Department of Energy
Washington, DC 20585

WM-00064

January 21, 2016

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Deputy Director
Mail Stop T8F5
Washington, DC 20555-0001

Subject: Transmittal of 2015 Rock Monitoring Data and Results, Lakeview, Oregon, Uranium Mill Tailings Radiation Control Act Title I Disposal Site

To Whom It May Concern:

This letter transmits the 2015 rock gradation and durability monitoring data and results from the U.S. Department of Energy Office of Legacy Management's (DOE-LM's) annual inspection of the Lakeview, Oregon, disposal site on September 16 and 17, 2015. Rock monitoring is performed annually of the disposal cell's basalt erosion control riprap on the west-facing side slope. At the request of the U.S. Nuclear Regulatory Commission (NRC), the 2015 monitoring approach deviated from the established monitoring procedure by using pre-determined grid monitoring locations within a subset area of the west-facing side slope instead of randomly-selected monitoring locations on the entire west-facing side slope.

Enclosed are:

- Table 1, which identifies the 2015 monitoring locations.
- Table 2, which consists of a data sheet showing the overall 2015 mean diameter (D_{50}) value rock gradation monitoring result and the results by monitoring location.
- Table 3, which provides the rock type classifications developed for the site. This table identifies the rock types, which are representative of the rocks found on the side slopes, provides rock descriptions, and assigns a durability class and code (ranging from "highly durable" to "nondurable – crumbled/rubblized"). The Table 3 durability classes were assigned by a geologist/mineralogist's examination of the rocks.
- Tables 4 through 6, which present the 2015 durability results. Table 4 provides the durability monitoring results by rock count and shows the correlation between rock size and durability class. Table 5 provides the percentage of each durability class by sieve size. Table 6 provides the percentage of sieve size by durability class.
- The monitoring field data log, which was requested by NRC.

General observations about the data:

- The 2015 rock size measurement gradation data indicates that for the sampled locations within the subset area of the west-facing side slope, the riprap D_{50} is 2.39 inches with a 95 percent confidence interval between 2.21 and 2.56 inches. This D_{50} value falls below the original D_{50} design size range of 2.7 to 3.9 inches for the Type B size side slope riprap.

NMSS20

- Over forty four percent of the total rock sampled is 2.5 inch or larger.
- Seventy four percent of the total rock sampled is durability class code A "highly durable" or durability class code B "durable."
- Over 70 percent of the 4 inch or larger rock is durability class code B "durable."
- Over 90 percent of the 3 inch or larger rock is durability class code A or B.
- Over 80 percent of the 1.5 inch or larger rock is durability class code A or B.
- The smallest rock (less than 1 inch) is mostly durability class code Da "susceptible to near-term degradation."
- Only 6.8 percent of the rock in this biased sample is "moderately durable" (durability class codes Ca and Cb), and less than 18 percent of the total sampled rock is "susceptible to near-term degradation" (durability class codes Da and Db).

Please reference DOE-LM's letter dated March 2, 2015, for further discussion on the rock monitoring and degradation at the Lakeview disposal site.

Also, be advised that I am now the DOE-LM site manager for the Lakeview site. Please call me at (970) 248-6073 if you have any questions. Please send any correspondence to:

U.S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

Sincerely,

Richard P. Bush
Site Manager

Enclosure:

cc w/ enclosure:
Z. Cruz, NRC
M. Meyer, NRC
D. Engstrom, ORDOE
J. Carman, Navarro (e)
C. Goodknight, Navarro (e)
A. Houska, Navarro (e)
S. Smith, Navarro (e)
File: LKD 045.15 (rc-grand junction)

Sites\LKD\1-20-16 LKD 2015 Rock Monitoring Results (NRC).docx

Table 1. 2015 Rock Monitoring Locations[1]

Sample Year 2015[1]	Non-random[1] Sample Location[2]	
Sample Number	**Longitudinal[3] Distance (ft.)**	**Transverse[4] Distance (ft.)**
1	675	25
2	625	25
3	575	25
4	525	25
5	475	25
6	675	75
7	625	75
8	575	75
9	525	75
10	475	75
11	675	125
12	625	125
13	575	125
14	525	125
15	475	125
16	675	175
17	625	175
18	575	175
19	525	175
20	475	175

[1] At the request of the U.S. Nuclear Regulatory Agency, the 2015 monitoring approach deviated from the established monitoring procedure by using grid monitoring locations within a subset area of the west-facing side slope, instead of using randomly selected monitoring locations on the entire west side slope.

[2] The sample location coordinates use a local site reference point (coordinate 0 longitude, 0 transverse), which is the southern contact boundary between the cell top and west-facing side slope.

[3] Longitudinal distance measurements increase to the north.

[4] Transverse distance measurements increase to the west.

