling during the third quarterly sampling period.

The licensee's records show that the licensee was not timely in initiating the confirmatory resampling and the monthly sampling schedule for Wells WN-3 and WN-24. The licensee was therefore cited with a Notice of Violation from NRC Headquarters by letter dated April 14, 1998, after an in-office review of sampling reports submitted by the licensee covering the period of the above described exceedances. The records show that the licensee was timely in resampling Well WN-18, which indicates that some internal corrective action measures had been initiated.

The April 18, 1997, submittal specifies that the licensee is to notify the NRC within 30 days if a monitoring well continues to exceed concentration limits for three consecutive monthly samplings and to provide a description of the appropriate contingency action. Monitoring Wells WN-3, WN-18, and WN-24 continued to exceed the established concentration limits for monthly samples taken in February, March, and April of 1998. The laboratory results for the April 1998 sampling episode had not been received by the licensee at the time of this inspection. The licensee received the results shortly after the inspection and submitted a written notification and contingency proposal to NRC Headquarters by letter dated May 20, 1998. This submittal fulfilled the requirement of License Condition 74.C, as detailed in the April 18, 1997, submittal.

5.3 Conclusions

A review of the licensee's environmental monitoring program indicated that the licensee was in compliance with the license requirements of the license and 10 CFR Part 20 and 10 CFR Part 40. The licensee had collected and reported all samples required by the license. None of the sample results exceeded the regulatory limits, and the 1997 sample results were comparable to or were below the 1995-1996 sample results.

A review of the ground water monitoring program was performed and areas found acceptable included the physical condition of the wells and evaporation pond integrity. The ground water concentration limits established in the license to monitor cleanup for

various constituents had been exceeded in samples obtained from three wells. The licensee was aware of this situation and had taken some corrective actions.

6 Followup (92701)

6.1 NRC Information Notice 96-70: Year 2000 Effect on Computer System Software

This Notice was issued to alert licensees of the potential problems that may occur with their computer systems and associated software as a result of the upcoming change to the new century. During this inspection, the licensee's actions taken in response to this issue were reviewed.

The NRC inspector noted that the licensee had a copy of the Notice and were aware of the potential problem. The licensee stated that their corporate office was aware of the problem and was taking actions on a corporate-wide level. The licensee also stated that there were no critical computer programs or computer uses at the site that are expected to still be in service at year 2000. In summary, no short term changes are planned because of the year 2000 issue, and the licensee expects there will be no critical computer uses at the site when the year 2000 occurs.

7 Exit Meeting Summary

The inspector presented the inspection results to the representatives of the licensee at the conclusion of the inspection on May 14, 1998. Licensee representatives acknowledged the findings as presented. A telephonic exit briefing was held with the licensee on June 19, 1998, to provide the licensee with a summary of the NRC's soil sample results. The licensee did not identify any material reviewed by the NRC inspectors as proprietary.

ATTACHMENT 1

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

S. Baker, Manager of Environmental Services
L. Fiske, Civil Engineer/Radiation Specialist, Shepherd Miller, Inc.
J. Gearhart, Resident Agent/Environmental Engineer
T. Herrera, Safety Director/Radiation Safety Officer
L. Miller, Vice President, Shepherd Miller, Inc.

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

40-1162/9801-01	IFI	Comparison of licensee's soil sample results to NRC's sample results. The licensee's results were not available at end of inspection period.

Closed

None

Discussed

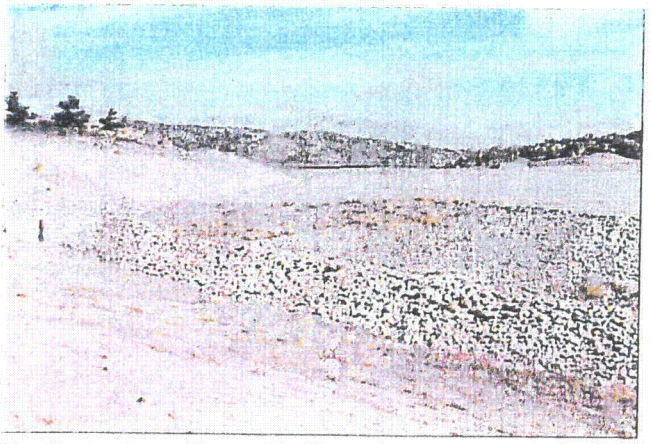
None

LIST OF ACRONYMS

ALARA	as low as reasonably achievable
IFI	inspection followup item
pCi/g	picocuries per gram
TDS	total dissolved solids

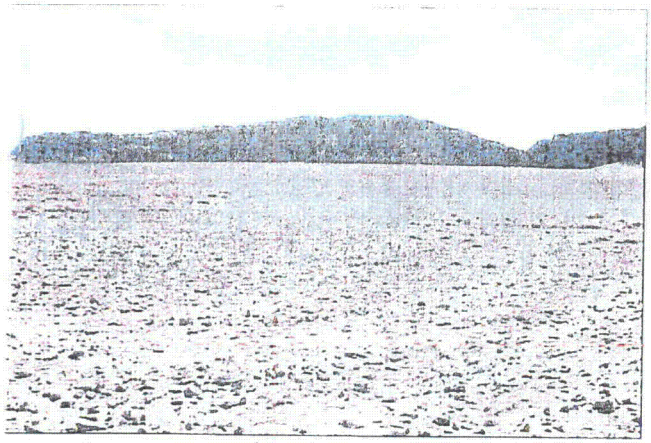
ATTACHMENT 2

WESTERN NUCLEAR, INC.'s SPLIT ROCK MILL SITE

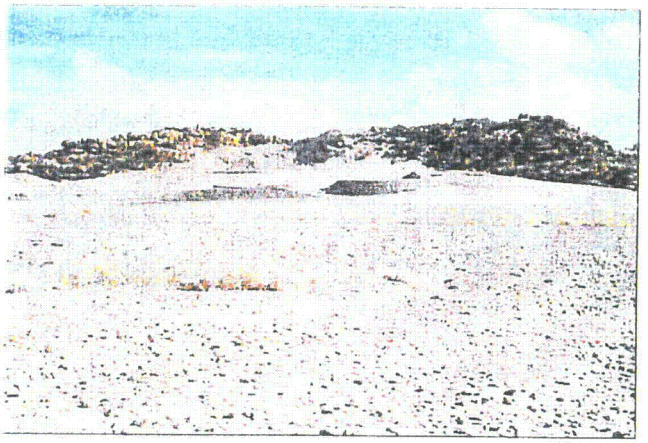


Northwest section of tailings impoundment and north-central diversion ditch.

North-central diversion ditch with rip-rap.



Top of tailings impoundment area reclaimed during 1994-1996.



Rock stockpile area exempted from radiological cleanup.

Top of tailings impoundment area reclaimed during 1997.

Vegetation on top of tailings impoundment area reclaimed during 1996.

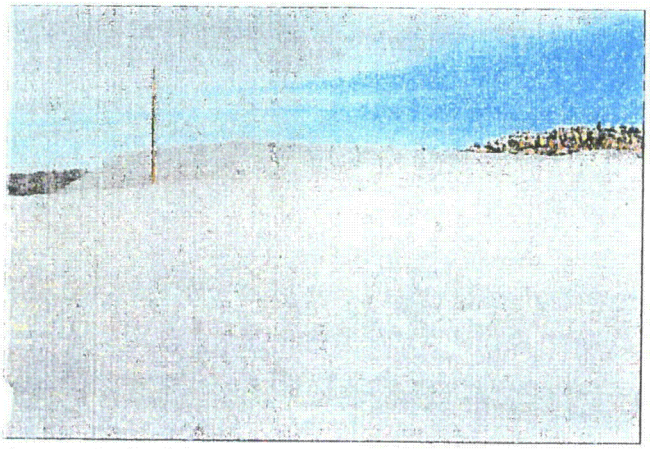
WESTERN NUCLEAR, INC.'s SPLIT ROCK MILL SITE

South diversion ditch with varying rip-rap gradations.

Northeast section of tailings impoundment.

Southwest section of tailings impoundment and south diversion ditch with 18-inch rip-rap.

Confluence of north diversion ditch and drainage swale on top of tailings impoundment.



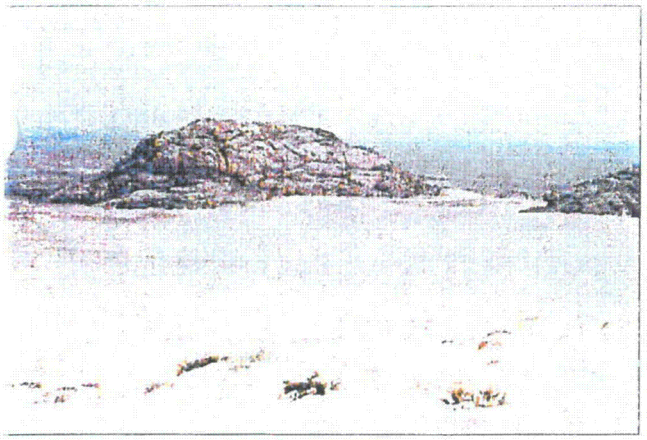
Area of windblown cleanup (foreground) and rock exempted from cleanup (background).

Area of windblown cleanup near northeast environmental monitoring station.

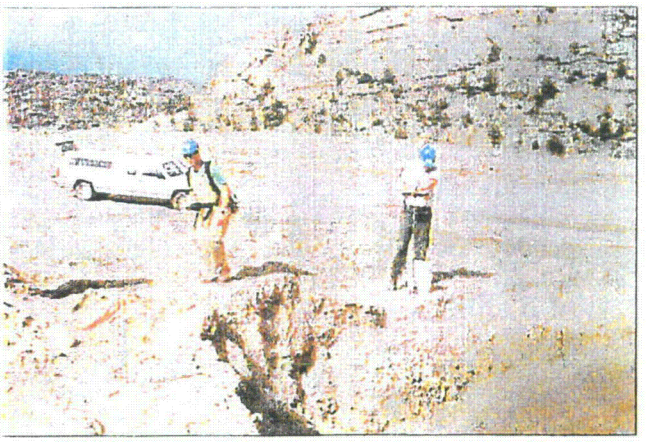
WESTERN NUCLEAR, INC.'s SPLIT ROCK MILL SITE

Tailings impoundment areas reclaimed during 1997 (foreground) and 1996 (background).

Front side of North Dune area exempted from radiological cleanup.

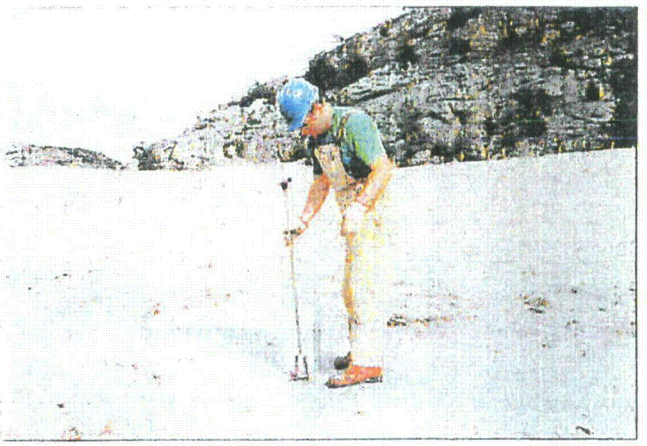


Windblown cleanup performed in Northeast Valley area.



Licensee personnel performing gamma survey and soil sampling in NRC-selected grid.

Gamma scanning and soil sampling by licensee personnel.



Soil sampling in progress by licensee personnel.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

July 27, 1998

Ms. Stephanie J. Baker, Manager of
Environmental Services
Western Nuclear, Inc.
Union Plaza Suite 300
200 Union Boulevard
Lakewood, Colorado 80228

SUBJECT: NRC INSPECTION REPORT 40-1162/98-01

Dear Ms. Baker:

On May 14, 1998, the NRC completed a team inspection at the site of your former Split Rock uranium milling facility. During the inspection, soil samples were collected from the site. The samples were split with your organization. The NRC analyzed the soil samples and published the sample results in NRC Inspection Report 40-1162/98-01 dated June 30, 1998. When this NRC inspection report was issued, your soil sample results were not available; therefore, this subject area was considered an NRC Inspection Followup Item (IFI 40-1162/9801-01) pending completion of your sample analyses and our review of your sample results.

By facsimile dated July 20, 1998, we received your soil sample results. Those results, as well as the NRC's results, are included in the enclosure to this letter. In summary, none of the sample results exceeded the acceptance criteria limit of 6 picocuries of radium-226 per gram of soil, suggesting that you have adequately remediated the site of all loose, windblown material. Furthermore, this IFI is considered closed since the activity specified in the inspection report has been completed. Since no additional questions or concerns were identified during the review of your data, no response to this letter is required.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this letter, please contact Mr. Robert Evans at (817) 860-8234 or Mr. D. Blair Spitzberg at (817) 860-8191.

Sincerely,

D. Blair Spitzberg, Ph.D., Chief
Fuel Cycle and Decommissioning Branch
Division of Nuclear Materials Safety

Docket No.: 40-1162
License No.: SUA-56

Enclosure:
Soil Sample Results

cc w/enclosure:
Resident Agent
Western Nuclear, Inc.
P.O. Box 630
Jeffrey City, Wyoming 82310

Mr. Christopher D. Lidstone
Lidstone & Anderson
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Mr. David Finley
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Solid and Hazardous Waste Division
122 W. 25th Street
Cheyenne, Wyoming 82002

Mr. Mark Moxley, District II Supervisor
Land Quality Division
Wyoming Department of Environmental Quality
250 Lincoln Street
Lander, Wyoming 82520

Mr. Russel W. Edge, Project Manager
U.S. Department of Energy
Grand Junction Project Office
2597 B 3/4 Road
Grand Junction, Colorado 81503

Mr. Pat Mackin, Assistant Director
Systems Engineering & Integration
Center for Nuclear Waste Regulatory Analyses
6220 Culebra Road
San Antonio, Texas 78238-5166

Wyoming Radiation Control Program Director

ENCLOSURE

Soil Sample Results

Appendix A to 10 CFR Part 40, Criterion 6, lists the acceptance criteria for cleanup of windblown material. According to Criterion 6, the allowable concentration of radium-226 in land, averaged over 100 square meters, should not exceed the background level by more than 5 picocuries per gram (pCi/g) of radium-226 averaged over the first 15 centimeters (roughly 6 inches) below the surface. The samples were obtained from the first 15 centimeters of soil, and the samples were averaged from multiple samples obtained over 100 square meter grids. With an NRC-approved background level of 1 pCi/g, the acceptance criteria for all soil samples obtained from the site was 6 pCi/g. The soil sample results listed in the table below are for radium-226 in units of pCi/g:

SAMPLE ID	DESCRIPTION	LICENSEE'S SAMPLE RESULTS	NRC SAMPLE RESULTS
C2217281	Inside windblown cleanup area	3.32 ± 0.14	3.32 ± 0.26
C3106121	Inside windblown cleanup area	1.57 ± 0.11	1.89 ± 0.22
E5310416	Inside windblown cleanup area	2.49 ± 0.11	2.91 ± 0.24
E6672707	Inside windblown cleanup area	1.70 ± 0.10	2.06 ± 0.27
N1468497	Inside windblown cleanup area	4.15 ± 0.13	4.75 ± 0.31
N1858898	Inside windblown cleanup area	1.16 ± 0.09	1.47 ± 0.33
S1260278	Inside windblown cleanup area	1.34 ± 0.11	1.61 ± 0.16
S3105111	Inside windblown cleanup area	3.57 ± 0.12	5.29 ± 0.46
W1116127	Inside windblown cleanup area	3.39 ± 0.13	3.93 ± 0.36
W3501611	Inside windblown cleanup area	3.11 ± 0.15	3.25 ± 0.22
R1001004	Outside of windblown cleanup area	1.36 ± 0.09	1.70 ± 0.17
R1005008	Outside of windblown cleanup area	2.21 ± 0.10	2.39 ± 0.22
R1013016	Outside of windblown cleanup area	1.84 ± 0.09	2.36 ± 0.29
R1009012	Outside of windblown cleanup area	2.99 ± 0.15	2.33 ± 0.24
R1017020	Outside of windblown cleanup area	2.11 ± 0.09	2.09 ± 0.31

In summary, none of the sample results exceeded the acceptance criteria limit of 6 pCi/g.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 12, 1998

Ms. Stephanie J. Baker, Manager
of Environmental Services
Western Nuclear, Inc.
Union Plaza Suite 300
200 Union Boulevard
Lakewood, CO 80228

SUBJECT: SITE VISIT TO SPLIT ROCK, WYOMING ON AUGUST 17, 1998

Dear Ms. Baker:

During a site visit to Western Nuclear Inc.'s (WNI's) Split Rock site near Jeffrey City, Wyoming, on August 17, 1998, U.S. Nuclear Regulatory Commission (NRC) staff observed that considerable erosion damage and sedimentation has occurred in the North Diversion Channel (NDC). Based on these observations, it appears that the design of the channel may not be adequate to meet the requirements of 10 CFR Part 40, Appendix A. Specifically, it is not clear that the current design of the channel is sufficient to provide adequate protection for control of tailings for a period of 200 -1000 years.

The NRC staff recognizes the design of WNI's NDC was previously approved by NRC. In general, the NRC staff has determined reclamation work, performed in conformance with plans approved by the NRC, also meets the requirement of the Uranium Mill Tailings Remediation Control Act (UMTRCA), whereby all applicable standards and requirements must be met at license termination. Furthermore, the Commission has directed the NRC staff to not revisit previously-approved reclamation plans unless certain conditions are identified. Consistent with this direction, the NRC staff does not plan on revisiting any approved reclamation design unless: 1) the NRC staff identifies a significant health, safety, or environmental concern with a particular site; 2) the NRC staff determines there is a need to reevaluate the seismic aspects of a design; or 3) a licensee requests that the ongoing review proceed. At the time of license termination, the NRC staff will simply confirm that reclamation of the tailings was performed consistent with the approved plan by reviewing the construction report for the site. Any sites that have degraded before their transfer to the long-term custodian will be required to be repaired, and the licensee will be required to justify that the design meets 10 CFR Part 40 requirements in light of the observed degradation.

For the Split Rock site, significant degradation and damage has occurred to the NDC since its recent construction. Based on these observed problems, it is the NRC staff's position that repair, reconstruction, and/or redesign of the deficiencies be performed by WNI before the site is transferred to the long-term custodian. Furthermore, the adequacy of the NDC design must be shown to meet the requirements of 10 Part CFR 40, Appendix A.

NRC staff observations have indicated that there are actually two distinct problems with the NDC. First, upgradient slopes are relatively steep, and a significant amount of sediment has accumulated in the channel in a very short period of time. This suggests the channel could become completely blocked by sediment rather quickly and that flood runoff could be directed over the top of the tailings pile, rather than flowing in the diversion channel. Second, due to the

formation of upgradient gullies, the riprap placed on the side slopes of the channel has been significantly damaged by concentrated flows in these gullies occurring directly down the channel side slopes. This indicates that the rock is not large enough to resist such flow capacities.

However, there may be several options available to WNI to resolve these issues:

(1) WNI could redesign the NDC to flush or store expected sediments that will be transported in the next 1000 years and redesign the erosion protection features to resist concentrated inflows into the channel. Such design improvements could include widening or deepening the channel, increasing the slope of the channel to encourage sediment scouring, and/or increasing the size of the riprap on the side slopes.

(2) WNI could redesign the NDC such that complete blockage of the channel and failure of the erosion protection features would not cause a significant problem. Such a design improvement could include an apron of large rock placed on the top of the tailings pile to dissipate the forces associated with concentrated flows passing over or around the blocked channel and impinging directly on the top slope of the tailings.

(3) WNI could provide additional analyses to justify the current channel design is adequate, even in light of the observed damage and degradation. In part, such analyses would have to document that tailings will not be eroded and the tailings cover and radon barrier will not be damaged. Additionally, these analyses would need to show how the current channel is capable of withstanding erosive forces and/or is capable of storing or flushing sediments that would be transported during the next 1000 years, to the extent reasonably achievable, and in any case, for at least 200 years.

(4) WNI could propose that active maintenance be used to restore channel functioning on a periodic basis. The amount of funds required would be a function of the annual maintenance costs. The maintenance costs would be based on the amount of sediment needed to be removed annually and the costs of periodic repair of important design features. Use of this option would be considered an alternative to meeting the requirements of 10 CFR Part 40, Appendix A. As such, WNI would need to provide additional information indicating the economics of their situation justify such an approach, and that equivalent protection of public health and safety is achieved.

WNI may also propose an alternative option; but regardless of the option(s) proposed, WNI should provide design details, analyses, and detailed calculations to support its proposal. The NRC staff will then conduct further reviews to determine their acceptability. It is important to note the design must be stable for a 1000-year period unless it can be justified that designing for 1000 years is not reasonably achievable. If it can be demonstrated that a 1000-year design is not practicable (e.g., due to excessive costs), a shorter design period may be chosen. In no case, however, can the stability period be less than 200 years. Some guidance is available in the NRC Final Staff Technical Position, "Design of Erosion Protection Covers For Stabilization of Uranium Mill Tailings Sites," to justify in a step-by-step manner if a 1000-year design period is not reasonably achievable.

In addition, during the August 17th site visit, WNI personnel requested that the NRC staff observe other diversion channels, and accompanied the NRC staff during those observations. The staff was shown various site locations and portions of different diversion channels that had received fluvial and/or wind-blown sediments. At the time it was not obvious that serious degradation had occurred to these channels, or if the original design of the channels considered the possibility of sedimentation. Because the sediment quantities appeared to be minimal, the staff was not able to identify any specific locations where degradation had definitely occurred, or where there was a problem with erosion or channel capacity. However, because these channels have received sediment deposition over a short interval since their construction and there may be potential for significant sediment accumulation over a longer period of time, the NRC staff is concerned that channel flow capacities may be reduced beyond those anticipated in WNI's original design. Therefore, WNI should provide additional information and analyses to support the adequacy of its design for any diversion channel that has received noticeable amounts of fluvial or wind-blown sediments. If WNI is unable to show that the current designs of the other diversion channels meet 10 CFR Part 40 requirements, alternatives may be proposed as discussed above.

The aforementioned analyses should be provided as soon as possible to expedite a timely review of this issue by the NRC staff. If you have any questions concerning this subject, please contact Mr. Robert Carlson of my staff at (301) 415-8165.

Sincerely,

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

APPENDIX Y

TECHNICAL SPECIFICATIONS, TABLES, AND FIGURES FROM THE NRC APPROVED (2/94) TAILING RECLEMATION PLAN

Report

Western Nuclear, Inc. Split Rock Mill Addendum A (February 7, 1994) to Revision No. 5 to the June 30, 1987 Uranium Tailings Reclamation Plan

SMI
Shepherd Miller, Inc.

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS FOR RECLAMATION OF URANIUM TAILING DISPOSAL AREA WESTERN NUCLEAR, INC. SPLIT ROCK MILL SITE JEFFREY CITY, WYOMING

1.0 GENERAL PROJECT REQUIREMENTS

1.1 General Description of Work

The work covered by these Specifications consists of reclamation construction activities for the tailing disposal area at Western Nuclear Inc.'s (hereinafter referred to as "Owner") former uranium milling facility located approximately two miles north of Jeffrey City, Wyoming. All work performed shall be in accordance with these Specifications and the Reclamation Plan Drawings attached. In the event of discrepancies, or if any aspect of the work is questionable, the Contractor shall be solely responsible for requesting clarification from the Owner. Work shall be conducted in basic accordance with the schedule provided by the Owner. The work will be considered as having been completed upon inspection and written approval by the Owner.

Work by the Contractor shall be conducted in compliance with the Health and Safety Plan identified herein. The materials and products used shall be as specified herein for the services intended. Products or materials may be substituted only with the written consent of the Owner.

The methods used shall produce satisfactory work for the services intended and shall be in accordance with standard construction industry practices.

1.2 Reclamation Work Items

Reclamation shall be conducted to stabilize the tailing area, to prevent further migration of tailing by either wind or surface water runoff, and to reduce infiltration of precipitation through the tailing. Work categories which will be required during reclamation are as follows:

Work Category	Specifications Section
Clearing and Grubbing	2.0
Excavation	3.0
Final Reclamation Cover Placement	4.0
Erosion Protection Placement	5.0
Revegetation	6.0
Quality Control	7.0
Health and Safety	8.0

A general description of the proposed activities is provided below. Detailed descriptions of the seven specific work categories listed above are provided in the subsequent sections of these specifications.

- Windblown tailing shall be excavated as described in these Specifications. Affected soils as defined in these Specifications shall be excavated and placed according to the criteria described in these Specifications.

- Surface water diversion ditches shall be excavated in native soil or tailing to the dimensions described in these Specifications, and as shown on the Reclamation Plan Drawings. Tailing excavated from diversion ditches shall be placed within the tailing impoundment. Excavated native soils

meeting the requirements of these Specifications shall be used as either borrow for the reclamation soil cover or as clean fill to meet the subgrade, if necessary. Riprap and filter material shall be placed in the diversion ditches and in the tailing swale to provide erosional stability for these structures.

- A final reclamation cover will be placed over either the existing interim cover or over the fill required to meet the desired subgrade. The final reclamation cover will consist of the following:

  1. A radon barrier layer with varying thickness from 6 inches to 44 inches, placed over subgrade material (i.e., tailing, clean fill, or interim soil cover).

  2. A 8-inch to 12-inch thick borrow soil layer placed over the radon barrier layer. This soil layer shall be between 8 to 12 inches thick.

  3. Each component of the reclamation cover will be placed, moistened, and compacted in accordance with the specific requirement for each layer as described in these Specifications.

- A six-inch thick erosion protection layer consisting of a soil/rock matrix shall be placed over the borrow soil layer to provide erosional stability for the reclamation cover system. In addition, a 14-inch thick erosion protection layer consisting of a soil/rock matrix shall be placed over the areas oustide of the south diversion channel as shown in Figure 5.

- Reclamation shall be completed by revegetating all soil borrow areas disturbed by the reclamation efforts.

- All on-site workers shall be required to comply with the Health and Safety Plan included as part of these Specifications. These requirements include use of on-site health and safety protection and monitoring equipment, and radiological surveying and decontamination of all equipment or materials leaving the site.

1.3 Sanitary Facilities

A potable water supply and suitable sanitary facilities shall be provided and maintained on the construction site at all times. These facilities shall be subject to approval by the county and state health departments.

1.4 Reclamation Plan Drawings

The Reclamation Plan Drawings accompany and form a part of the Specifications. The location, extent, and general character of the work is shown on the Reclamation Plan Drawings and is described within these Specifications. The work shall be executed in accordance with these Reclamation Plan Drawings and such additional or supplemental drawings as may be developed periodically by the Owner.

1.5 As-Built Reclamation Plan Drawings

As-built Reclamation Plan Drawings will be produced after the construction work is complete. **(Note: As built Reclamation Plan Drawings will be submitted to the NRC within 6 months of final completion of all surface tailing reclamation work).**

1.6 State, Local, and Environmental Laws and Permits

The work will comply with all federal, state, and local laws. All appropriate permits and licenses will be obtained.

1.7 Archaeological Considerations

Should Contractor find or uncover any significant archaeological or anthropological artifact within the Work area, Contractor shall notify Owner immediately. All cultural features will be evaluated for cultural significance by Owner and shall be protected. Owner may decide to temporarily stop Work until matters are resolved and clearance is obtained from the regulatory agencies.

Specifically, all equipment operators or any other parties who may have reason to excavate materials from any borrow area will be instructed to stop all excavation activities in that area should any of the following cultural features be observed:

- Black soil stains or rings
- Artifacts including arrowheads
- Any other archaeological or anthropological artifact that Owner deems significant

Provisions for this training will be made in Radiation Work Permits. **(Note: Owner shall excavate in borrow areas in accordance with provisions of correspondence dated March 30, 1992, previously approved by NRC).**

1.8 Construction Water

River water, if granted by the State, or water from an on-site well may be used.

1.9 Codes and Standards

Work described herein shall be conducted in accordance with industry standards including, but not limited to, the most current designation of the codes and standards designated herein. Wherever the following abbreviations are used in these Specifications or on the plans, they shall be construed the same as the respective expressions represented:

1. ASTM, "American Society for Testing of Materials."

2. ASTM D 698, "Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5-lb. (2.49-kg) Hammer and 12-in (305-mm) Drop."

3. ASTM D 422, "Method for Particle-Size Analysis of Soils."

4. D 1140-54 (1971), "Amount of Material in Soils Finer than the No. 200 (75 um) Sieve."

5. D 2922-81, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)."

6. D 1556-82, "Density of Soil In Place by the Sand-Cone Method."

7. D 3017-88, "Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)."

8. D 4643-87, "Water (Moisture) Content of Soil by the Microwave Oven Method, Determining."

1.9.1 Health and Safety

All work shall be conducted in accordance with the Health and Safety Plan included as part of these Specifications.

1.10 Submittals

1.10.1 Permits

If required by federal, state, or local ordinances, permits will be obtained prior to the commencement of the permitted activity including, but not limited to, the following:

1. Fugitive Dust,
2. Surface Water Control,
3. Burning,
4. Road Use,
5. General Construction,
6. Off-site Materials Disposal, and
7. Construction Water.

1.10.2 Products

Before use, appropriate documentation for all products used in construction shall be obtained, stating and supplying supporting data that the products meet or exceed the specified requirements given for each product. The products requiring submittals to the Owner prior to use are presented below:

1. Riprap,
2. Filter Material,

3. Radon Barrier Layer Material
4. Seed Mixture,
5. Fertilizer, and
6. Mulch.

1.11 Definitions

As used in these Specifications, the following terms are detailed as follows:

Affected Soil - Affected soil is any soil at depth in the borrow areas exhibiting a gamma radiation survey value greater than 18 μR/hr in areas not affected by shine and greater than 30 μR/hr in areas affected by shine (i.e. within approximately 50 feet of either granite or exposed tailing). Affected soil shall be handled as tailing material and placed within the tailing impoundment beneath the radon barrier layer or in a stockpile for subsequent appropriate disposal.

Affected soil shall be identified during each construction season using an external gamma radiation survey conducted in each borrow area as specified in Section 7.0.

Diversion Ditch - Perimeter ditches constructed around the regraded tailing that intercept water flowing toward the reclaimed area, that collect water flowing from the reclaimed area, and that convey runoff off-site.

Erosion Apron - Area at the outlet of a diversion ditch designed to decrease the depth of flow and flow velocity, and to prevent headcutting at the interface of the diversion ditch and natural soils.

Filter Layer - Sized angular granite obtained from an approved rock borrow area to be placed beneath riprap in the diversion ditches, the tailing swale, and the erosion aprons.

Final Reclamation Cover - The soil cover system that is placed over the existing surface that consists of a radon barrier layer and a borrow soil layer.

Radon Barrier Layer - The radon barrier layer shall consist of material from the designated borrow area which is located approximately 7 miles south of the site. The material shall have at least 90 % passing the number 200 sieve. The radon barrier layer is referred to as "imported clay", "Cody Shale", "Cody Shale Radon Barrier" and other similar terms in the supporting appendices, specifically Appendix G.

Reclamation Areas - The areas comprising the mill tailing and former mill area are divided into 8 different areas. These areas will receive different radon barrier layer thicknesses because of the different source term associated with each area. The limits of these areas are shown on Figure 4 of the Reclamation Plan Drawings.

Area 1A — The eastern portion of the new tailing impoundment is designated as Area 1A. This area covers approximately 81 acres.

Area 1B — The western portion of the new tailing impoundment is designated as Area 1B. This area covers approximately 47 acres

Area 1C — The old tailing impoundment is designated as Area 1C. This area covers approximately 24 acres.

Area 2A — The alternate tailing area is designated as Area 2A. This area covers approximately 39 acres.

Area 2B — The southern portion of the old tailing impoundment and the low level radioactive waste burial area is designated as Area 2B. This area covers approximately 6 acres.

Area 2C — The winter storage pond area is designated as Area 2C. This area covers approximately 19 acres.

Area 3A — The former mill area that contains imported tailing is designated as Area 3A. This area covers approximately 43 acres.

Area 3B — The former mill area that did not receive imported tailing is designated as Area 3B. This area covers approximately 8 acres.

Riprap - Sized angular granite obtained from an approved rock borrow area to use as erosion protection in diversion ditches, the tailing swale, and erosion aprons.

Rock - Rock shall consist of all earth materials harder than soil that must be excavated by ripping with a D-9 Caterpillar bulldozer, or equivalent, equipped with a single shank ripper, hammering, or blasting. Rock exhibits a natural background external gamma radiation value in excess of 35 μR/hr.

Soil - Soil consists of all earth materials capable of being excavated with conventional earthwork excavation equipment without the use of hammers, or blasting, as may be required for rock. Soil shall be free from freshly redeposited windblown tailing materials, affected soil, debris, branches, and stumps.

Soils that are considered acceptable to use as borrow soil cover material shall meet the following criteria:

1. Soil shall not contain windblown tailing or affected soil.

2. No more than 10 percent of the soil volume shall contain particles larger than 6 inches.

Soil/Rock Matrix - A layer consisting of sized angular granite with interbedded and overlying acceptable soil obtained from approved soil and rock borrow areas to use as erosion protection for the final reclamation cover.

Tailing - Tailing consist of milled ore materials that are a by-product of the extraction of uranium. The tailing are low level radioactive wastes that were hydraulically discharged during past milling operations to the tailing disposal area identified on the Reclamation Plan Drawings.

Tailing Swale - Channel that collects water from the regraded top of the tailing impoundment and that conveys the runoff to the North Diversion Ditch.

Windblown Tailing - Windblown tailing consist of tailing that have been transported by wind. Windblown tailing generate an external gamma radiation value greater than 18 μR/hr in areas not affected by shine and greater than 30 μR/hr in areas affected by shine (i.e. within approximately 50 feet of granite outcrops or exposed tailing). Windblown tailing shall be placed beneath the radon barrier layer of the final reclamation cover.

Windblown tailing shall be identified before each construction season using an external gamma radiation survey conducted in each borrow area as specified in Section 7.0.

2.0 CLEARING AND GRUBBING

2.1 General

2.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with clearing and grubbing in accordance with the Reclamation Plan Drawings and these Specifications.

2.1.2 Related Work

Section 1.0 - General Project Requirements
Section 6.0 - Revegetation
Section 8.0 - Health and Safety

2.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

2.1.4 Products

Not applicable.

2.2 Execution

As necessary, limited clearing and grubbing shall be conducted primarily within the approximate limits of the Southwest Valley and Northwest Valley soil borrow areas, shown on Figure 3 of 10 of the Reclamation Plan Drawings. Clearing and grubbing

shall also be conducted to a minimum distance of 20 feet outside the limits to be disturbed by construction activities. The work shall provide for completely removing all brush and trees on the surface and all major root systems beneath the surface. Where feasible all uncontaminated vegetative debris shall be placed in a stockpile for reuse in revegetation. All fill and reclamation cover materials shall be reasonably free of vegetative debris.

After removing trees and shrubs, uncontaminated topsoil containing roots, grasses, and forbes shall be stripped to the topsoil depth available or to a minimum depth of 6 inches. This material shall be stockpiled and used as seed bed material for the areas to be revegetated. Additional material may be stripped and stockpiled, as determined by the Owner, for use as seed bed material.

3.0 EXCAVATION

3.1 General

3.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with natural soils, affected soil, wind blown tailing and tailing excavation in accordance with the Reclamation Plan Drawings and these Specifications.

The work described in this section is intended to achieve the desired configuration, to reduce radon gas emanation, to reduce surface water erosion of tailing, and to reduce precipitation infiltration before placing the final reclamation cover.

Work shall include, but not be limited to, the following activities, as described in these Specifications and shown on the Reclamation Plan Drawings:

1. Excavating tailing material to:

    - Construct the remaining unbuilt section of the tailing swale in Area 3A.

    - Achieve desired configuration, where necessary.

2. Excavating windblown tailing and affected soils, where present, and placing within the tailing impoundment beneath the radon barrier layer or in a stockpile for subsequent appropriate disposal.

3. Excavating tailing or native soil to construct surface water diversion ditches. The excavated tailing shall be placed within the tailing impoundment to meet the subgrade requirements beneath the final reclamation cover. Excavated native soils meeting the requirements in these Specifications shall be used for the borrow soil layer in the reclamation cover system, as soil for the soil/rock matrix layer or for clean fill to meet the subgrade beneath the reclamation cover, if necessary. A summary of the diversion ditch design is presented on Table 1.

4. Placing soil fill material to achieve desired configuration before placing the radon barrier layer.

5. Conducting the required testing to comply with the requirements of the Reclamation plan Drawings and these Specifications.

The Owner shall designate, by staking, all areas subjected to earthwork operations identified herein. The Owner will be responsible for providing all surveying necessary to conduct earthwork to the configuration specified.

3.1.2 Related Work

Section 1.0 - General Project Requirements
Section 2.0 - Clearing and Grubbing
Section 4.0 - Final Soil Cover Placement
Section 5.0 - Erosion Protection Placement
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

3.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

3.1.4 Products

Not applicable.

3.2 Execution

3.2.1 General

The Reclamation Plan Drawings, Figures 4 and 5, indicate the location of settlement platforms, the extent of the soil cover (i.e., area to be reclaimed), the location of soil borrow areas, the location of diversion ditches and the tailing swale, and the final reclaimed contours (i.e., top of erosion protection layer).

In soil borrow areas to be disturbed, excavation and grading operations shall begin by clearing and grubbing the work area. **(Note: Owner shall excavate in borrow areas in accordance with provisions of correspondence dated March 30, 1992, previously approved by NRC).**

All work shall be conducted in a manner that minimizes surface water runoff into tailing disposal areas and construction or fill areas. Surface water runoff from exposed tailing surfaces, if any, shall be collected and pumped to areas within the tailing and shall not be allowed to flow outside the tailing disposal area.

The Contractor shall also use adequate water from a source designated by the Owner for dust suppression on haul/access roads and for all grading and compaction work.

All work shall be conducted in strict accordance with the Health and Safety Plan included as part of these Specifications. These requirements include worker protective equipment, and environmental monitoring during, but not limited to, all earth moving and regrading activities.

3.2.2 Tailing Material Excavation and/or Regrading

All tailing have been regraded and embankments have been recontoured to achieve slopes equal to or less than 5H:1V.

3.2.3 Windblown Tailing Excavation and Grading

Windblown tailing located in the Northeast and Northwest Valleys were removed during previous construction activities involving interim stabilization, and removal was verified by radiological survey by Owner. The results of the survey were previously submitted to NRC. Excavated windblown tailing were placed within the tailing impoundment.

To confirm that windblown tailing have not been redeposited over the borrow soils, an external gamma radiation survey shall be conducted in each borrow area before each construction season. This survey is required annually for the four borrow areas indicated on Figure 3. The details of the survey are provided in Section 7.0 of these Specifications. Rejected soils or materials shall be removed and placed beneath the radon barrier layer of the final reclamation cover.

3.2.4 Affected Soil Excavation

To prevent any affected soil from being used as the borrow soil layer of the final reclamation cover, affected soils shall be identified during each construction season

using an external gamma radiation survey conducted in each borrow area as specified in Section 7.0.

Random external gamma radiation surveys shall be conducted daily during construction according to the procedures and criteria described in Section 7.0. The purpose of these surveys is to detect any affected soils located at depth in the soil borrow areas that would require excavation and ultimate placement within the tailing impoundment beneath the radon barrier layer.

3.2.5 Diversion Ditch Excavation and Grading

The diversion ditches shall be graded to conform to the configurations shown on the Reclamation Plan Drawings. All tailing encountered in the excavations shall be placed on the tailing surface prior to placement of the radon barrier layer. Soils excavated during construction of the ditches that meet the criteria in these Specifications may be used in the borrow soil layer of the final reclamation cover (see Section 4.0) or in the soil portion of the soil/rock matrix erosion protection layer.

Any fill placed in the swale or ditches shall be placed as described in Section 3.2.7 and Section 7.0 of these Specifications. The final elevation of all components of the diversion ditches, including the outlets of the ditches, shall be constructed to achieve the approximate contours shown on the Reclamation Plan Drawings, and shall be consistent with contours of adjacent areas. Grading of the diversion ditches to the final elevations shall allow for placing all of the elements of reclamation (i.e. the radon barrier layer, the borrow soil layer, soil/rock matrix, filter layers and riprap as required).

3.2.6 Placement of Interim Soil Cover

Using borrow soil meeting the requirements of these Specifications, a 2-foot thick interim soil cover was placed in Areas 2A, 2B, 3A and 3B over regraded tailing and

the former mill area. In addition, a 1-foot thick interim soil cover was placed in Areas 1A, 1B and 1C over regraded tailing. These Areas are shown on Figure 4 of the Reclamation Plan Drawings. The interim soil cover was placed and compacted in accordance with the performance criteria for compacted fill described in these Specifications. No credit has been taken, however, for any radon attenuation afforded by the interim soil cover.

3.2.7 Placement of Fill to Achieve Desired Subgrade

The base maps for Figures 4 and 5 of the Reclamation Plan Drawings show the topographic contours existing as of February 1, 1992, and also show the desired final reclaimed contours indicating the top of the soil/rock matrix. As described above, significant earthwork, including tailing regrading, excavation, and placement of windblown tailing, and placement of an interim soil cover has previously been conducted by the Owner. However, in order to achieve the desired subgrade, additional placement of fill may be required before placing the final reclamation cover.

Excavated soil and tailing resulting from diversion ditch construction shall be used to achieve the desired configuration indicated on the Reclamation Plan Drawings. If necessary, borrow soil may be used to achieve desired grades. Placement of fill to final elevations will allow for placing not only the final reclamation cover, but also the filter material, riprap and soil/rock matrix to meet the configuration shown on the Reclamation Plan Drawings.

The existing surface shall be proof rolled prior to placement of either additional fill or the final reclamation cover. This proof rolling shall consist of at least 1 pass with a Caterpillar 815 (or equivalent) smooth drum compactor. All additional fill that will be placed prior to emplacement of the final reclamation cover will be placed in lifts not to exceed 8 inches in loose thickness and compacted with both local construction

traffic and at least one pass with a Caterpillar 815 smooth drum compactor or equivalent.

Depressions on slopes shall be filled beyond the configuration shown on the Reclamation Plan Drawings and shall then be trimmed to the desired configuration for subsequent placement of the final reclamation cover. The fill shall be graded such that the surface of the final reclamation cover has a uniform grade without localized depressions and maintains the general configuration shown on Figures 4 and 5.

The regraded tailing surface may have settled prior to final reclamation construction operations. The subgrade configuration depicted on the Reclamation Plan Drawings was determined immediately upon completion of regrading operations. If modest settlement of the tailing has been observed, fill shall be placed to attain the configuration shown on the Reclamation Plan Drawings. If instead, significant settlement of the tailing has been observed (i.e., significant settlement precludes reasonably attaining the configuration identified on the Reclamation Plan Drawings), then adjustments to the general configuration of the impoundment top will be made to compensate for observed field conditions and settlement. In all cases, the fill shall be graded such that the surface of the final reclamation cover has a uniform grade without localized depressions and maintains the general configuration shown on Figures 4 and 5.

4.0 FINAL RECLAMATION COVER PLACEMENT

4.1 General

The final reclamation cover consists of a radon barrier layer and a borrow soil layer. The final reclamation cover will be stabilized with a soil\rock matrix erosion protection layer. The radon barrier and the borrow soil layer are discussed in this Section of the Specifications. The soil/rock matrix erosion protection layer is discussed in Section 5.0

The radon barrier layer has been designed to limit the release of radon-222 from uranium by-product materials and to reduce infiltration due to precipitation. A radon barrier layer, with thickness varying from 6 inches to 44 inches that will be placed over subgrade, has been designed to limit radon-222 release to an average rate of 20 picoCuries per square meter per second. The radon barrier layer does not account for radon attenuation afforded by borrow soil layers placed as either interim cover or to meet subgrade requirements. The thickness of the radon barrier layer for each Reclamation Area is shown on Figure 10 of the Reclamation Plan Drawings. Tables 3A-3H present a summary of the input parameter used to design the radon barrier layer. Table 4 summarizes all of the radon barrier input parameters for all of the areas.

Placement of the final reclamation cover shall be initiated only after completion of primary consolidation of tailing. Completion of primary consolidation shall be identified by the Owner. This information will be provided to the Nuclear Regulatory Commission (NRC) for review and approval. Once primary consolidation has been achieved to the satisfaction of NRC, placement of the radon barrier layer may begin. In the event primary consolidation has not been achieved to NRC's satisfaction, Owner may suspend work for an indefinite period. Work will resume upon NRC approval.

Surveying shall be conducted as necessary to perform all work in accordance with the Reclamation Plan Drawings and these Specifications.

4.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with excavating and placing the final reclamation cover in accordance with the Reclamation Plan Drawings and these Specifications.

Work shall include, but not be limited to, excavating, placing, and grading the materials that will comprise the radon barrier and the borrow soil layers of the final reclamation cover.

The Owner and/or Owner's representative (QA/QC Contractor) shall conduct the following work:

1. Testing borrow areas to confirm the soils, including material for the radon barrier layer are acceptable for use in the final reclamation cover, and

2. Materials testing to comply with the requirements of the Reclamation Plan Drawings and these Specifications.

The Owner shall designate, by staking, all areas subject to earthwork operations identified herein. All surveying necessary to conduct earthwork to the final configuration shall be specified by the Owner.

4.1.2 Related Work

Section 1.0 - General Project Requirements
Section 2.0 - Clearing and Grubbing
Section 3.0 - Excavation
Section 5.0 - Erosion Protection Placement
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

4.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

4.1.4 Products

Not applicable.

4.2 Execution

4.2.1 General

If necessary, excavation and grading operations shall begin by clearing and grubbing the soil borrow area. All work shall be conducted in a manner that minimizes surface water runoff into construction or fill areas and that prevents surface water runoff from exiting the site.

The existing surface shall be proof rolled prior to placement of either additional fill or the final reclamation cover. This proof rolling shall consist of at least 1 pass with a Caterpillar 815 (or equivalent) smooth compactor. All slopes and excavations shall be configured by either cutting existing materials to form the design configuration, or

by placing compacted fill to beyond the desired configuration and subsequently trimming to the design configuration. All additional fill that will be placed prior to emplacement of the final reclamation cover will be placed in lifts not to exceed 8 inches in loose thickness and compacted with both local construction traffic and at least one pass with a Caterpillar 815 smooth drum compactor or equivalent.

Adequate water shall be used for dust suppression on haul/access roads and on all areas where grading and compaction work is conducted.

4.2.2 Placement and Grading of Final Reclamation Cover

The final reclamation cover shall be placed over the regraded tailing area to the general configuration shown on the Reclamation Plan Drawings, making an allowance in elevation for riprap and rock armor placement. The final reclamation cover will be constructed as follows:

1. A radon barrier layer with a minimum thickness varying from 6 inches to 44 inches placed over subgrade material (i.e., interim soil cover, fill material, or tailing), and

2. An 8 to 12-inch thick borrow soil layer.

Contractor shall verify that minimum layer thicknesses shown on the Reclamation Plan Drawings, have been achieved at the intersecting points of a 200-foot by 200-foot survey grid.

The radon barrier layer shall be graded such that the surface of the final reclamation cover has a uniform grade without localized depressions and maintains the general configuration shown on Figures 4 and 5, making allowance for the thickness of either the soil/rock matrix or the riprap and filter layer(s).

4.2.2.1 Excavation, Hauling, Preparation, Placement, and Grading of Radon Barrier Layer

The material for the radon barrier layer shall be obtained from an off-site borrow area. This borrow area is permitted by the WDEQ/LQD (small mining permit number 694(s). Specific information regarding the location of that borrow area is included in that permit and is not repeated here.

Placement and completion of the radon barrier layer shall be in accordance with the following:

1. The material for the radon barrier layer shall be obtained from the designated borrow area and shall have at least 90 percent passing the number 200 sieve as determined by (ASTM D 1140).

2. The maximum density shall be determined using the Standard Proctor method (ASTM D 698). The compacted material shall be placed at a density of greater than 90% of the maximum density for the first six-inch lift and 95% for any subsequent lifts. The moisture content shall be between 2 percent below to 4 percent above the optimum moisture content determined using the Standard Proctor method (ASTM D 698). **(Note: The moisture content shall not be below 16.9%)**

3. The radon barrier layer shall be placed in lifts with a maximum nominal compacted thickness of 6 inches. Measurements will be taken at the intersecting points of a 200-foot by 200-foot survey grid to verify thickness of both the first 6-inch layer that must be compacted to at least 90% of the standard Proctor density and, also, of the entire radon barrier layer following placement of the final lift comprising the radon barrier layer.

3a. The thickness of the first 6-inch lift of the radon barrier layer may be less than 6 inches in all areas that will receive additional radon barrier material (Areas 1A, 1B, 1C 2A, 2B, and 3A). Thickness measurements of the first 6-inch layer compacted at 90% of the standard Proctor density shall be taken just prior to placement of the second 6-inch layer to ensure the required thickness of the initial 6-inch lift has been placed.

3b. In areas where the total thickness of the radon barrier layer will be only 6 inches (Areas 3B and 2C) the radon barrier layer shall be at least 6 inches thick. All radon barrier material in these two areas shall be compacted to at least 90% of the standard Proctor density.

(Note: Owner shall determine radiological source term for the Winter Storage Ponds (Area 2C) and confirm radon barrier cover thickness requirements as stated herein and secure NRC approval prior to final reclamation. Should the calculated radon barrier thickness exceed the 6-inch thick design, the design changes shall be made accordingly in Area 2C and submitted to the NRC for approval).

3c. Thickness measurements of the entire radon barrier layer shall be taken just prior to placement of the borrow soil layer to ensure the required thickness has been placed.

3d. For all areas, the total thickness of the radon barrier layer shall be at least the thickness required for the specific area as shown on the Reclamation Plan Drawings. Measurements shall indicate that no single measurements shall be less than the required thickness.

The radon barrier layer shall be graded to have a uniform grade without localized depressions and to maintain the general configuration shown on Figures 4 and 5, making an allowance for the thickness of the soil/rock matrix.

3e. All transitions between areas with different radon barrier thickness requirements shall ensure that the minimum radon barrier thickness has been provided for all areas and that the final configuration shall be as shown on the Reclamation Plan drawings.

4. Radon barrier layer material placed adjacent to previously compacted radon barrier material shall be placed such that the new material overlaps the previously compacted material. At the area of overlap, the new and previously placed material shall be compacted together such that the radon barrier layer is continuous without gaps or discernable seams.

5. After quality control testing assures the radon barrier layer has been placed and compacted as specified (e.g., considering density and moisture criteria), moisture shall be added to the surface of the radon barrier layer, as necessary, to prevent drying of the layer until the borrow soil layer is placed over the radon barrier layer. In addition, the borrow soil layer shall be constructed, as specified below, over the radon barrier layer, following completion of each portion of the radon barrier layer as soon as practicable as directed by the Owner.

4.2.2.2 Placement and Grading of Borrow Soil Layer

Borrow soils that meet the requirements of these Specifications shall be used in the borrow soil layer of the reclamation cover system. **(Note: Owner shall excavate in**

borrow areas in accordance with provisions of correspondence dated March 30, 1992, previously approved by NRC). Placement of the borrow soil layer shall be in accordance with the following:

1. The borrow soil layer shall be constructed as soon as practicable over the radon barrier layer following completion of each portion of the radon barrier layer.

2. The borrow soil layer shall be between 8 and 12 inches thick as measured at the intersecting points of a 200-foot by 200-foot survey grid. The minimum thickness shall be 8 inches. Thickness measurements of the borrow soil layer shall be taken just prior to placement of the soil/rock matrix layer to ensure the required thickness of borrow soil layer has been placed. The borrow soil layer thickness shall have a total thickness between 8 and 12 inches. The top surface of the borrow soil layer shall be graded to have a uniform grade without localized depressions and to maintain the general configuration shown on Figures 4 and 5, making an allowance for the thickness of the soil/rock matrix.

3. Grading of the top surface of the borrow soil layer shall take into consideration shaping of the diversion ditches and tailing swale. The ditches and swale shall be graded to the configuration shown on the Reclamation Plan Drawings, making an allowance for the thickness of the riprap and filter layer(s).

4. After quality control testing assures that the required thickness of the borrow soil layer has been placed, moisture shall be added to the surface of the borrow soil layer, as necessary, to prevent drying of the layer until the layer is temporarily stabilized. The borrow soil layer shall be

temporarily stabilized by placing either a physical agent or the rock mulch portion of the soil/rock matrix over the borrow soil layer. In addition, the temporary stabilization of the borrow soil layer shall be achieved following completion of each portion of the borrow soil layer.

5. There are no compaction or moisture specifications for the borrow soil layer.

For details of testing requirements, frequencies, and quality control, see Section 7.0.

5.0 EROSION PROTECTION PLACEMENT

5.1 General

5.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with placement of erosion protection in accordance with the Reclamation Plan Drawings and these Specifications.

As indicated on the Reclamation Plan Drawings, the work shall include, but not be limited to, the following:

1. Placing a filter layer or layers as required in the tailing swale and diversion ditches,

2. Placing riprap in the tailing swale and diversion ditches,

3. Placing soil/rock matrix to protect the final reclamation cover, where applicable, and

4. Placing soil/rock matrix to protect existing native soils lying between the final reclamation cover and the diversion ditches, where applicable.

The size, thickness, and areal extent of erosion protection shall be as designated on the Reclamation Plan Drawings and in these Specifications.

5.1.2 Related Work

Section 1.0 - General Project Requirements
Section 3.0 - Excavation
Section 4.0 - Final Soil Cover Placement
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

5.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

5.1.4 Products

5.1.4.1 Riprap

Riprap shall consist of sized angular granite obtained from the specified on-site rock source (see Figure 3) or an alternate source approved by the Owner. **(Note: Should alternate source be used, it shall be tested and approved by the NRC prior to its use).** The material shall be angular, resistant to abrasion and weathering, and shall be free from cracks, seams, and other defects that would tend to increase weathering by water and frost action. Only riprap approved by the Owner shall be used. Riprap shall be well-graded and sized as specified for each particular ditch reach or apron in these Specifications (Table 2A), unless otherwise approved by the Owner.

5.1.4.2 Filter Material

The filter material shall consist of sized angular granite as required to meet these Specifications. The granite shall be obtained from the specified on-site sources (see Figure 3) or an alternate source approved by the Owner. The filter material shall be

reasonably free from clay, loam, or deleterious material. The filter material shall be well-graded and sized as specified for each particular ditch reach or apron in these Specifications (Table 2B), unless otherwise approved by the Owner.

5.1.4.3 Soil/Rock Matrix

The soil/rock matrix shall consist of sized angular granite and soil obtained from the specified on-site borrow sources (see Figure 3), soil obtained during excavation of the ditches or alternate sources approved by the Owner. The soil used must be acceptable as defined in these Specifications. The rock material shall be angular, resistant to abrasion and weathering, and shall be free from cracks, seams, and other defects that would tend to increase weathering by water and frost action. Only rock material approved by the Owner shall be used. Rock material shall be well graded and sized as specified for each particular area in these Specifications (Table 2C), unless otherwise approved by the Owner.

5.2 Execution

5.2.1 Rock Durability Testing and Permissible Use

Laboratory durability test results and durability rating for each rock borrow area shall be developed before use of the rock.

Durability testing shall consist of the following:

1. Bulk Specific Gravity ASTM C-127,
2. Absorption ASTM C-127,
3. Sodium Sulfate Soundness ASTM C-88, and
4. L.A. Abrasion at 100 cycles ASTM C-131 or ASTM C-535.

The results of the above testing shall be used to determine a rock durability rating in accordance with Table D1 of the NRC's Staff Technical Position (STP) "Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailing Sites," August, 1990. The following criteria shall be used to determine acceptable uses of rock borrow based on the rock durability rating:

1. Rock having a durability rating of greater than or equal to 80 may be used as riprap, filter, or soil/rock matrix,

2. Rock having a durability rating of less than 80 and greater than or equal to 65 may be placed in diversion ditches or the tailing swale (i.e., "critical areas" as defined by the NRC's August 1990 STP) as riprap or filter material only after being oversized in accordance with the criteria in Section 5.2.2 of these Specifications,

3. Rock having a durability rating of less than 80 and greater than or equal to 50 may be used in the rock mulch portion of the soil/rock matrix, a "non-critical area," only after being oversized in accordance with the criteria in Section 5.2.2 of these Specifications,

4. Rock having a durability rating of less than 65 may not be used for riprap or filter, and

5. Rock having a durability rating of less than 50 may not be used for any application.

In addition to durability testing before use, rock durability testing also shall be conducted periodically during construction. Details of testing frequencies are presented in Section 7.0.

5.2.2 Riprap, Filter, and Matrix Rock Size and Gradation Requirements

Tables 2A, 2B and 2C of these Specifications indicate the design D_{50} (median rock size) for each riprap and filter layer and for rock mulch sizes. Riprap, filter, and rock mulch shall conform with the following criteria:

1. A minimum of 50 percent by weight of the material shall be greater than the design D_{50} shown in Tables 2A, 2B and 2C of these Specifications.

2. The material shall be well-graded and shall meet the gradation requirements shown in Tables 2A, 2B and 2C of these Specifications.

3. Rock to be used for riprap, filters or rock mulch shall have a minimum durability rating as specified in Section 5.2.1 above.

Based on previous testing conducted for the on-site borrow area, test results of available rock have durability ratings in excess of 80. However, should testing indicate a durability rating less than 80, the rock from these sources shall be oversized by applying an oversizing factor that is the difference between the tested durability rating and the required durability rating of 80, expressed as the percentage to be increased. For example, if the rock durability rating is 67, the rock would require oversizing of at least 13 percent (i.e., 80 - 67 = 13).

The results of rock oversizing calculations, if necessary, shall be submitted to the Owner prior to use. The following information shall be provided:

1. A modified gradation curve accounting for required oversizing and ensuring material is well graded, and

2. Modified gradation envelopes that ensure minimum sizing requirements are met and material will be well graded.

At least five days before placing any erosion control material, particle-size analysis of the crushed rock shall be developed and approved for each rock gradation. The Contractor shall provide the Owner with samples of crushed rock for quality control gradation checks at the frequencies described in Section 7.0.

5.2.3 Riprap Placement

Riprap shall be placed at the locations and grades shown on the Reclamation Plan Drawings. The riprap shall be placed in a manner to prevent segregation and to provide a layer of riprap of the specified thickness. Hand placing will be required only to the extent necessary to ensure the results specified above.

Material which does not meet the requirements described in Section 7.0, shall be either reworked, or removed and replaced as necessary to meet these Specifications.

5.2.4 Filter Material Placement

Each filter layer will be placed in one lift and tracked in-place by three passes of a Caterpillar D-8 bulldozer or equivalent. Minimum filter layer thicknesses for each particular application are specified in Table 2B. Each layer shall be placed in a manner that prevents segregation of the material.

Material which does not meet the requirements described in Section 7.0, shall be either reworked, or removed and replaced as necessary to meet these Specifications.

5.2.5 Soil/Rock Matrix

Placement of the soil/rock matrix shall commence following placement of the final soil cover. The soil/rock matrix gradation specified in Table 2C shall be placed at the locations and to the depths shown on the Reclamation Plan Drawings. Care shall be taken while placing the rock to prevent segregation of materials.

The rock for the soil/rock matrix shall be placed first by end or belly dump trucks or other means in a manner that shall minimize degradation and separation of the material. Next, the soil for the soil/rock will be placed and spread in a similar manner. The material shall be spread with a road grader to achieve the desired specifications listed below.

The soil/rock matrix shall be compacted with a vibratory roller/compactor to push the soil into the rock mulch. The soil shall be forced into the rock voids while maintaining a maximum thickness of 2 inches of soil above the rock layer after compaction. Compaction shall densify the soil/rock matrix by tightly wedging the stones. If the desired soil rock matrix cannot be achieved in this manner, alternative placement procedures will be used as directed by the Owner. If the total rock mulch layer thickness measures less than the thickness required for each area as shown on the Reclamation Plan Drawings additional soil material will be spread until measurement verifies the appropriate thickness has been placed.

The thickness of the emplaced soil/rock matrix shall be at least the thickness required for each area as shown on the Reclamation Plan Drawings and verified by construction control, staking, and probing, as described in Section 7.0. Material that does not meet the requirements specified above and in Table 2C shall be either reworked, or removed and replaced as necessary to meet these Specifications.

5.2.6 Erosion Aprons

The erosion protection at the discharge location for the diversion ditch outlets has been extended into riprap lined flares and rock aprons to prevent headcutting. Figure 5 of the Reclamation Plan Drawings provides the plan locations of each erosion flare and apron (four total), and Figure 9 shows typical details of the erosion flare and apron.

The flares shall be constructed using the same filter and riprap as specified for the diversion ditch reach immediately upstream of the flare (i.e., North Reach 7, South Reach 5, North Central Reach 3, and South Central Reach 2). Filter(s) and riprap in the flare shall be well-graded, and shall be sized, placed, and tested in accordance with the criteria specified for diversion ditch riprap and filter materials.

Each rock apron shall be constructed using the same riprap as specified for the diversion ditch reach immediately upstream of the flare (i.e., North Reach 7, South Reach 5, North Central Reach 3, and South Central Reach 2). Each rock apron shall be constructed by excavating a trench to a depth equal to or greater than the appropriate scour depth specified on Figure 9 of the Reclamation Plan Drawings. Riprap shall be placed against the upstream sideslope of the excavated trench in a manner that achieves a uniform distribution of the larger and smaller rock fragments. These fragments shall form a densely placed layer of riprap that meets the thickness specified for the corresponding diversion ditch reach.

After the rock apron is constructed, the apron trench shall be backfilled with soil material to conform to the surrounding soil surface and to provide drainage from the flare to the native soil.

6.0 REVEGETATION

6.1 General

6.1.1 Scope of Work

Revegetation efforts shall be directed at all areas disturbed by construction and shall include, soil borrow areas, windblown tailing excavation areas, and Contractor staging areas. Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with replacing topsoil (if available) and revegetating in accordance with the Reclamation Plan Drawings and these Specifications.

6.1.2 Related Work

Section 1.0 - General Project Requirements
Section 2.0 - Clearing and Grubbing
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

6.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

6.1.4 Products

6.1.4.1 General

Submittals for each of the following products shall be provided to the Owner for approval before use of the products.

6.1.4.2 Site Seed Mixture

All seed for the disturbance areas shall be fresh, clean, new crop seed of the following composition by weight of pure live seed (PLS) per acre:

Scientific Name	Common Name	Seeding Rate (pounds of PLS per acre (recommended increase)
Agropyron Dasystachyum	Thickspike Wheatgrass (Critana)	3.0
Agropyron Inerme	Beardless Bluebunch Wheatgrass (Whitmar)	2.5
Agropyron Riparium	Streambank Wheatgrass (Sodar)	3.0
Agropyron Smithii	Western Wheatgrass (Arriba/Rosana)	3.0
Oryzopsis Hymenoides	Indian Ricegrass (Paloma)	2.5
Stipa Comata	Needle and Thread (Common)	1.5
	TOTAL	15.5

The specified application rates are for drill seeding. The application rates for broadcast methods should be increased by 1.5 times the rate given. All seed shall be furnished in original containers showing analysis of seed mixture, seed source and

production location, percentage of PLS, year of production, net weight, date, and location of packaging. Seed which has become moldy or otherwise damaged in transit or storage shall not be accepted. The seed mixture may be adjusted to include other perennial grass species and/or forb species depending upon site specific conditions and seed availability.

6.1.4.3 Mulch

Mulch shall be certified weed-free small-grain hay or straw in a dry condition. Mulch shall be free of foreign matter detrimental to plant life.

Wood fiber mulch, if used, shall be virgin long fiber aspen mulch, Douglas fir mulch, or other similar wood fiber such as mulch from trees located on-site that will be cleared from borrow areas. The mulch shall not be from recycled material and shall be free from foreign material such as printers ink, glues, etc.

6.2 Execution

6.2.1 General

Replacing topsoil (if available) and revegetating shall be conducted as specified on the soil borrow and windblown tailing areas, and any other areas disturbed by the reclamation activities. All seeding shall be conducted only in the fall months (between September 1 and November 30) provided the soil is not frozen. Areas that cannot be seeded during the same season that construction occurs may be temporarily stabilized until the next seeding season. Temporary stabilization will be accomplished using mulch or an annual agronomic plant species adapted to site conditions.

6.2.2 Preparation

The area to be revegetated shall be prepared by first replacing topsoil removed and stockpiled during clearing and grubbing (see Section 2.0), if available. Construction staging areas will be ripped to a depth of 6-12 inches prior to topsoil placement to alleviate compaction that may have occurred. Available topsoil shall be spread evenly over the area to be revegetated in a nominal 6-inch unconsolidated layer. If topsoil is not available to replace over an area to be revegetated, the soil shall be prepared by first cultivating to a minimum depth of 6 inches.

Fertilizer shall be added, if required, to the soil at an application rate to be determined after soil analyses are conducted by the Owner and shall be worked into the upper 6 inches of soil by disking along the contours to the extent practical.

Native and introduced species have different responses to fertilizer requirements. A program capable of stimulating initial growth and root development without favoring one species or group of species over another is required. Introduced species have the ability to use abundant levels of plant nutrients with greater efficiency than many native species. Overstimulations of a species group could increase competition and cause a reduction in the total native plant population.

Both native and introduced species play an important role in the revegetation process. Introduced species provide rapid establishment of cover and production, while the native species provide a stable plant community with the ability to regenerate while being subjected to varying climatic conditions. A balance must be maintained when both introduced and native species are seeded so that a reduction in native species does not result from competition with introduced species, due to the fertilization program.

To alleviate the problem of overcompensation, a soil investigation may be conducted before final revegetation. Results of the soil test would allow determination of the amount of nutrients contained in the replaced topsoil or existing surface soil. Samples should be taken from areas which represent distinctly different soil conditions to determine inherent plant available nutrient levels, including the following:

1. Available nitrogen (N) for seed germination and plant development,

2. Available phosphorus (P_2O_5) to stimulate root development and plant growth,

3. Available potash (K_2O), and

4. Organic matter.

Composite soil samples should be collected from the surface to a suitable depth from each area that represents distinctly different soil conditions. One composite sample should be taken to represent each soil condition. The composite sample should consist of five to eight random grab samples from a given area. The random samples should be mixed together and a composite sample extracted from the mixture to represent a given soil condition.

Guidelines for fertilization should be developed from the above criteria. Deficiencies in nutrient availability could therefore be predicted and controlled.

Fertilizer shall be applied, as necessary, using one of the following methods:

1. Broadcast,

2. Hydrofertilization, or

3. Drill.

The method used will be dependent on climatic conditions, rate of application, time of application, and will be determined on an area-by-area basis and pre-approved by the Owner.

6.2.3 Seeding

Seeding shall be conducted by drill or broadcast seeding the specified seed mixture (as specified in Section 6.1.4.2) at the specified application rates along the contours or opposite the direction of the prevailing wind.

Broadcast seeding may be allowed upon approval by the Owner using 1.5 times the application rate specified for drill seeding. Seeding shall not be conducted immediately following a heavy rain, during windy periods, or when the ground is too dry. Drill seeding shall use a roller attachment, or its equivalent, attached behind the drill to inhibit movement of seeds previously sown. No seeding shall be conducted in areas too large to be mulched the same day.

6.2.4 Mulching

Certified weed-free straw, grass hay, or suitable wood fiber mulch will be applied to all seeded areas to conserve soil moisture and to protect against soil erosion. Application will immediately follow seeding unless soil or climate conditions prohibit the operation (wet soils or inclement weather). Certified weed-free straw or hay mulch shall be anchored with a crimper except for those slopes where crimping is not possible. All slopes too steep for crimping will have cellulose wood fiber mulch (hydromulch) applied at the rate of 2,000 pounds per acre minimum. If an area is of critical concern, or if otherwise necessary, a mulch netting may be applied rather than the cellulose wood fiber.

6.2.5 Restoration

Intact plant communities outside of planned disturbance areas that may be disturbed during reclamation will be restored using methods described above. Any revegetated area or portion of an area that exhibits poor plant establishment or no plant establishment, shall be reseeded during the next growing season with the specified seed mixture and methodology.

7.0 QUALITY CONTROL

7.1 General

7.1.1 Scope

This section summarizes inspection and testing for construction and verification that the execution of the Reclamation Plan Drawings and Specifications will meet the intent of the Reclamation Plan, and meet or exceed all design criteria.

Unless otherwise specified, the Owner shall furnish all labor, materials, and required equipment, and shall perform all operations in connection with conducting quality control monitoring in accordance with the Reclamation Plan Drawings and these Specifications.

Quality control tasks shall include, but not be limited to, materials testing and settlement monitoring. Table 5 summarizes required field and laboratory testing and inspection frequencies.

7.1.2 Related Work

All sections included in these Specifications.

7.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

7.1.4 Products

Not applicable.

7.2 Execution

7.2.1 Settlement Monitoring

To monitor settlement of the tailing, settlement monitoring platforms were installed in 1990 and 1991 during regrading operations and in 1992 during the placement of the vertical band drains at the approximate locations shown on the Reclamation Plan Drawings. Elevation readings shall continue to be recorded (minimum of one reading per quarter) until primary consolidation has occurred.

Final soil cover placement shall not begin until primary consolidation of the tailing has occurred. The Owner shall determine when primary consolidation has been completed, as approved by the NRC.

Following NRC approval that primary consolidation has been achieved and before final soil cover placement, the settlement monitoring platforms will be removed.

7.2.2 Borrow Soil Placement, and Testing

The quality control and testing procedures described in this section are applicable to any and all soil used as fill during reclamation including, but not limited to, the following:

1. Placing soil fill to achieve desired contours and grades before placing the radon barrier layer, and

2. Placing a 8-inch to 12-inch thick borrow soil layer above the radon barrier layer.

Inspection and testing described herein of all earth moving shall be conducted by the Owner to ensure that specified materials are placed and compacted as designated on the Reclamation Plan Drawings and in these Specifications.

The existing surface and all soil and tailing placed to achieve desired contours and grades before placement of the radon barrier layer shall be compacted with normal construction traffic and with at least one pass with a caterpillar 815 smooth drum compactor (or equivalent). All material to be placed to achieve desired contours and grades before placement of the radon barrier layer shall be placed in loose lifts not to exceed 8 inches. Documentation to demonstrate that at least one pass with a caterpillar 815 smooth drum compactor or equivalent has been conducted for the existing surface and for all subsequent fill placed before placement of the radon barrier will be provided by the Owner. This documentation shall be included in the weekly inspection reports required by these specifications (Section 7.2.7).

The borrow soil layer will be compacted using passive means in that compaction will be achieved by construction traffic. No active compaction will be used and no density requirements or testings of the borrow soil layer is specified herein.

7.2.2.1 Windblown Tailing Identification Survey

Before each construction season, an external gamma radiation survey shall be conducted in each borrow area to confirm that windblown tailing have not been redeposited over the borrow soils. An external gamma radiation value of either 18 μR/hr in areas not affected by shine or 30 μR/hr in areas affected by shine (i.e. within approximately 50 feet of either granite outcrops or exposed tailing) will be used to determine if freshly deposited windblown tailing are present in the soil borrow area. Soils or materials exceeding these criteria shall be removed and placed beneath the radon barrier layer.

7.2.2.2 Affected Soils Identification Survey

A random external gamma survey shall be conducted during borrow area excavation to identify affected soils present at depth in the soil borrow areas. The survey shall be conducted by traversing the borrow area at the following frequencies:

1. At least once each day for each active onsite borrow area previously impacted by windblown tailing, and

2. At least once each shift if the soil volume excavated exceeds 15,000 cubic yards per day per borrow area.

The survey shall be conducted more frequently as conditions warrant, such as:

1. Anomalously high readings,

2. Visual indications of tailing, or

3. Visual indications of previous disturbance at depth such as buried man-made debris.

If the random external gamma survey to identify affected soils at depth in the soil borrow areas indicates an external gamma measurement value exceeding either 18 μR/hr in areas not affected by shine or 30 μR/hr in areas affected by shine (i.e. within approximately 50 feet of either granite outcrops or exposed tailing), then the following restrictions apply to the material:

1. The material cannot be used in the tailing cover,

2. The material cannot remain in an area to be released for unrestricted access, and

3. The material shall be segregated and disposed of as tailing material (i.e., shall be placed within the tailing impoundment beneath the final radon barrier layer or in a stockpile for subsequent appropriate disposal).

If the random external gamma survey to identify affected soils at depth in the soil borrow areas indicates an external gamma measurement value less than that specified above, then the soil is acceptable for use in the tailing cover.

7.2.3 Radon Barrier Layer Preparation, Placement, Compaction, and Testing

7.2.3.1 Radon Barrier Gradation Testing

Gradation testing for percent passing the #200 sieve (ASTM D1140), of off-site borrow soil to be used in the radon barrier layer shall be conducted at the following frequencies:

1. Minimum of one test for each 1,000 cubic yards of radon barrier layer material to be placed, and

2. Minimum of one test for each day when radon barrier layer material soil in excess of 150 cubic yards is placed.

7.2.3.2 Radon Barrier Layer Compaction Testing

The Standard Proctor test (ASTM D 698) will be used to determine the maximum density for compaction. The Standard Proctor test shall be conducted at a rate of one

test for every 15 field density tests. Additionally, 1-point Proctor tests will be conducted at a rate of one test for every 5 field density tests.

The compacted material shall be placed at a density of greater than 90% percent of the maximum density for the first 6-inch and 95% for any subsequent lifts. The radon barrier layer material shall be placed at a moisture content between 2 percent below and 4 percent above optimum moisture content as determined using the Standard Proctor test. **(Note: The moisture content shall not be below 16.9%).** To satisfy the in-place density and moisture content criteria, field tests of the radon barrier layer as placed and as compacted shall be conducted at the following frequencies:

1. Minimum of one test for each 500 cubic yards of placed radon barrier layer,

2. Minimum of two tests for each day when radon barrier layer material in excess of 150 cubic yards is placed, and

3. Minimum of one test per lift and a minimum of one test per full shift of radon barrier layer compaction operations.

Field tests to determine density and moisture content of the radon barrier layer may be conducted using the nuclear gauge with the quality control restrictions described in Section 7.2.6.

Any area that fails either the density or moisture specification shall be reworked, moisture conditioned and recompacted as necessary to achieve the required specifications.

Test results documentation shall be included in the weekly inspection reports required by these Specifications (Section 7.2.7).

The required thickness of the initial radon barrier layer to be compacted to 90% of the standard Proctor density and the total radon barrier layer thickness shall be tested as specified in Section 4.0.

7.2.4 Riprap and Filter Rock Sizing and Testing

7.2.4.1 Rock Durability Testing

In accordance with the STP requirements, the durability testing frequency will include a minimum of initial testing before use and testing for each additional 10,000 cubic yards of rock from a particular rock source. Additional tests more frequent than every 10,000 cubic yards may be conducted as directed by the Owner if it is suspected that the rock has changed substantially from that previously tested. Any visual change that is noted will be recorded as described in Section 7.2.7.

7.2.4.2 Riprap and Filter Gradation and Thickness

Testing of the riprap as placed will include verifying that both the crushed rock gradation and the riprap layer thickness are consistent with the design as specified below.

The riprap gradation used for erosion protection will be verified, at the frequency recommended in the January 1989 NRC STP on "Testing and Inspection Plans," for each different gradation of rock specified. Specifically, the gradation testing frequency will include a minimum of initial testing and testing for each additional 10,000 cubic yards of the particular riprap size (i.e., gradation requirement). A minimum of three gradation tests will be required for those riprap sizes with less than 30,000 cubic yards of riprap required (i.e., before use and after one-third and two-thirds of the total volume).

The in-place riprap shall be visually inspected to confirm that material has been placed according to Section 5.0 of these Specifications. Furthermore, the riprap layer thickness shall be measured to confirm that the thickness is greater than the minimum specified in Tables 2A and 2B. The thickness of riprap placed in the diversion ditches shall be verified by measuring the layer thickness in a test section (August 1990 NRC STP) constructed at the initial placement of a specific size riprap. In addition, the riprap layer thickness shall then be measured at the leading edge of the rock layer placement at intervals of 100 lineal feet.

7.2.5 Soil/Rock Matrix Placement, Compaction, and Testing

A soil/rock matrix shall be constructed over the entire extent of the final reclamation cover for erosion protection as shown on Figure 5 of the Reclamation Plan Drawings.

The thickness of the emplaced soil/rock matrix shall be verified by construction control, staking, and probing. The measurements shall be conducted using the following procedures:

1. Establish a 200-foot by 200-foot grid over the tailing impoundment,

2. Use a tape measure or surveying equipment to locate and mark the center point of each grid square,

3. Use a spade to make a vertical, straight-edged cut that penetrates the soil/rock matrix at the center point of the grid square,

4. Place a straight-edge horizontally on top of the rock at the edge of the cut and measure the vertical distance from the bottom of the straight-edge to the bottom of the soil/rock matrix to the nearest 0.1 foot,

5. Record the thickness measurements for the rock mulch and overlying soil at each test location,

6. If the average soil/rock matrix thicknesses within the grid meet the requirements specified in Section 5, the soil/rock matrix within the grid area is acceptable, and

7. If the average thicknesses within the grid do not meet the requirements specified in Section 5, mark the location and add additional soil/rock matrix, or remove and recompact as necessary to achieve the specifications. Then repeat the test, starting with Step 2 above.

7.2.6 Quality Control Procedures: Nuclear Density and Moisture Correlations

The quality control procedures in this section shall apply if a nuclear gauge is used in the field to measure in-place density and moisture to meet the requirements of Section 7.2.3.

Density Correlation Background - During interim stabilization activities in 1990, 52 in-situ density tests were conducted using both the sand cone apparatus and the nuclear gauge. These test results were used to establish a correlation between the sand cone and nuclear gauge density measurements. Using the least-squares linear regression method, the "best-fit" line has an equation of:

$$\text{Sand Cone Density} = 4.25 + 0.96\ (\text{Nuclear Density})$$

and an r^2 of 0.94. Therefore, the correlation between the results using the nuclear density gauge and the sand cone apparatus is very strong (i.e., greater than 0.9) for this site.

Density Correlation Specification - Figure 11 of these Specifications includes the 95 percent confidence boundary for the 52 results from 1990 field measurements and the 95 percent confidence prediction interval for determining the acceptability of future field testing results using this correlation equation. All density measurements determined using the nuclear density gauge shall be adjusted using the above equation.

As a quality control procedure, duplicate analyses shall be conducted using both the sand cone apparatus and the nuclear gauge once in every 10 tests of in-place density using the nuclear density gauge. As additional duplicate density results -- determined using both the sand cone apparatus and nuclear gauge -- become available during final reclamation, the data shall be plotted on the graph included as Figure 11. If the duplicate results plot within the 95 percent prediction interval, use of the nuclear gauge will be considered acceptable. If the results for any of the duplicate analyses plot outside of the 95 percent prediction interval, the nuclear gauge will no longer be acceptable until the results of an additional 20 consecutive duplicate analyses fall within the 95 percent prediction interval.

Moisture Specification The field moisture content shall be determined using the following methods:

> ASTM D 2216, "Laboratory Determined Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures" (oven-drying method).
>
> ASTM D 3017-88, "Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)."

Where the nuclear method is used to determine moisture content, the oven-drying method shall also be conducted as a duplicate analysis for the first series of ten consecutive moisture tests to confirm that the two test methods are producing results

within ± 1.0 percent moisture. If all ten pairs of results are within this tolerance, the nuclear method may be used for subsequent testing with the following restrictions:

1. After the first series of ten tests, the oven-drying method shall also be conducted as a duplicate analysis at a frequency of once every ten tests using the nuclear method.

2. If for any tenth test, the results of the duplicate analyses are not within ± 1.0 percent moisture, then only the oven-drying method will be used until another ten consecutive duplicate tests confirm that the nuclear method will produce results within ± 1.0 percent moisture of the oven-drying method.

If field moisture tests are not being conducted with a nuclear gauge, laboratory moisture content tests will constitute the moisture test corresponding to each field density test. The moisture content analyses will be conducted using the following laboratory methods:

1. ASTM D 2216, "Laboratory Determined Water (Moisture) Content of soil, Rock, and Soil-Aggregate Mixtures" (oven-drying method).

2. ASTM D 6463, "Determination of Water (Moisture) Content by the Microwave Oven Method for Expedited Test Results" (microwave method) with the following restrictions.

Where the microwave method may be used, the oven-drying method shall also be conducted as a duplicate analysis for the first series of ten consecutive laboratory moisture tests to confirm that the two test methods are producing results within ± 1.0 percent moisture. If all ten pairs of results are within this tolerance, the

microwave method may be used for subsequent testing with the following restrictions:

1. After the first series of ten tests, the oven-drying method shall also be conducted as a duplicate analysis at a frequency of once every ten tests using the microwave method.

2. If for any tenth test, the results of the duplicate analyses are not within $\pm$ 1.0 percent moisture, then only the oven-drying method will be used until another ten consecutive duplicate tests confirm that the microwave method will produce results within $\pm$ 1.0 percent moisture of the oven-drying method. Alternatively, only the oven-drying method may be used for all laboratory moisture tests.

7.2.7 Records

Weekly inspection reports shall be written that address the adequacy, progress, details of construction activities, and decisions. The reports shall include the results of visual inspection, measurements, and daily tests performed in the laboratory and in the field. Volumes of placed materials and the number of field and laboratory tests performed on each material on a weekly basis shall be summarized. The inspection and test reports shall become part of the permanent record of the implementation of the Reclamation Plan.

Records shall include the date, name of the tester, items inspected or tested, type of inspection or test, identification of test method, results, acceptability and acceptance criteria, and name and initials of the reviewer. The records shall also identify the testing equipment or instruments used in performing the test. When documenting deviations, nonconformances, and stop work order situations, the report shall provide

sufficient details so that acceptability of the necessary corrective action and final resolution can be independently reviewed.

8.0 HEALTH AND SAFETY

8.1 General

8.1.1 Scope

This section is intended to provide working conditions and monitoring that will ensure the health and safety of workers. This section, though comprehensive, does not necessarily satisfy all of the Owner's requirements for worker protection. All work will be conducted under the auspices of a Radiation Work Permit (RWP). The Contractor in conjunction with the Owner's Safety Director will develop a health and safety plan (HASP) that will direct site activities to protect workers.

All work shall be carried out in strict compliance with applicable NRC, State Mine Inspector, and Owner requirements.

All radiological contamination surveys and radiological monitoring will be conducted by the Owner.

Site conditions are expected to vary. The Radiation Safety Officer (RSO) and the Safety Director, with approval of the Site General Manager who represents the Owner may authorize deviations from the schedule of reclamation activities and the HASP after evaluating the potential hazards of changing the sequence.

8.1.2 Related Work

All sections included in these Specifications.

8.1.3 Definitions

A complete list of definitions is provided in section 1.11.

8.2 Safety Equipment

8.2.1 Personal Protective Equipment

Personal protective equipment shall consist of a hard hat, work clothes or coveralls, respirators with appropriate cartridges if required, safety glasses, and work boots.

8.2.2 Exposure Monitoring

The Owner will conduct external gamma ray exposure rate surveys monthly. Time studies will be correlated after gamma survey results to determine worker exposure.

The Owner will outfit at least one worker with a lapel monitor to measure airborne uranium as discussed in Section 8.4.5.

8.3 Hazard Analysis

The potential hazards associated with site activities include physical and radiological hazards. The radiological hazards include exposure to external radiation (gamma), and to internal radiation (alpha and beta via inhalation and ingestion of airborne contamination). Physical hazards include potential physical (e.g., lifting, welding, wind, heat, cold, blasting) and mechanical (e.g., equipment operation and working around moving machines) hazards. The Contractor shall specify the measures to be taken to mitigate or minimize these hazards and any other hazards anticipated during site activities in the HASP.

8.4 Radiological Safety

The radiation safety program consists of the following elements:

1. The Owner, RSO and all workers will share in the responsibility of a written and practiced "as low as reasonably achievable" (ALARA) philosophy.

2. The RSO has the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or a violation of NRC rules or license conditions.

3. The RSO is delegated the authority to enforce regulations and administrative policy that affects any aspect of the radiological safety program.

4. The RSO develops and administers the ALARA program and is active in review and approval of plans for changes or changes in operating procedures. This ensures that the plans do not adversely affect the protection program against uranium and its decay products.

5. RWPs are required for all activities involving radioactive materials.

6. Daily inspections are conducted by the RSO.

7. Weekly inspections are conducted and documented by radiation personnel.

8. Technically qualified personnel are employed and key personnel continue to receive training.

9. A comprehensive radiation safety training program is implemented.

10. An extensive surveying and monitoring program is conducted by the radiation safety staff.

11. Respiratory protection is provided for employees, if required.

12. Areas of potential exposure to airborne radioactivity are restricted.

13. Dusting of tailing is minimized.

14. Written procedures are followed for instrument operation, sample collection, instrument calibration, and documentation.

15. Records relating to the radiation safety program are maintained and filed.

The Owner shall specify minimum equipment requirements for the levels of protection to be maintained on-site, in accordance with the RSO's program. The Contractor shall provide all equipment for his employees. All site visitors, Contractor personnel, and regulatory personnel shall provide their own equipment that meets or exceeds the levels specified in the HASP.

8.4.1 ALARA Program

The Owner, RSO and all workers will share in the responsibility of a written and practiced ALARA philosophy. The RSO develops and administers the ALARA program in accordance with NRC Regulatory Guide 8.31 "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be as Low as Reasonably Achievable (ALARA)" and is active in the review and approval of plans for changes in operating procedures. This process ensures that the reclamation plans do not

adversely affect worker protection from uranium and its decay products. The program consists of specific worker training regarding the potential radiological hazards of each task, and applicable routine radiation surveys as required by 10 Code of Federal Regulations (CFR) Part 20. Respiratory protection, a bioassay program, independent inspection by RSO or his designate, ongoing review of both personnel and on-site monitoring data, and modification of work practices as appropriate are also part of the ALARA program. At least semi-annually, an audit will be conducted of the radiation protection and ALARA program.

In addition to the initial inspection conducted prior to issuance of radiation work permits, documented daily inspections for radiation safety hazards will be conducted by the RSO or delegate. Results of these daily inspections will be submitted to the Site General Manager for periodic review and corrective action as warranted.

8.4.2 Training

The Contractor and all Contractor's workers will be given general radiation safety training, by the Owner, that complies with the provisions of 10 CFR 19.12, Instructions to Workers. Female workers will also be instructed in the potential health problems associated with prenatal radiation exposures outlined in NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." A written test addressing applicable principles of the radiation safety program will be administered to each worker. Test results will be reviewed and any incorrect answers discussed to ensure worker understanding of appropriate protection practices. Results of testing will be maintained in each worker's file.

In addition, task training will be conducted as necessary in accordance with specific hazards identified when issuing the radiation work permits.

All visitors and subcontractors shall be instructed in industrial and/or radiation safety requirements relating to their project-specific function. All visitors touring the restricted area will be escorted by someone properly trained and knowledgeable about the site hazards.

The site RSO has completed four weeks of specialized classroom training in health physics specifically applicable to uranium milling. In addition, the RSO has attended refresher training on uranium mill health physics.

8.4.3 Management Audits

Independent auditing of all radiation-associated practices will be conducted by the Owner at the Owner's expense at least every six months during reclamation activities. The Contractor and Subcontractor will be involved with the RSO or delegate in a review of work practices, including possible interviews with the Owner, an inspection performed prior to issuance of radiation work permits, and documented daily inspections for radiation safety hazards. Results of the daily inspections will be submitted to the Site General Manager for periodic review and corrective action as warranted.

8.4.4 Radiation Work Permits

RWPs are required for all activities involving work around radioactive materials and are issued in accordance with Section A of the Owner's Written Procedures (see Section 8.4.11).

8.4.5 Radiation Surveys

Radiation surveys will be performed as described in NRC Regulatory Guide 8.30 "Health Physics Surveys in Uranium Mills".

1. Gamma - External gamma surveys of the project area will be performed monthly with a gamma detector (PRM-7 or equivalent). Time studies of the workers will be performed and documented. The time any worker is on the site will be documented on the Contractor Daily Log and/or the Contractor's time sheets. The time and gamma exposure rate will be transferred to the Contractor's Restricted Area Occupancy Log for subsequent calculation for gamma exposure. The gamma exposure will be recorded.

2. Airborne Radionuclides - Surveys for airborne radionuclides will be conducted weekly during the construction activities. At least one worker in each construction area will be required to wear a calibrated constant flow air sampling pump. The sampling apparatus will be distributed at the beginning of the shift and collected at the end of the shift. The filters will be analyzed for gross alpha. If the calculated uranium concentration exceeds 10 percent of Derived Air Concentration (DAC), exposure calculations will be performed and recorded for each worker in that construction area.

8.4.6 Radiological Contamination Surveys

Radiological contamination surveys will be conducted in the construction equipment cabs, lunch rooms, change rooms, and offices at a typical frequency of once every two weeks during active reclamation tasks. Any contaminant level exceeding 1,000 disintegrations per minute (dpm)/100 centimeters squared removable alpha is cause for investigation by the RSO and subsequent decontamination. Equipment used for alpha counting will be calibrated semiannually and after any repairs.

All workers involved in reclamation activities will be required to monitor themselves before leaving the property. A written procedure will be posted near the personnel

monitor and all workers will be instructed in the proper use of the instrument. If the preset alarm indicates an action level of 1,000 dpm total alpha/100 square centimeters is exceeded, the worker will wash and perform a follow-up survey. Results of all exit surveys will be documented on a log sheet positioned near the survey monitor. Performance testing of monitor response will be conducted and documented on a daily basis by using a check source. The exit monitor will be calibrated at least semiannually or following repair.

Release of equipment or materials from the restricted area shall be in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release For Unrestricted Use or Termination of Licenses for By Product or Source Materials" dated September 1984.

Policy statements shall be issued regarding housekeeping and cleanup requirements. Individuals shall be suspended for violations of management radiation safety rules.

8.4.7 Respiratory Protection

Respiratory protection will be provided to workers in accordance with the provisions of 10 CFR Part 20.103(c)(d)(e) and as described in NRC Regulatory Guide 8.15 "Applicable Programs for Respiratory Protection." Respirators will be required whenever the weekly samples for airborne radionuclides exceed 50 percent of DAC.

A routine physical evaluation (pulmonary function test) will be required for all workers who will use respirators.

As part of the respiratory protection program, bioassays will be collected and analyzed in accordance with NRC Regulatory Guide 8.22 "Bioassays at Uranium Mills." Specifically, urine samples will be collected from each worker on the first work day. Urine samples may be collected during the course of the work if airborne radionuclide

concentrations exceed 50 percent of DAC to evaluate the effectiveness of the respiratory protection program. A final urine sample will be collected from each worker on their last work day.

8.4.8 Inspections

Daily inspections are conducted by the RSO or his designate and are recorded on the Contractor's Daily Log. All monitoring and exposure data will be reviewed quarterly and any trends or deviations in the ALARA philosophy will be addressed and a formal report will be submitted to the Site General Manager.

8.4.9 Restricted Area Access

In accordance with Condition 37 of Source Material License SUA-56, all entrances to the restricted area are conspicuously posted in accordance with Section 20.203(e)(2) of 10 CFR Part 20 and with the words, "Any area within this facility may contain radioactive material."

8.4.10 Minimizing Dusting

Dusting from the tailing will be minimized by spraying water from a water truck over haul roads and active working areas.

8.4.11 Written Procedures

Written procedures are established for site reclamation activities, including sample collection, instrument operation, instrument calibration, and documentation.

All instruments will be calibrated semiannually or after any repair. The results of sampling, analysis, surveys, and monitoring, the calibration of equipment, reports on

audits and inspections, and all meeting and training courses will be documented and maintained.

8.5 Responsible Personnel

The Owner shall designate safety personnel and lines of authority.

8.5.1 Management Control

The Owner shall be responsible for management control to the extent provided herein. Contractor shall consult with the designated Owner personnel in the morning, at noon, and at the end of the day (and at such other times during the day as deemed necessary or appropriate by either party) on every work day to discuss the implementation and adherence to construction procedures and radiation protection programs. The primary Owner personnel to be consulted in such regard are the Site General Manager, the Director of Safety, or the RSO.

Contractor shall consult with the Site General Manager on a daily basis to assure that all reclamation activities are conducted in the most cost- and time-effective manner. The Director of Safety and the RSO are responsible for the implementation of and adherence to the radiation safety programs, and the Contractor shall coordinate its activities and consult with them in that regard.

The RSO, through the Site General Manager, has the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or is a violation of NRC requirements. The RSO is also responsible for administering the ALARA program and actively reviewing and approving of plans or changes in plans for reclamation activities to assure that the procedures do not adversely affect worker protection.

8.6 Emergency Procedures

The Owner shall designate a local facility for treatment of work injuries. Appropriate routes to the treatment center must be maintained on-site. The Contractor shall provide a copy of the "Emergency Procedures" to Owner.

Methods of emergency contact shall also be specified. A list of emergency phone numbers shall be maintained on-site.

8.7 Site Control and Decontamination

The Owner shall designate a support area and a decontamination area.

The methods to be used for the decontamination of equipment and personnel shall be specified.

All equipment contacting tailing shall be cleaned and surveyed in an area designated by the Owner prior to its removal from the site. Release of equipment shall be in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By Product or Source Materials," dated September 1984.

8.8 General Site Health and Safety and Work Rules

The Contractor shall delineate its standard operating rules and a chain of command as applying to job safety.

TABLES

TABLE 1

SUMMARY OF DIVERSION DITCH SPECIFICATIONS

Diversion Ditch	Reach Number (a)	Stations	Channel Slope (ft/ft)	Bottom Width (ft)	Channel Depth (b) (ft)	Channel Sideslope (ftH:ftV)	Peak Discharge Q (cfs)
North	Transition	all	0.0598	15	7.5	3:1	1112
North Reach	N1	all	0.0050	15	7.8	3:1	1645
North Reach	N2	all	0.0050	15	8.1	3:1	1954
North Reach	N3	29+00 - 29+50	0.0050	15	7.3	3:1	2468
North Reach	N3	29+50 - 36+70	0.0387	15	6.4	3:1	2468
North Reach	N4	all	0.0387	15	8.4	3:1	2539
North Reach	N5	all	0.0303	15	9.2	3:1	4217
North Reach	N6	all	0.0200	15	9.1	3:1	4618
North Reach	N7	53+00 - 56+60	0.0300	15	8.5	3:1	4985
North Reach	N7	Flare/Apron	0.0050	varies	varies	3:1	4985
Swale Reach	SW1	all	0.0070	15	4.4	16:1	590
Swale Reach	SW2	all	0.0070	15	5.1	16:1	1601
Swale Reach 3	SW3	all	0.0409	15	4.4	varies	1736
North Central Reach	NC1	all	0.0050	15	3.6	3:1	327
North Central Reach	NC2	4+95 - 11+90	0.0300	15	6.1	3:1	471
North Central Reach	NC2	11+90 - 13+00	0.0050	15	5.7	3:1	471
North Central Reach	NC3	13+00 - 15+15	0.0050	15	3.8	3:1	960
North Central Reach	NC3	Flare/Apron	0.0050	varies	varies	3:1	960
South Central Reach	SC1	0+00 - 6+50	0.0069	15	4.5	3:1	799
South Central Reach	SC1	6+50 - 8+00	0.0400	15	3.9	3:1	799
South Central Reach	SC1	8+00 - 15+75	0.0154	15	6.5	3:1	799
South Central Reach	SC2	15+75 - 22+50	0.0090	15	6.1	3:1	1609
South Central Reach	SC2	22+50 - 23+00	0.0068	15	6.1	3:1	1609
South Central Reach	SC2	Flare/Apron	0.0068	varies	varies	3:1	1609
South	Transition	all	0.0650	15	1.3	3:1	24
South Reach	S1	1+00 - 11+50	0.0082	15	8.4	3:1	864
South Reach	S1	11+50 - 14+00	0.0040	15	8.3	3:1	864
South Reach	S2	all	0.0040	15	9.7	3:1	2052
South Reach	S3	26+00 - 45+00	0.0040	15	8.2	3:1	3171
South Reach	S3	45+00 - 48+00	0.0229	15	7.5	3:1	3171
South Reach	S3	48+00 - 49+00	0.0231	15	8.9	3:1	3171
South Reach	S4	all	0.0231	15	8.8	3:1	4654
South Reach	S5	57+00 - 66+00	0.0231	15	8.7	3:1	4896
South Reach	S5	Flare/Apron	0.0050	varies	varies	3:1	4896

(a) See Reclamation Plan Drawings for plan location of each diversion ditch and reach.

(b) Depth at end of reach including required 12 inches of freeboard.

TABLE 2A

SUMMARY OF RIPRAP GRADATION REQUIREMENTS

(Allowable Percent Passing Given Dimensions)

Revised: March, 1994

Location	Stations	Necessary (a) D50 (inches)	Design (b) D50 (inches)	Effective Oversizing (percent)	Layer Thickness (in)	36"	24"	20"	15"	12"	10"	6"	4"	3"	2"	1"	3/4"	1/2"	3/8"	Sieve No. 4
North Transition	0+00 - 1+20	18		0																
North Reach 3	29+40 - 30+00	15		20																
North Reach 3, 4, 5	30+00 - 46+50	18	18	0																
North Reach 6	46+50 - 53+00	15		20																
					27	100	50-100	30-60	15-37	10-32	4-20	0-10	0-5	0-1						
North Reach 7	53+00 - 56+20	18		0																
North Reach 7	56+00 - 56+60	6	18	300																
	Flare/Apron	4		450																
South Reach 3, 4, 5	44+90 - 66+20	18	18	0																
South Reach 5	Flare/Apron	6		300																
North Central Confluence 1		13		38.5																
South Confluence 2		16		12.5																
South Confluence 4		16		12.5																
Swale Reach 3	21+40 - 28+95	12		0																
North Central Reach 2	4+85 - 12+10	12		0																
			12		18			100	30-100	25-50	17-42	5-20	0-13	0-10	0-6	0-1				
South Central Reach 1	6+40 - 8+20	12		0																
North Confluence 1		12		0																
South Confluence 1		8		50																
South Confluence 3		10		20																
South Central Reach 1	0+00 - 6+40	4		50																
					12				100	85-100	71-92	30-50	10-35	2-20	0-10					
South Central Reach 1, 2	8+20 - 23+00	6	6	0																
	Flare/Apron	6		0																
Swale Reach 1, 2	2+00 - 21+40	2		33																
North Reach 1, 2, 3	1+20 - 29+40	3		0																
			3																	
South Transition	0+00 - 1+00	3		0																
					6						100	89-100	55-69	35-50	10-30	0-10	0-6			
South Reach 1, 2, 3	1+00 - 44+90	3		0																
North Central Reach 1	0+00 - 4+85	3		0																
North Central Reach 2	12+10 - 13+00	3		0																
			3																	
North Central Reach 3	13+00 - 15+15	3		0																
	Flare/Apron	2		33																

(a) Taken from ditch design caculcations, Appendix C, Section C.1

(b) Taken from ditch design calculations, Appendix C, Section C.3

TABLE 2B

SUMMARY OF FILTER GRADATION REQUIREMENTS
(Allowable Percent Passing Given Dimensions)

Filter Layer	Locations	Stations	Design D50 (c) (inches)	Filter Layer Thickness (inches)	54"	48"	36"	24"	20"	15"	12"	10"	6"	4"	3"	2"	1"	3/4"	1/2"	3/8"	Sieve No. 4
Borrow Soil Pre-Filter	South Transition	0+00 - 1+00	N/A	6																	
	South Reach 1, 2, 3	1+00 - 44+90																			
	North Central Reach 1	0+00 - 4+85																			
	Swale Reach 1, 2, 3	2+00 - 28+50																			
Filter I (a)	All	All	0.62	6												100	85-95	61-78	38-52	28-39	10-21
Filter IIABC (b)	North Transition	0+00 - 1+20	3	6									100	58-74	32-51	12-26	0-1				
	North Reach 3, 4, 5, 6, 7	29+40 - 56+00																			
	Swale Reach 3	21+40 - 28+95																			
	South Reach 3, 4, 5	44+00 - 66+00																			
	North Central Reach 2	4+85 - 12+10																			
	South Central Reach 1	6+40 - 8+20																			
	North Confluence 1																				
	South Confluence 1, 2, 3, 4																				
	North Central Confluence 1																				
	North Reach 7	Flare/Apron																			
	South Reach 5	Flare/Apron																			

(a) Filter Layer I shall be placed in each diversion ditch.

(b) Filter Layer II shall be placed in diversion ditches as noted, above Filter Layer I.

(c) Taken from Appendix C, Section C.3

Revised: March, 1994

TABLE 2C

SUMMARY OF ROCK MULCH GRADATION REQUIREMENTS
(Allowable Percent Passing Given Dimensions)

Rock Mulch Type	Location	Design D50(a) (inches)	Thickness (inches)	24"	20"	15"	12"	10"	6"	4"	3"	2"	1"	3/4"	1/2"	3/8"	Sieve No. 4
2 inch	See Figure 5	2	4						100	88-100	52-84	25-50	2-20	0-12			
3 inch	See Figure 5	3	4					100	89-100	55-69	35-50	10-30	0-10	0-6			
6 inch	See Figure 5	6	12			100	85-100	71-92	30-50	10-35	2-20	0-10					

(a) Taken from soil/rock matrix design calculations, Appendix E

TABLE 3A

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 1A - EAST NEW TAILING

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	280 pCi/g	SMI[A] 1993 tailing borings 9, 10, 11, 12 & 13	A-84, G-42
		WWL[B] 1988 tailing surface samples SS-1 through SS-14	A-15, G-42
		WWL 1988 new embankment surface sample	A-15, G-42
		WWL 1988 tailing borings 1, 2, 3, & 4	A-13, G-42
Emanation Coefficient	0.28	WWL 1988 tailing borings 1, 2, 3, & 4	A-13, G-42
		WWL 1988 tailing surface sample SS-5	A-15, G-42
		WWL 1988 new embankment surface sample	A-15, G-42
Long Term Moisture	1.5%	Canonie coarse tailing sample, listed as sample 7	A-24, G-14
Dry Density	1.62 g/cm^3	SMI 1993 tailing borings 9, 10, 11, & 12	A-79, G-43
Specific Gravity	2.65	Default value	G-42
Porosity	0.39	Calculated using dry density and specific gravity	G-43
Diffusion Coefficient	5.667E-02 cm^2/sec	Calculated by the RADON model	G-21
Source Term	6.839E-04 pCi/sec/cm^3	Calculated by the RADON model	G-21

[A] SMI is Shepherd Miller, Inc.
[B] WWL is Water, Waste, and Land

TABLE 3B

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 1B - WEST NEW TAILING

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	450 pCi/g	WWL[A] 1988 tailing borings 1, 2, 3, & 4	A-13, G-44
Emanation Coefficient	0.37	WWL 1988 tailing boring 3	A-13, G-44
Long Term Moisture	1.5%	Canonie coarse tailing sample, listed as sample 7	A-24, G-45
Dry Density	1.55 g/cm^3	Calculated from porosity and specific gravity	G-45
Specific Gravity	2.59	WWL 1988 tailing boring 3	A-13, G-44
Porosity	0.4	Default value	G-45
Diffusion Coefficient	5.758-02 cm^2/sec	Calculated by the RADON model	G-24
Source Term	1.355E-03 pCi/sec/cm^3	Calculated by the RADON model	G-24

[A] WWL is Water, Waste, and Land

TABLE 3C

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 1C & 2B - OLD TAILING

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	341 pCi/g	SMI[A] 1993 tailing borings 14, 15, 16, 21 & 22 WWL[B] 1988 tailing borings 5 & 6	A-84 & 85, G-46 A-14, G-46
Emanation Coefficient	0.27	WWL 1988 tailing boring 5	A-14, G-47
Long Term Moisture	6.00%	NRC default value	
Dry Density	1.61 g/cm^3	SMI 1993 tailing borings 14, 15, 16, 21 & 22	A-79 & 80, G-48
Specific Gravity	2.65	NRC default value	
Porosity	0.39	Calculated using dry density and specific gravity	G-48
Diffusion Coefficient	3.011E-02 cm^2/sec	Calculated by the RADON model	G-27
Source Term	7.982E-04 pCi/sec/cm^3	Calculated by the RADON model	G-27

[A] SMI is Shepherd Miller, Inc.
[B] WWL is Water, Waste, and Land

TABLE 3D

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 2A - ALTERNATE TAILING

Revised: December, 1993

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	448 pCi/g	SMI[A] 1993 tailing borings 17, 18, 19, 20, 23, 24 & 25	A-84 & 85, G-49
		WWL[B] 1988 tailing borings 7 & 8	A-14, G-49
		WWL 1988 old embankment surface sample	A-14, G-49
Emanation Coefficient	0.27	WWL 1988 tailing borings 7 & 8	A-14, G-50
		WWL 1988 old embankment surface sample	A-14, G-50
Long Term Moisture	6.00%	NRC default value	
Dry Density	1.64 g/cm^3	SMI 1993 tailing borings 17, 18, 19, 20, 23, 24 & 25	A-79 & 80, G-51
Specific Gravity	2.62	NRC default value	
Porosity	0.38	Calculated using dry density and specific gravity	G-51
Diffusion Coefficient	2.872E-02 cm^2/sec	Calculated by the RADON model	G-30
Source Term	1.096E-03 pCi/sec/cm^3	Calculated by the RADON model	G-30

[A] SMI is Shepherd Miller, Inc.
[B] WWL is Water, Waste, and Land

TABLE 3E

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 3A - MILL AREA WITH TAILING

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	88 pCi/g	SMI[A] 1993 tailing borings 1, 2, 3, 4, 5, 6, 7 & 8	A-84, G-52
Emanation Coefficient	0.27	Average used for Area 2A	
Long Term Moisture	6.00%	NRC default value	
Dry Density	1.65 g/cm^3	SMI 1993 tailing borings 1, 2, 3, 4, 5, 6, 7 & 8	A-79, G-53
Specific Gravity	2.65	NRC default value	
Porosity	0.38	Calculated using dry density and specific gravity	G-53
Diffusion Coefficient	2.856E-02 cm^2/sec	Calculated by the RADON model	G-33
Source Term	2.167E-04 pCi/sec/cm^3	Calculated by the RADON model	G-33

[A] SMI is Shepherd Miller, Inc.

TABLE 3F

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 3B - MILL AREA WITHOUT TAILING

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration			
Top 12 inches	20.3 pCi/g	REM[A] 1987 tailing borings 3-1, 3-2, 3-3, 3-5 & 3-6	A-175, G-54
Lower 14 feet	5.5 pCi/g	Canonie 1989 composite surface sample C-3	A-38, G-54
		REM 1987 tailing borings 3-1, 3-2, 3-3, 3-5 & 3-6	A-175, G-55
Emanation Coefficient	0.35	Default value	G-56
Long Term Moisture	1.5%	Canonie coarse tailing sample, listed as sample 7	A-24, G-56
Dry Density	1.57 g/cm^3	Calculated from porosity and specific gravity	G-56
Specific Gravity	2.61	Canonie 1989 composite surface sample C-4, listed as sample 5	A-23, G-56
Porosity	0.4	Default value	G-56
Diffusion Coefficient			
Top 12 inches	5.744E-02 cm^2/sec	Calculated by the RADON model	G-36
Lower 14 feet	5.744E-02 cm^2/sec	Calculated by the RADON model	G-36
Source Term			
Top 12 inches	5.856E-05 pCi/sec/cm^3	Calculated by the RADON model	G-36
Lower 14 feet	1.587E-05 pCi/sec/cm^3	Calculated by the RADON model	G-36

[A] REM is Radiant Energy Management

TABLE 3G

Revised: December, 1993

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
RADON BARRIER LAYER MATERIAL (CODY SHALE)

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	0 pCi/g	Radium activity is neglected since the radon barrier layer material is obtained from an uncontaminated area	G-57
Emanation Coefficient	0	N/A[B]	N/A
Long Term Moisture	16.9%	SMI[A] Cody Shale composite sample #2	A-155, G-57
Dry Density			
90% Proctor	1.56 g/cm^3	SMI Cody Shale composite sample #2	A-155, G-57
95% Proctor	1.65 g/cm^3	SMI Cody Shale composite sample #2	A-155, G-57
Specific Gravity	2.78	SMI Cody Shale composite sample #2	A-155, G-57
Porosity	0.44	Calculated using dry density and specific gravity	G-57
	0.41	Calculated using dry density and specific gravity	G-57
Diffusion Coefficient			
90% Proctor	7.440E-03 cm^2/sec	Calculated by the RADON model	G-37
95% Proctor	4.068E-03 cm^2/sec	Calculated by the Radon model	G-37
Source Term	0	N/A	N/A

[A] SMI is Shepherd Miller, Inc.
[B] N/A is not applicable

TABLE 3H

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
BORROW SOIL LAYER

Input Parameter	Value Used in TRP #5	Source	Location in TRP #5 Page(s)
Radium Concentration	1.1 pCi/g	Assumed as agreed by WNI[A] and NRC[B] to account for the possible presence of affected soils in the sandy soil borrow area.	G-58
Emanation Coefficient	0.35	Default value	G-58
Long Term Moisture	2.0%	Assumed value typical for sandy soil	G-58
Dry Density	1.55 g/cm^3	Calculated from default specific gravity and porosity	G-58
Specific Gravity	2.65	Default value	G-58
Porosity	0.40	Default value	G-58
Diffusion Coefficient	5.395E-02 cm^2/sec	Calculated by the RADON model	G-22
Source Term	3.133E-06 pCi/sec/cm^3	Calculated by the RADON model	G-22

[A] WNI is Western Nuclear, Inc.
[B] NRC is Nuclear Regulatory Commission

TABLE 4
SUMMARY OF RADON BARRIER DESIGN INPUT PARAMETERS

Revised: December, 1993

AREA	RADIUM CONCENTRATION (pCi/g)	EMANATION COEFFICIENT	LONG TERM MOISTURE (%)	DRY DENSITY (g/cm^3)	SPECIFIC GRAVITY	POROSITY	DIFFUSION COEFFICIENT (cm^2/sec)	SOURCE TERM ($pCi/sec/cm^3$)
AREA 1A - EAST NEW TAILING	280	.28	1.5%	1.62	2.65	.39	5.667E-02	6.839E-04
AREA 1B - WEST NEW TAILING	450	.37	1.5%	1.55	2.59	.40	5.758E-02	1.355E-03
AREA 1C - OLD TAILING	341	.27	6.00%	1.61	2.65	.39	3.011E-02	7.982E-04
AREA 2A - ALTERNATE TAILING	448	.27	6.00%	1.64	2.65	.38	2.872E-02	1.096E-03
AREA 2B - OLD TAILING	341	.27	6.00%	1.61	2.65	.39	3.011E-02	7.982E-04
AREA 2C - WINTER STORAGE PONDS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AREA 3A - MILL AREA WITH TAILING	88.0	.27	6.00%	1.65	2.65	.38	2.856E-02	2.167E-04
AREA 3B - MILL AREA W/O TAILING								
TOP 1 FOOT	20.3	.35	1.5%	1.57	2.61	.40	5.744E-02	5.865E-05
LOWER 14 FEET	5.5	.35	1.5%	1.57	2.61	.40	5.744E-02	1.587E-05
RADON BARRIER LAYER MATERIAL								
90% PROCTOR	0	0	16.9	1.56	2.78	.44	7.440E-03	0
95% PROCTOR	0	0	16.9	1.65	2.78	.41	4.068E-03	0
BORROW SOIL	1.1	0.35	2.0	1.55	2.65	0.4	5.395E-02	3.133E-06

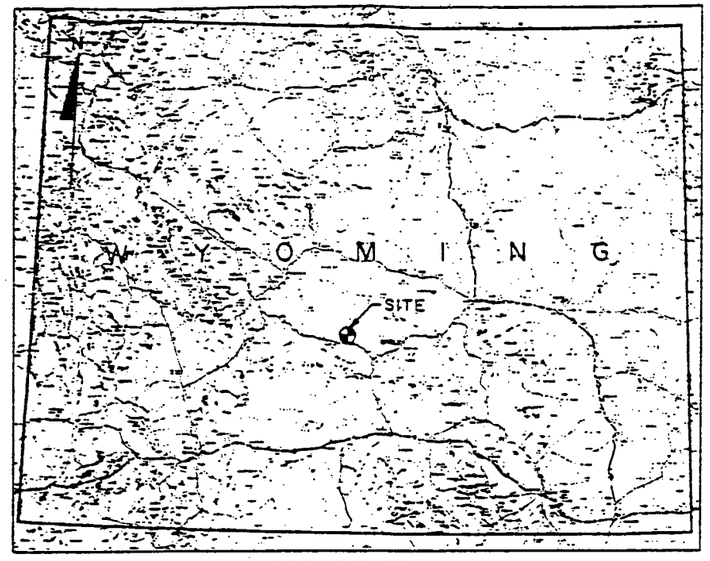
TABLE 5
SUMMARY OF FIELD TESTING AND INSPECTION FREQUENCIES

Quality Control Activity	NRC Staff Technical Position Frequency[a]
Radon Barrier Layer Material:	
Laboratory Density (i.e. standard proctor)	One test per every 15 field density tests
One-point proctor tests	One test per every 5 field density tests
Field test for moisture/density	One test for each 500 cubic yards (cy) or a minimum of two tests for each day of radon barrier layer material placed in excess of 150 cy and a minimum of one test for each lift and one test for each full shift of radon barrier layer material placement
Gradation tests	Minimum of one test each day of material in excess of 150 cy and one test per 1000 cy
Nuclear density gauge correlation	One sand cone test and one oven-dry test per every 10 nuclear density tests
Riprap, Filter and Rock for Soil/Rock Matrix:	
Gradation tests	One test prior to placement and one test for every 10,000 cy of each size of material placed with a minimum of 3 tests for each material size
Rock durability tests (specific gravity, absorption, soundness, L.A. Abrasion)	One test series prior to placement and one test series for every 10,000 cy of material from the rock source

[a] The August 1990 NRC Staff Technical Position Paper is officially titled "Testing and Inspection Plans during Construction of DOE's Remedial Action at Inactive Uranium Mill Tailings Sites."

FIGURES

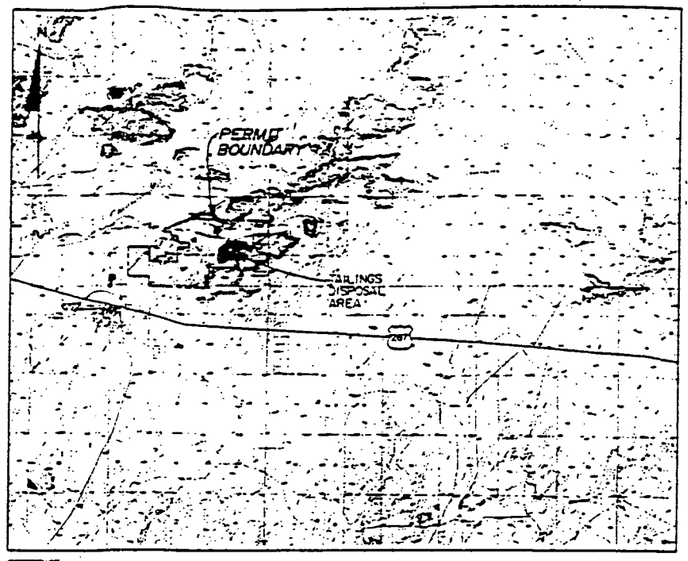
DRAWING NUMBER 91-225-E50



LOCATION MAP

SCALE
40 0 40 80 MILES

INDEX OF DRAWINGS		
FIGURE NO.	DRAWING NO.	TITLE
1 of 10	91-225-E50	TITLE SHEET
2 of 10	91-225-E51	1989 SITE CONDITIONS
3 of 10	91-225-E52	TEST PITS, BORINGS, AND BORROW AREA LOCATIONS
4 of 10	91-225-E53	RECLAIMED URANIUM MILL AND TAILINGS DISPOSAL AREA
5 of 10	91-225-E54	LIMITS OF EROSION PROTECTION AND DIVERSION DITCH LOCATIONS FOR RECLAIMED URANIUM MILL AND TAILINGS DISPOSAL AREA
6 of 10	91-225-E55	DIVERSION DITCH AND TAILINGS SWALE CROSS SECTIONS AND JUNCTION DETAILS
7 of 10	91-225-E56	EXISTING AND REGRADED SITE CROSS SECTIONS
8 of 10	91-225-E57	DIVERSION DITCH PROFILES
9 of 10	91-225-E58	TYPICAL EROSION APRON DETAILS
10 of 10	91-225-E59	COVER PROFILES AND DETAILS



REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF STAMPEDE MEADOW, JEFFREY CITY, SPLIT ROCK NW, AND BLACK ROCK SW, WYOMING.
DATED: 1951.

VICINITY MAP

SCALE
6000 0 6000 12000 FEET

RECLAMATION PLAN DRAWINGS
URANIUM MILL AND TAILINGS DISPOSAL AREA

JEFFREY CITY, WYOMING

PREPARED FOR

WESTERN NUCLEAR, INC.

9905170229-09

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	2-7-94	REISSUED FOR ADDENDUM A TO REVISION 5	T.G.B.	J.G.C.	J.G.C.
2	10-25-93	ISSUED FOR REVISION 5	T.G.B.	J.G.C.	J.G.C.
1	4-20-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	D.F.S.	P.E.C.	D.W.K.

SMI REVISED-DATE: OCTOBER, 1993

DATE: 4-10-92
SCALE: AS SHOWN

FIGURE 1

DRAWING NUMBER 91-225-E50 3

TITLE SHEET
PREPARED FOR
WESTERN NUCLEAR, INC.

CanonieEnvironmental

DRAWN BY | M.B.H. 2-14-89 | CHECKED BY | APPROVED BY | DRAWING NUMBER 88-194-E12

N

NORTHWEST WINDBLOWN TAILINGS AREA (129.3 acres)

NORTHEAST WINDBLOWN TAILINGS AREA (14.1 acres)

LOW-LEVEL ORE PAD (9.3 acres)

WINDBLOWN TAILINGS AREA (12.7 acres)

ACID PLANT COOLING POND AREA (7.3 acres)

WINDBLOWN TAILINGS AREA (5.2 acres)

CRUSHED GILSONITE

ORE PAD (0 acres)

ACID PLANT (1.1 acres)

MAIN OFFICE

GUARD HOUSE

RELAY STATION

ENHANCED EVAPORATION SYSTEM

EXISTING MISTER SYSTEM

BARGE WITH 2-75 HP PUMPS

EXISTING POND WATER ELEVATION 6374.4 FEET AS OF 2-10-89

NEW TAILINGS POND (127.2 acres)

MILL AREA EXISTING FOUNDATIONS AND CONCRETE SLABS (8.9 acres)

OLD TAILINGS POND (28.9 acres)

EXISTING MISTER SYSTEM

NEW TAILINGS EMBANKMENT

OLD TAILINGS EMBANKMENT

ALTERNATE TAILINGS POND (23.9 acres)

SEWAGE LAGOON (3.2 acres)

LOW LEVEL RADIOACTIVE WASTE BURIAL TRENCH (7.7 acres)

PERMIT BOUNDARY

E 7,000 E 8,000 E 9,000 E 10,000 E 11,000 E 12,000 E 13,000 E 14,000 E 15,000

N 9,000 N 8,000 N 7,000 N 6,000 N 5,000 N 4,000

NOTE:

1. EXISTING TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.

LEGEND:

APPROXIMATE EXTENT OF WINDBLOWN TAILINGS

EXTENT OF WINDBLOWN TAILINGS TO BE COVERED IN PLACE

EXISTING GROUND SURFACE CONTOUR ELEVATION ABOVE 6000 FEET

REFERENCE:
TOPOGRAPHY DIGITIZED FROM MAP PROVIDED BY WESTERN NUCLEAR, INC. PREPARED BY INTRASEARCH. SCALE: 1"=200'. DATED: 4-16-87.

SCALE
300 0 300 600 FEET

No.	DATE	ISSUE NUMBER / REVISIONS	DRWN BY / DATE	CHK'D BY / DATE	APP'D BY / DATE
1	3-31-89	ISSUED FOR USE AS CONSTRUCTION DRAWINGS	M.B.H. 3-31-89		

9905170229-10

EXISTING SITE CONDITIONS

PREPARED FOR

WESTERN NUCLEAR, INC.

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DATE: 2-14-99	FIGURE 2	DRAWING NUMBER 88-194-E12	REV. 1
SCALE: AS SHOWN			

DRAWING NUMBER 91-225-E52

NORTHWEST VALLEY SOIL BORROW

NORTHWEST VALLEY

ROCK ARMOR/RIPRAP BORROW

NORTHEAST VALLEY SOIL BORROW

TAILING

OLD EMBANKMENT TEST PIT

NEW EMBANKMENT TEST PIT

SOUTHWEST VALLEY

SOUTHWEST VALLEY SOIL BORROW

SOUTH SOIL BORROW

ARCHAEOLOGICAL SENSITIVE AREA

PERMIT BOUNDARY

NOTE:
1. EXISTING TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.

LEGEND:

- SMI-6 — 1993 SHEPHERD MILLER INC. BORING LOCATION AND DESIGNATION
- TP-11 — 1991 CANONIE TEST PIT LOCATION AND DESIGNATION
- SB-2 — 1991 CANONIE SOIL BORING LOCATION AND DESIGNATION
- MA-3,4 — 1991 CANONIE IN-SITU DENSITY TESTS FOR MILL AREA SOIL LOCATIONS
- 3-3 — 1987 WESTERN NUCLEAR, INC. INVESTIGATION APPROXIMATE TEST PIT LOCATIONS
- 20 — 1988 WATER, WASTE AND LAND, INC. INVESTIGATION APPROXIMATE TEST PIT LOCATIONS
- 7 — 1988 WATER, WASTE AND LAND, INC. INVESTIGATION APPROXIMATE BORING LOCATIONS
- C-2 — 1989 CANONIE APPROXIMATE SURFACE SAMPLE LOCATIONS.
- SS-1 — 1988 WATER, WASTE, AND LAND, INC. SURFACE SAMPLE LOCATIONS
- 7-5 — 1987 REM SAMPLE LOCATIONS
- SOIL BORROW AREA
- ROCK ARMOR/RIPRAP BORROW AREA

REFERENCE:
TOPOGRAPHY PREPARED BY INTRASEARCH DENVER, CO. FOR WESTERN NUCLEAR, INC.
DATED: 2-1-92
SCALE: 1"=200'
CONTOUR INTERVAL 2 FT.

SCALE
300 0 300 600 FEET

9905170229-11

TEST PITS, BORINGS, AND BORROW AREA LOCATIONS
PREPARED FOR
WESTERN NUCLEAR, INC.
CanonieEnvironmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	10-25-93	ISSUED FOR REVISION 5	T.G.B.	J.G.C.	J.G.C.
2	8-24-92	ISSUED FOR REVISION 4 ADDENDUM	D.F.S.	J.W.S	D.W.K.
1	4-20-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	S.C.C.	P.E.C.	D.W.K

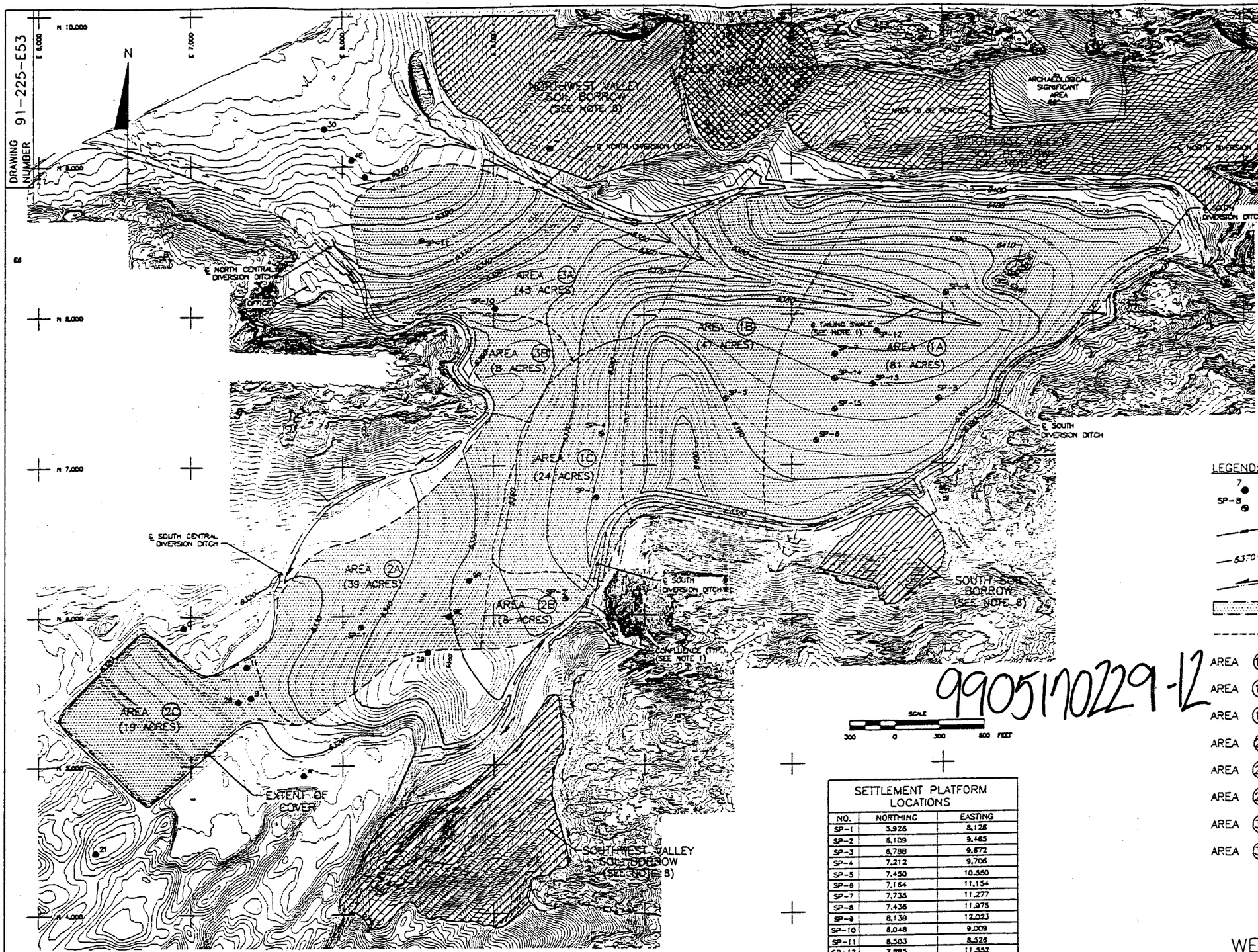
SMI REVISED DATE: OCTOBER, 1993

DATE: 3-16-92
SCALE: AS SHOWN

FIGURE 3

DRAWING NUMBER 91-225-E52 3

DRAWING NUMBER 91-225-E53



NOTES:

1. TYPICAL DETAIL OF DIVERSION DITCH CONFLUENCE IS SHOWN ON SHEET 9.
2. SETTLEMENT MONUMENT DETAIL IS SHOWN ON SHEET 10.
3. 1992 TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.
4. DETAILS OF SOIL COVER CONFIGURATIONS ARE SHOWN ON SHEET 10.
5. LOCATION OF EROSION PROTECTION IS SHOWN ON SHEET 5.
6. RECLAIMED CONTOUR ELEVATIONS INDICATE TOP OF SOIL/ROCK MATRIX FOR MILL AND TAILINGS DISPOSAL AREA.
7. SURFACE WATER CONTROL AND DETAILS ARE SHOWN ON SHEETS 5 THROUGH 9.
8. SOIL BORROW AREAS SHALL BE RECONTOURED TO PROVIDE DRAINAGE AND THEN REVEGETATED.

LEGEND:

- 7 ● MONITORING WELL
- SP-8 ⊗ SETTLEMENT PLATFORMS
- 1992 CONTOUR ELEVATION
- 6370 RECLAIMED CONTOUR ELEVATION
- DITCH LOCATION AND DIRECTION OF FLOW
- EXTENT OF SOIL COVER
- AREA BOUNDARY

AREA (1A) SOIL COVER CONFIGURATION 1A (SEE SHEET 10)
AREA (1B) SOIL COVER CONFIGURATION 1B (SEE SHEET 10)
AREA (1C) SOIL COVER CONFIGURATION 1C (SEE SHEET 10)
AREA (2A) SOIL COVER CONFIGURATION 2A (SEE SHEET 10)
AREA (2B) SOIL COVER CONFIGURATION 2B (SEE SHEET 10)
AREA (2C) SOIL COVER CONFIGURATION 2C (SEE SHEET 10)
AREA (3A) SOIL COVER CONFIGURATION 3A (SEE SHEET 10)
AREA (3B) SOIL COVER CONFIGURATION 3B (SEE SHEET 10)

SCALE
300 0 300 600 FEET

SETTLEMENT PLATFORM LOCATIONS

NO.	NORTHING	EASTING
SP-1	3,928	8,128
SP-2	5,109	9,465
SP-3	6,788	9,672
SP-4	7,212	9,706
SP-5	7,450	10,350
SP-6	7,164	11,154
SP-7	7,735	11,277
SP-8	7,436	11,975
SP-9	8,136	12,023
SP-10	8,048	9,009
SP-11	8,503	8,526
SP-12	7,885	11,552
SP-13	7,533	11,524
SP-14	7,571	11,276
SP-15	7,368	11,276

REFERENCE:
TOPOGRAPHY PREPARED BY INTRASEARCH DENVER, CO. FOR WESTERN NUCLEAR, INC.
DATED: 2-1-93
SCALE: 1"=200'
CONTOUR INTERVAL 2 FT.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
3	10-25-93	ISSUED FOR REVISION 5	T.S.B.	J.E.C.	J.E.C.
2	8-24-93	ISSUED FOR REVISION 4 ADDENDUM	M.T.H.	J.W.S.	D.W.K.
1	4-20-93	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	R.A.L.	P.E.C.	D.W.K.

9905170229-12

RECLAIMED URANIUM MILL
AND TAILINGS DISPOSAL AREA
PREPARED FOR
WESTERN NUCLEAR, INC.

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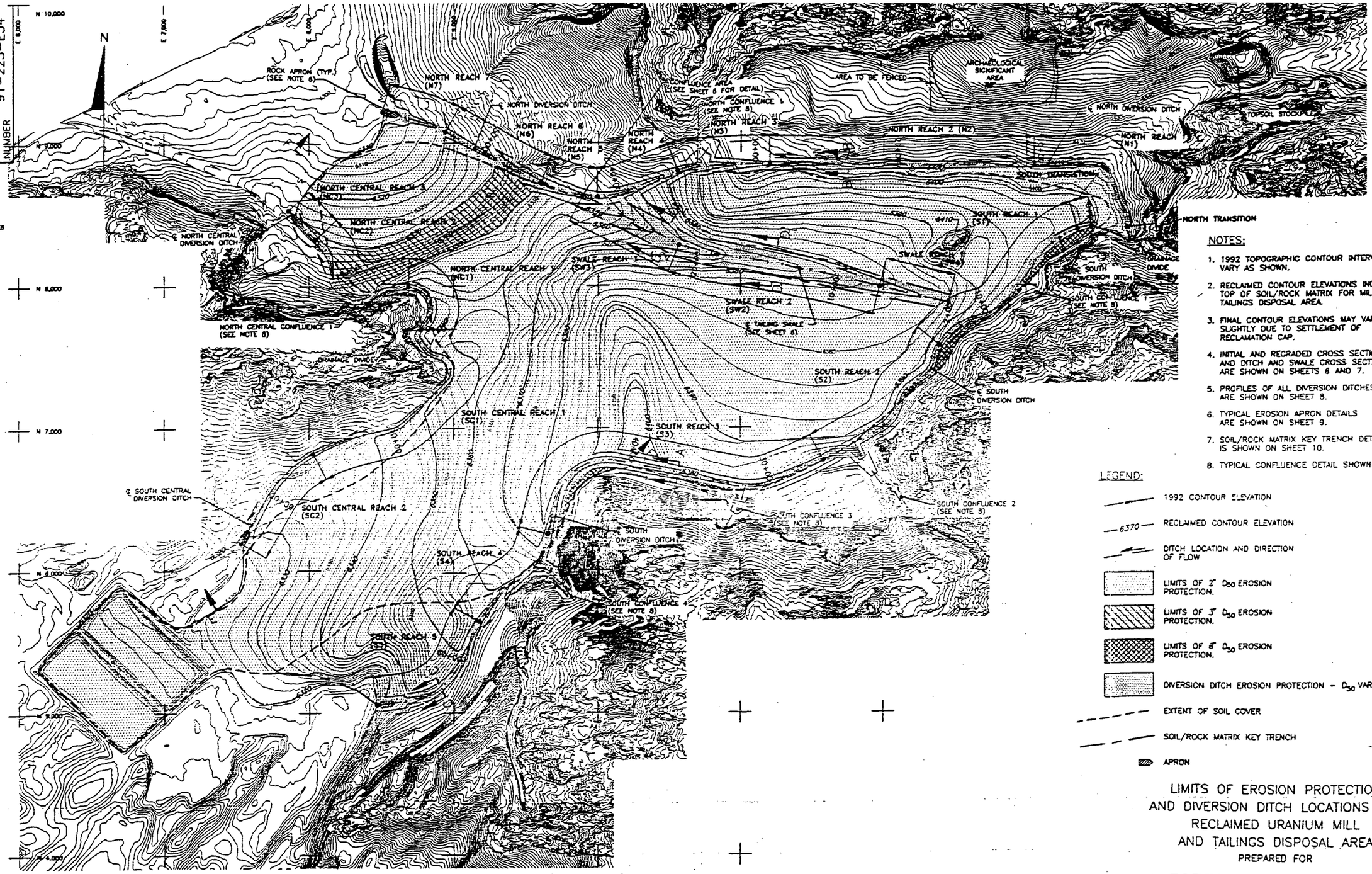
SMI REVISED DATE: OCTOBER, 1993

DATE: 3-5-92
SCALE: AS SHOWN

FIGURE 4

DRAWING NUMBER 91-225-553 3

DRAWING NUMBER 91-225-E54



NOTES:

1. 1992 TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.
2. RECLAIMED CONTOUR ELEVATIONS INDICATE TOP OF SOIL/ROCK MATRIX FOR MILL AND TAILINGS DISPOSAL AREA.
3. FINAL CONTOUR ELEVATIONS MAY VARY SLIGHTLY DUE TO SETTLEMENT OF RECLAMATION CAP.
4. INITIAL AND REGRADED CROSS SECTIONS AND DITCH AND SWALE CROSS SECTIONS ARE SHOWN ON SHEETS 6 AND 7.
5. PROFILES OF ALL DIVERSION DITCHES ARE SHOWN ON SHEET 8.
6. TYPICAL EROSION APRON DETAILS ARE SHOWN ON SHEET 9.
7. SOIL/ROCK MATRIX KEY TRENCH DETAIL IS SHOWN ON SHEET 10.
8. TYPICAL CONFLUENCE DETAIL SHOWN ON SHEET 9.

LEGEND:

- 1992 CONTOUR ELEVATION
- 6370 RECLAIMED CONTOUR ELEVATION
- DITCH LOCATION AND DIRECTION OF FLOW
- LIMITS OF 2" D_{50} EROSION PROTECTION.
- LIMITS OF 3" D_{50} EROSION PROTECTION.
- LIMITS OF 6" D_{50} EROSION PROTECTION.
- DIVERSION DITCH EROSION PROTECTION – D_{50} VARIES
- EXTENT OF SOIL COVER
- SOIL/ROCK MATRIX KEY TRENCH
- APRON

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
4	1-18-94	ADDENDUM A TO REVISION 3	T.G.B.	L.L.M.	L.L.M.
3	10-25-93	ISSUED FOR REVISION 3	T.G.B.	J.G.C.	J.G.C.
2	8-24-92	ISSUED FOR REVISION 4 ADDENDUM	M.T.H.	J.W.S.	D.W.K.
1	4-20-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	D.F.S.	P.E.C.	D.W.K.

REFERENCE:
TOPOGRAPHY PREPARED BY INTRASEARCH DENVER, CO. FOR WESTERN NUCLEAR, INC.
DATED: 2-1-92
SCALE: 1"=200'
CONTOUR INTERVAL 2 FT.

SCALE
300' 0 300 600 FEET

LIMITS OF EROSION PROTECTION AND DIVERSION DITCH LOCATIONS FOR RECLAIMED URANIUM MILL AND TAILINGS DISPOSAL AREA

PREPARED FOR

WESTERN NUCLEAR, INC.

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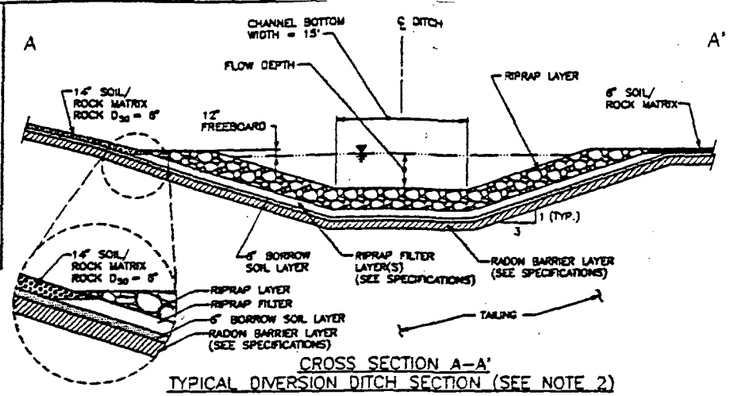
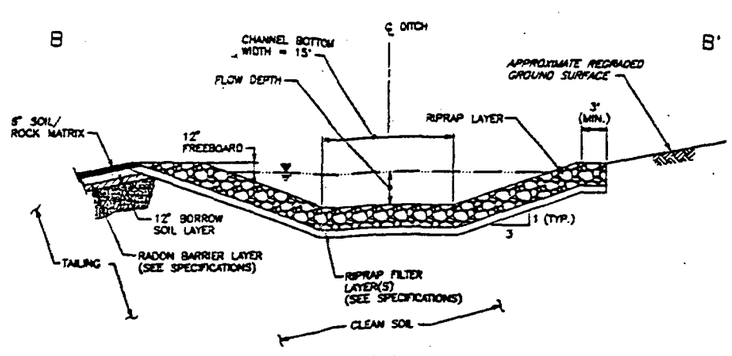
SMI REVISED DATE: OCTOBER, 1993	DATE: 3-16-92	FIGURE 5	DRAWING NUMBER 91-225-E54
	SCALE: AS SHOWN		4

9905170229-13

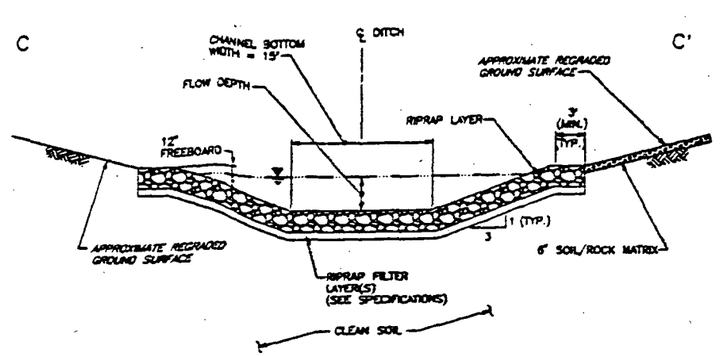
DRAWING NUMBER 91-225-E55



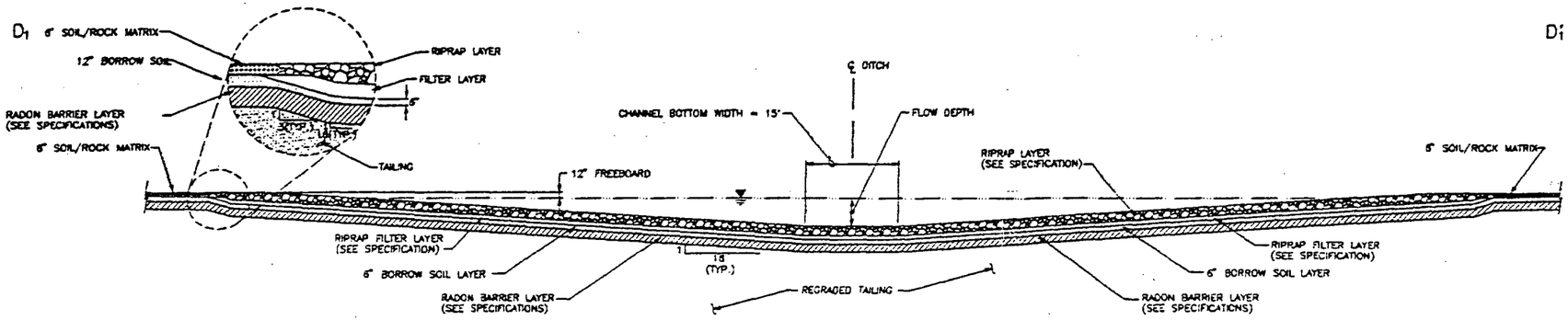
CROSS SECTION A–A'
TYPICAL DIVERSION DITCH SECTION (SEE NOTE 2)



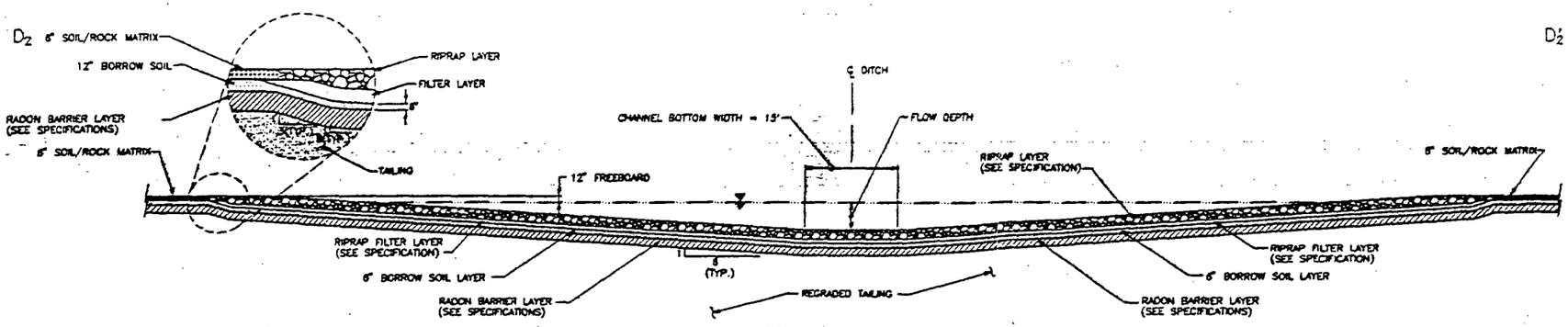
CROSS SECTION B–B'
TYPICAL DIVERSION DITCH SECTION (SEE NOTE 3)



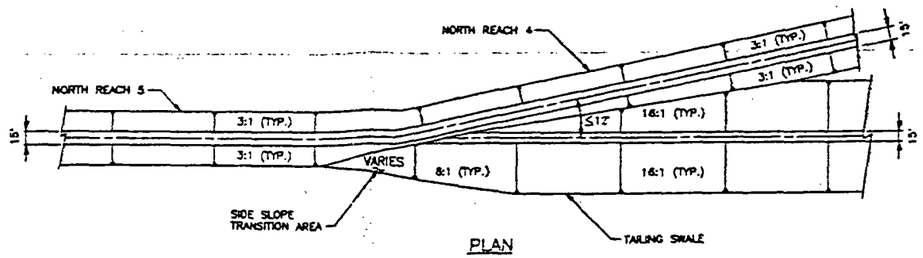
CROSS SECTION C–C'
TYPICAL DIVERSION DITCH SECTION (SEE NOTE 4)



CROSS SECTION D_1 – D_1'
TAILING SWALE



CROSS SECTION D_2 – D_2'
TAILING SWALE



PLAN
TAILING SWALE AND
NORTH DIVERSION DITCH JUNCTION

NOTES:

1. PLAN LOCATIONS OF CROSS SECTIONS AND LOCATIONS OF DITCHES AND REACHES ARE SHOWN ON SHEET 5.
2. TYPICAL OF NORTH CENTRAL 1, FIRST FEW HUNDRED FEET OF SOUTH CENTRAL 1, SOUTH 1, 2, AND 3.
3. TYPICAL OF NORTH CENTRAL 2 AND 3, AND ALL NORTH REACHES.
4. TYPICAL OF LAST SEVERAL HUNDRED FEET OF SOUTH CENTRAL 1, SOUTH CENTRAL 2, SOUTH 4, AND SOUTH 5 (i.e. BEYOND EXTENT OF TAILING IMPOUNDMENT).
5. DITCH SECTION DIMENSIONS AND RIPRAP AND FILTER GRADATIONS ARE GIVEN IN THE SPECIFICATIONS.
6. DITCH PROFILES ARE SHOWN ON SHEET 8.
7. THIS DRAWING IS NOT TO SCALE.

9905170229-14

DIVERSION DITCH AND TAILINGS SWALE
CROSS SECTION AND JUNCTION DETAILS
PREPARED FOR
WESTERN NUCLEAR, INC.

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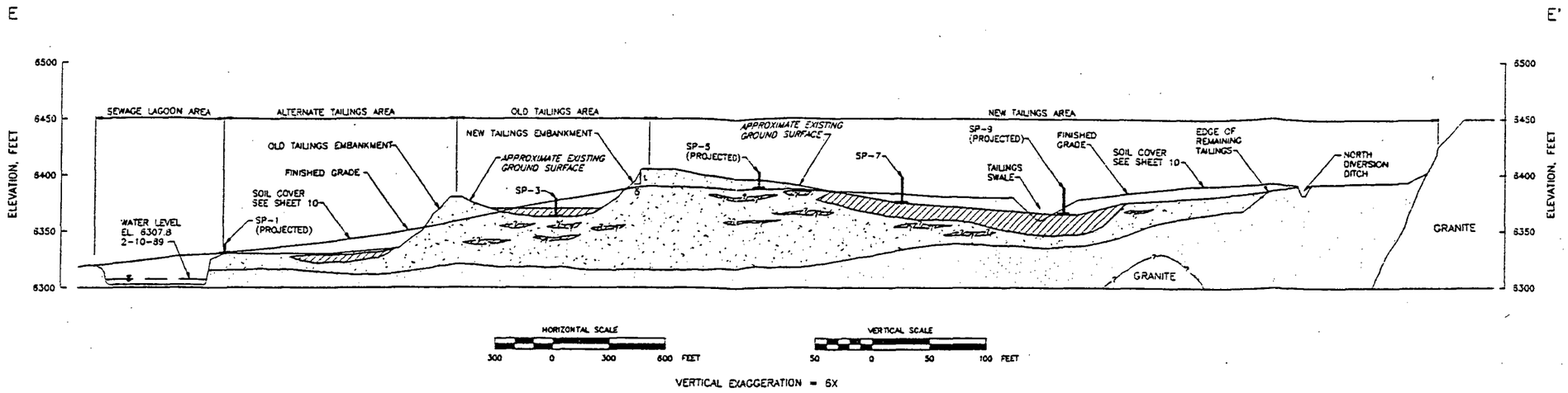
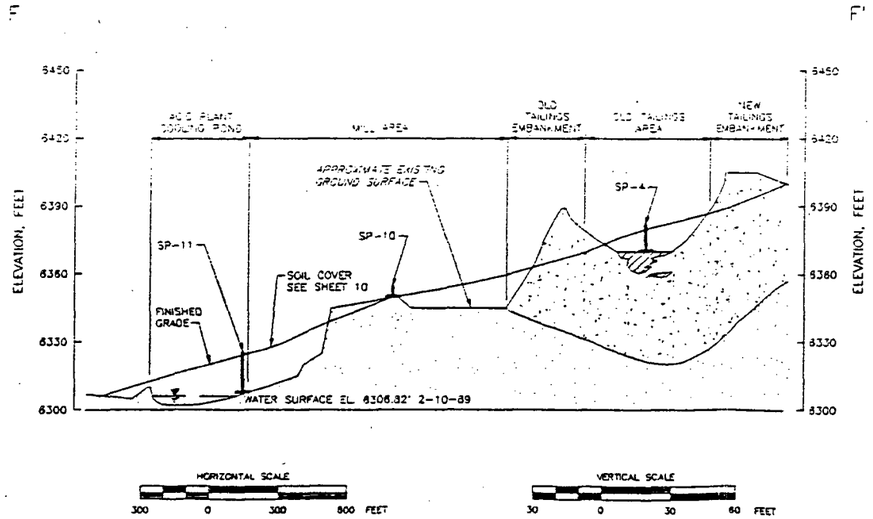
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	APP'D BY
3	1-18-94	ADDENDUM A TO REVISION 3	S.L.S.	L.L.M.	L.L.M.
2	10-25-93	ISSUED FOR REVISION 3	T.G.B.	J.G.C.	J.G.C.
1	8-24-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	R.A.L.	J.W.S.	D.W.K.

SMI REVISED DATE: OCTOBER, 1993 | DATE: 3-16-92 | SCALE: AS SHOWN | FIGURE 6 | DRAWING NUMBER 91-225-E55 | 3

DRAWING NUMBER 91-225-E56



CROSS SECTION E-E'



CROSS SECTION F-F'

NOTES:

1. CROSS SECTION LOCATIONS SHOWN ON SHEET 5
2. FINISHED GRADE REPRESENTS TOP OF EROSION PROTECTION ELEVATION (1992 DESIGN).
3. SETTLEMENT PLATFORMS WITHIN 200 FEET OF SECTION ARE SHOWN.

LEGEND

- COARSE TAILINGS
- INTERBEDDED SLIMES APPROXIMATE LOCATION
- NATURAL SAND
- SP-4 — SETTLEMENT PLATFORM LOCATION AND DESIGNATION

9905170229-15

EXISTING AND REGRADED
SITE CROSS SECTIONS
PREPARED FOR

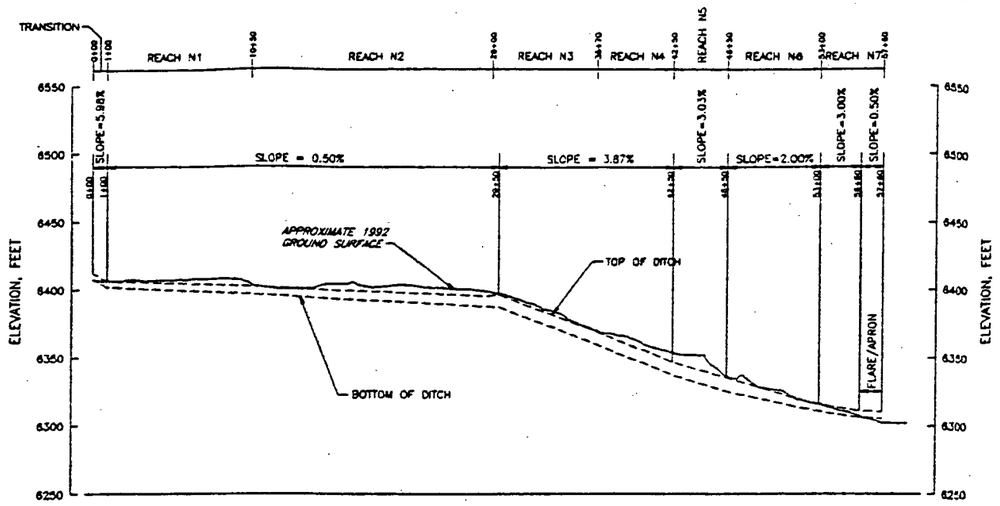
WESTERN NUCLEAR, INC.

CanonieEnvironmental

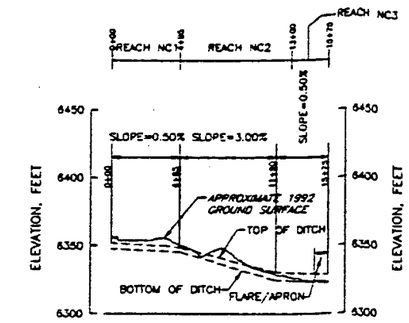
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1	4-20-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	S.C.G.	P.E.C.	D.W.K.

DATE: 3-17-92	FIGURE 7	DRAWING NUMBER 91-225-E56	1
SCALE: AS SHOWN			

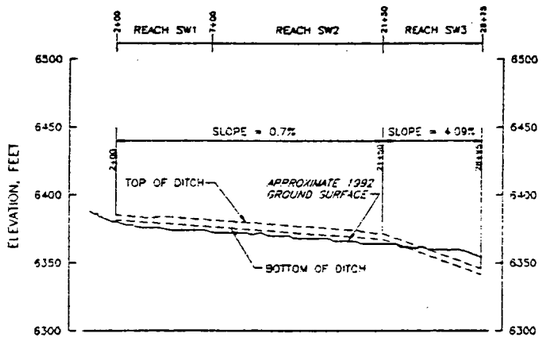
DRAWING NUMBER 91-225-E57



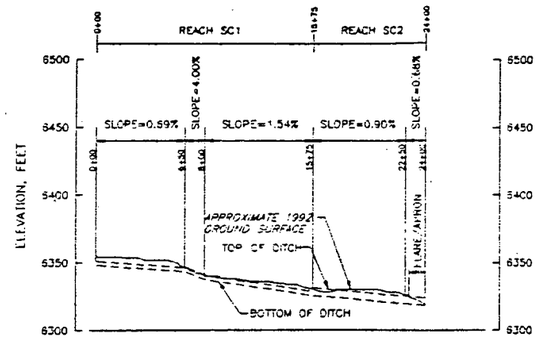
NORTH DIVERSION DITCH PROFILE
(LOOKING SOUTH)



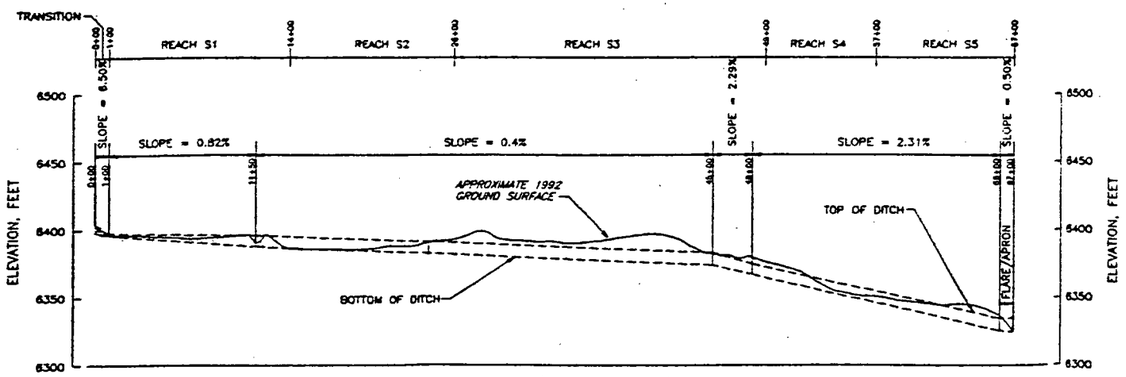
NORTH CENTRAL DIVERSION DITCH PROFILE
(LOOKING SOUTHWEST)



TAILING SWALE PROFILE
(LOOKING SOUTHWEST)



SOUTH CENTRAL DIVERSION DITCH PROFILE
(LOOKING SOUTHEAST)



SOUTH DIVERSION DITCH PROFILE
(LOOKING SOUTHEAST)

NOTE:

1. SEE SHEET 5 FOR DIVERSION DITCH LOCATIONS.

VERTICAL SCALE
50 0 50 100 FEET

HORIZONTAL SCALE
500 0 500 1000 FEET

VERTICAL EXAGGERATION = 10x

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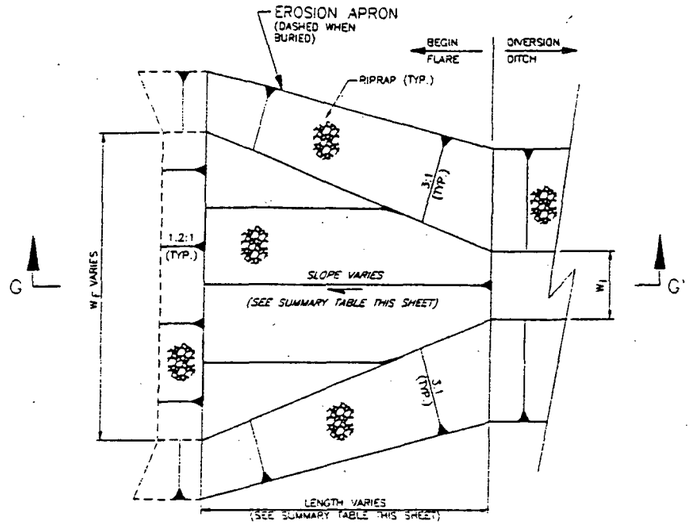
DIVERSION DITCH PROFILES
PREPARED FOR
WESTERN NUCLEAR, INC
Canonie Environmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
2	10-23-93	ISSUED FOR REVISION 3	T.C.S.	J.G.C.	J.G.C.
1	8-24-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	S.K.R.	J.W.S.	D.W.K.

SMI REVISED DATE: OCTOBER, 1993 | DATE: 3-18-92 | SCALE: N.T.S. | FIGURE 8 | DRAWING NUMBER 91-225-E57 | 2

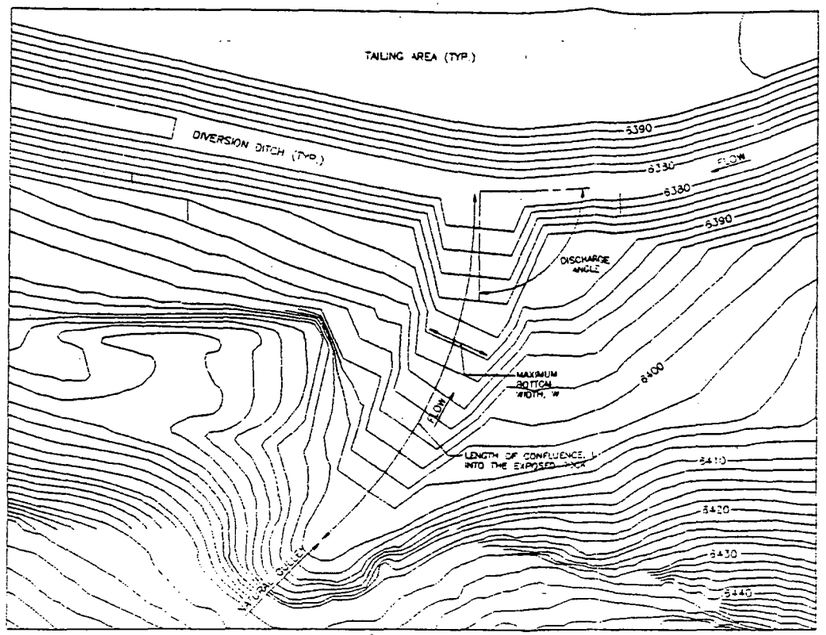
DRAWING NUMBER 91-225-E58



PLAN

RIPRAPPED EROSION APRON (TYP.)

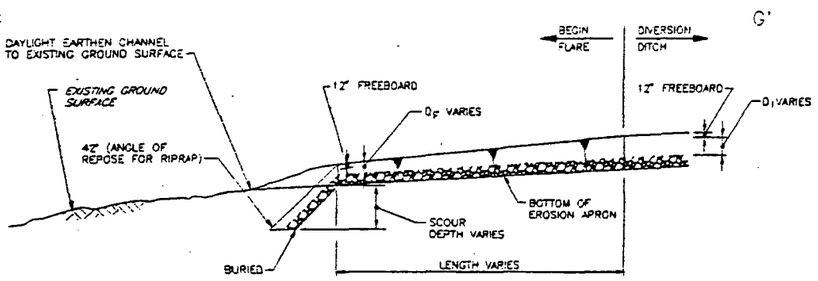
NOT TO SCALE



PLAN

CONFLUENCE DETAIL (TYP.)

NOT TO SCALE



SIDE VIEW

SECTION G-G'

NOT TO SCALE

SUMMARY TABLE OF APRON CHARACTERISTICS

CHANNEL REACH	CHANNEL AND APRON SLOPE (ft/ft)	BOTTOM WIDTH (ft)		FLOW DEPTH (ft)		LENGTH (ft)	SCOUR DEPTH (ft)
		INITIAL	FINAL	INITIAL	FINAL		
NORTH DIVERSION DITCH OUTLET	0.0050	15	90	7.30	3.06	100	13.1
SOUTH DIVERSION DITCH OUTLET	0.0050	15	90	7.70	2.37	100	12.6
SOUTH CENTRAL DIVERSION DITCH OUTLET	0.0065	15	50	5.08	2.09	50	7.0
NORTH CENTRAL DIVERSION DITCH OUTLET	0.0050	15	50	3.85	1.47	50	5.4

SUMMARY TABLE OF CONFLUENCE CHARACTERISTICS

CONFLUENCE	SLOPE (ft/ft)	BOTTOM WIDTH (ft)	FLOW DEPTH (ft)	LENGTH (ft)	DISCHARGE ANGLE
NORTH	0.092	100	0.66	325	46
NORTH CENTRAL 1	0.332	75	0.20	96.5	89
SOUTH 1	0.0625	75	0.81	160	79
SOUTH 2	0.07	50	1.20	311	70
SOUTH 3	0.113	50	0.80	250	90
SOUTH 4	0.057	50	1.21	258	60

NOTES:

1. DETAILS ARE TYPICAL OF EROSION APRONS AT THE TERMINATION OF EACH DIVERSION DITCH (4 TOTAL).
2. PLAN LOCATION OF EACH APRON SHOWN ON SHEET 5.
3. THIS DRAWING IS NOT TO SCALE.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
5	1-18-94	ADDENDUM A ISSUED FOR REVISION 5	T.G.B.	L.L.M.	L.L.M.
4	10-25-93	ISSUED FOR REVISION 5	T.G.B.	J.G.C.	J.G.C.
3	8-24-92	ISSUED FOR REVISION 4 ADDENDUM	S.C.G.	J.W.S.	D.W.K.
2	4-20-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	B.K.R.	P.E.C.	D.W.K.

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TYPICAL EROSION APRON DETAILS

PREPARED FOR

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SMI REVISED DATE: OCTOBER, 1993

DATE: 3-17-92

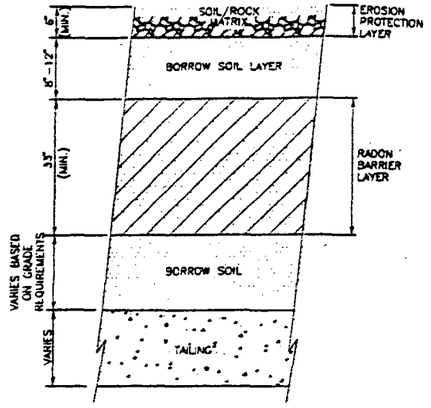
SCALE: N.T.S.

FIGURE 9

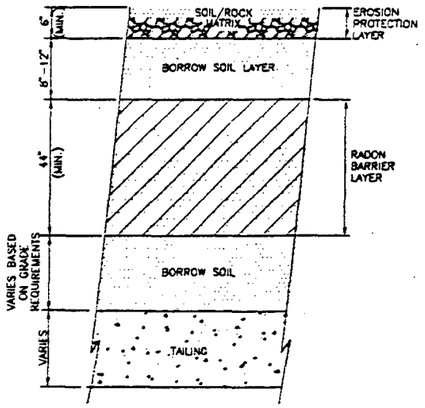
DRAWING NUMBER 91-225-E58

5

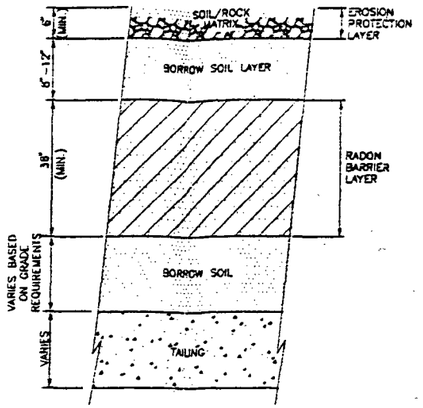
DRAWING NUMBER 91-225-E59



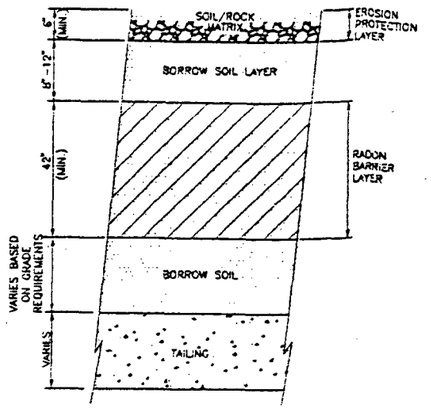
AREA 1A
FINAL SOIL LAYER PROFILE
EAST NEW TAILING



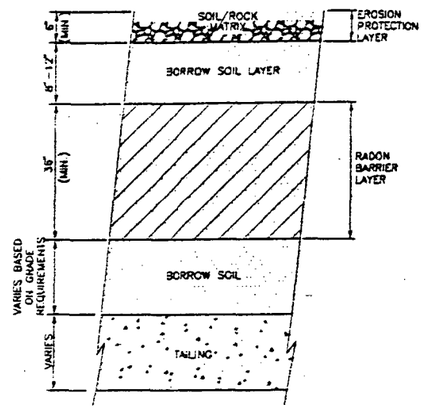
AREA 1B
FINAL SOIL LAYER PROFILE
WEST NEW TAILING



AREA 1C
FINAL SOIL LAYER PROFILE
OLD TAILING



AREA 2A
FINAL SOIL LAYER PROFILE
ALTERNATE TAILING

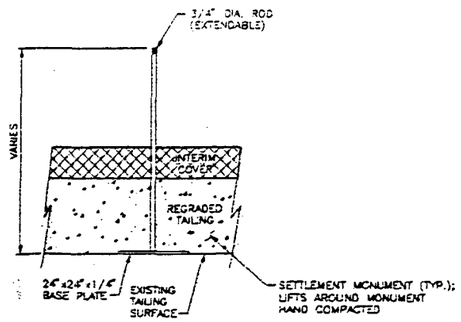


AREA 2B
FINAL SOIL LAYER PROFILE
OLD TAILING

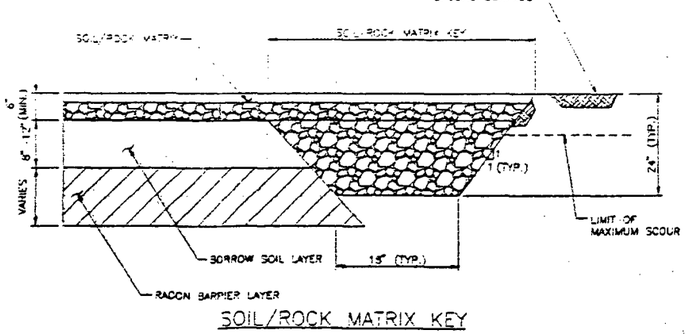
9905170229-18

AREA 3A
FINAL SOIL LAYER PROFILE
MILL AREA TAILING

AREA 3B AND 2C
FINAL SOIL LAYER PROFILE
MILL/WINTER STORAGE POND AREA SOILS



SETTLEMENT MONUMENT (TYP.)
(SEE NOTE 2)



SOIL/ROCK MATRIX KEY

NOTES:

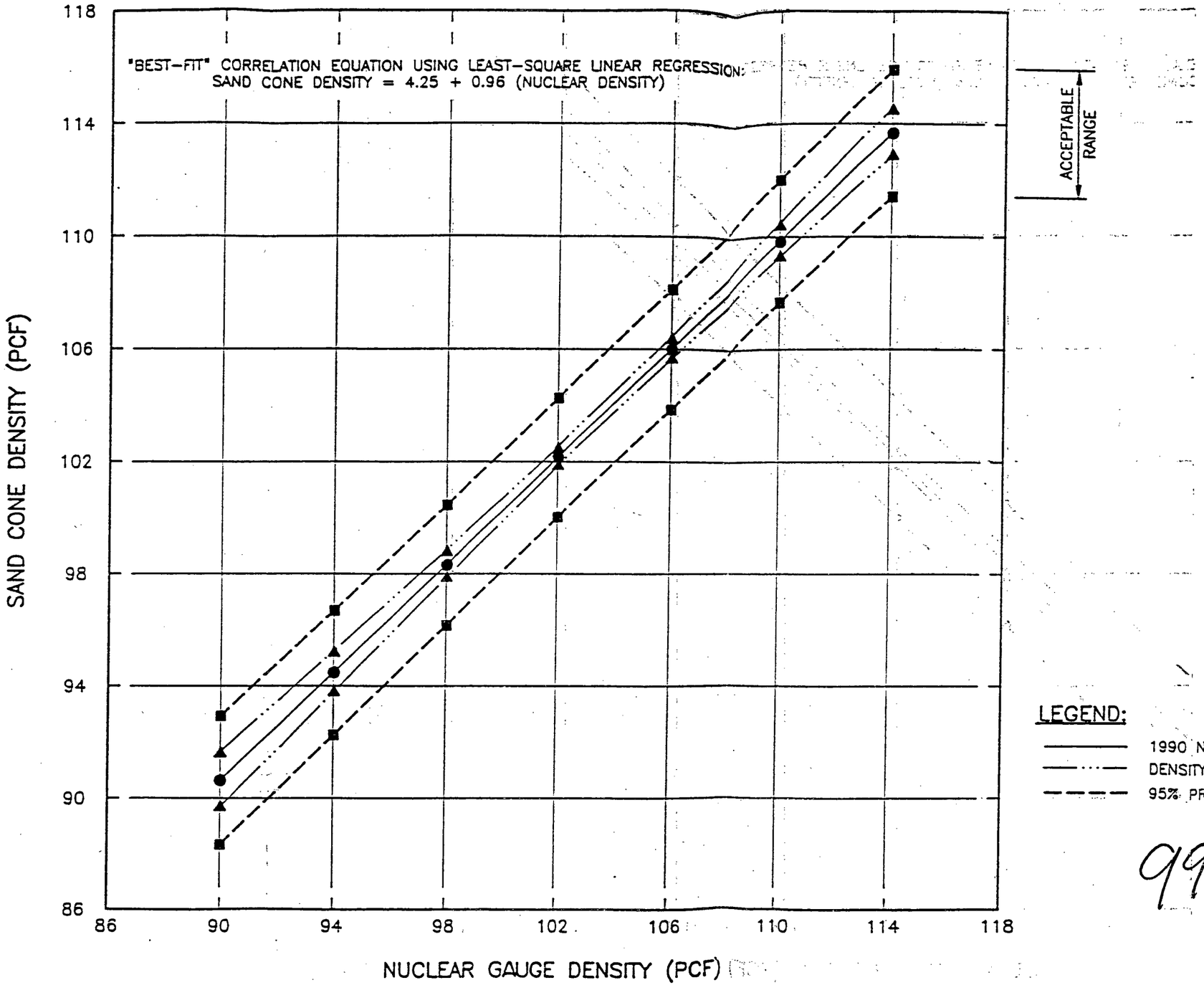
1. PLAN LOCATION OF SOIL LAYER CONFIGURATIONS IS SHOWN ON SHEET 4.
2. PLAN LOCATION OF SETTLEMENT MONUMENTS IS SHOWN ON SHEET 4.
3. THIS DRAWING IS NOT TO SCALE.

COVER PROFILES AND DETAILS
PREPARED FOR
WESTERN NUCLEAR, INC.
Canonie Environmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
4	1-18-94	ADDENDUM A TO REVISION 5	S.L.S.	L.L.M.	L.L.M.
3	12-9-93	REVISION TO REVISION 5	T.G.B.	J.G.C.	L.L.M.
2	10-25-93	ISSUED FOR REVISION 5	T.G.B.	J.G.C.	J.G.C.
1	8-24-92	ISSUED FOR USE AS RECLAMATION PLAN DRAWING	S.C.G.	J.W.S.	D.W.K.

SMI — REVISED DATE: DECEMBER, 1993 | DATE: 3-17-92 | SCALE: N.T.S. | FIGURE 10 | DRAWING NUMBER 91-225-E59 | 4

DRAWING NUMBER 91-225-B61



LEGEND:

- 1990 NUCLEAR GAUGE AND SAND CONE DENSITY DATA
- DENSITY DATA 95% CONFIDENCE BOUNDS
- 95% PREDICTION INTERVAL

9905170229-19

LINEAR REGRESSION OF
NUCLEAR GAUGE/SAND CONE DENSITY

PREPARED FOR

WESTERN NUCLEAR, INC.

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No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	APP'D BY
1	4-15-92	ISSUED FOR TECHNICAL SPECIFICATIONS	B.K.R.	REC	DWK

DATE: 3-27-92	FIGURE 11	DRAWING NUMBER 91-225-B61
SCALE: AS SHOWN		

1