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Table 2. 2015 Rock Gradation Monitoring Results

9/16-17/2015 LAKEVIEW

D_{50} by size - 5 seives

Note: D_{50} is the mean rock size at a given location

sample	total	number retained						cumulative number passing					cumulative percent passing					D_{50}	
number	painted	4 - inch	3 - inch	2.5 - inch	1.5 - inch	1.0-inch	<1-inch	4 - inch	3 - inch	2.5 - inch	1.5 - inch	1.0 - inch	4 - inch	3 - inch	2.5 - inch	1.5 - inch	1.0 - inch	(inch)	P/F
CP 12	25	0	0	1	13	5	6	25	25	24	11	6	100	100	96	44	24	1.62	F
CP 3	24	0	7	7	7	2	1	24	17	10	3	1	100	71	42	13	4	2.64	F
CP 13	24	1	5	0	12	2	4	23	18	18	6	4	96	75	75	25	17	2.00	F
CP 4	26	1	10	5	7	2	1	25	15	10	3	1	96	58	38	12	4	2.80	P
CP 14	24	2	5	2	10	1	4	22	17	15	5	4	92	71	63	21	17	2.20	F
CP 5	24	3	7	1	9	4	0	21	14	13	4	0	88	58	54	17	0	2.39	F
CP 15	24	1	6	7	5	3	2	23	17	10	5	2	96	71	42	21	8	2.64	F
CP 6	25	1	5	5	12	0	2	24	19	14	2	2	96	76	56	8	8	2.35	F
CP 16	25	0	7	5	10	3	0	25	18	13	3	0	100	72	52	12	0	2.45	F
CP 7	24	1	13	4	6	0	0	23	10	6	0	0	96	42	25	0	0	3.15	P
CP 17	25	1	1	8	10	5	0	24	23	15	5	0	96	92	60	20	0	2.25	F
CP 8	25	2	2	4	11	4	2	23	21	17	6	2	92	84	68	24	8	2.09	F
CP 18	24	1	8	3	11	1	0	23	15	12	1	0	96	63	50	4	0	2.50	F
CP 9	25	2	5	5	8	4	1	23	18	13	5	1	92	72	52	20	4	2.44	F
CP 19	25	2	3	4	11	4	1	23	20	16	5	1	92	80	64	20	4	2.18	F
CP 10	25	1	2	5	10	3	4	24	22	17	7	4	96	88	68	28	16	2.05	F
CP 20	22	3	7	5	7	0	0	19	12	7	0	0	76	48	28	0	0	3.07	P
total sum	416	22	93	71	159	43	28	394	301	230	71	28	95	72	55	17	7	2.36	F

9/16-17/2015	
Mean	2.39
Standard E	0.09
Median	2.41
Mode	2.64
Standard D	0.399
Sample Va	0.160
Range	1.54
Minimum	1.62
Maximum	3.15
Count	20
95% conf. int.	2.56
	2.21

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Table 3. Rock Types and Durability Classes and Subclasses

Rock Type Identification Number	Rock Type Description	Durability Class	Durability Class Code	Durability Subclass Code
1	Dense, hard, very fine-grained, dark gray basalt with no joints, fractures, white deposits, or alteration.	Highly Durable	A	Au
	As above in Au, except with tight, hairline fracture(s). Asterisk indicates the number of tight, hairline fractures.		A	Ah*
	As above in Au, except with open fracture(s). Asterisk indicates the number of open fractures in the rock that are ready to split.		A	Ao*
	As above in Au, except that the rock has split along fractures since placement on the cover, but the rocks are still in place.[1]		A	As
2	Dense, hard, dark gray to grayish brown, olivine basalt. No joints or white deposits; olivine phenocrysts have altered to amber and brown material representing various minerals such as iddingsite, antigorite, chlorite, and nontronite. On some exposed surfaces, altered olivine phenocrysts have weathered out to give a vesicular appearance.	Durable	B	----
3a	Dense, fine-grained, grayish brown to brown basalt with hairline fractures. Basalt is slightly altered and fractured outer surfaces have a brown, limonite-like coating.	Moderately Durable	Ca	----
3b	Greenish gray to green, dense basalt with hairline fractures. Some fractures may have white or light brown coatings. Deuteric and hydrothermal alteration have imparted a distinctive greenish cast to the basalt resulting from alteration of calcic plagioclase to the more sodic plagioclase, albite-oligoclase.	Moderately Durable	Cb	----
4a	Fine-grained, highly fractured gray to greenish gray basalt. Hairline to open fractures are mostly coated with white to pink calcite and commonly with the zeolite mineral, analcime.	Susceptible to Near-Term Degradation	Da	----
4b	Greenish gray to grayish brown olivine basalt that is highly fractured. Olivine phenocrysts have altered to brown material, possibly nontronite.	Susceptible to Near-Term Degradation	Db	----
5	Fine- to medium-grained, soft, grayish green, highly altered basalt. Rock has a granular appearance, has relatively low specific gravity, is probably highly chloritized, and it has commonly disintegrated (rubblized) into pieces smaller than 1 inch in diameter.	Nondurable - Crumbled/ Rubblized	E	----
6	Non-basaltic rocks such as sandstone or quartzite.	Highly Durable to Nondurable	F	----

[1] "As" must be determined while the rocks are still in place on the side slope before the rocks are picked up for gradation monitoring. The size of the monitored rock reflects the size of the selected/marked split piece, not the size of the pre-split rock.

Table 4. 2015 Durability Monitoring – Percent of Total Rock Count By Durability Class and Sieve Size

Durability Class & Subclass	Rock Count by Sieve Size (Retained on Sieve)						Total By Durability Class	Percent of Total
	4 Inch	3 Inch	2.5 Inch	1.5 Inch	1 Inch	< 1 Inch		
Class Au	1	9	12	48	18	6	94	19.3
Class As	1	0	0	2	1	0	4	0.8
Class Ao1	0	6	2	15	2	0	25	5.1
Class Ao2	0	8	8	4	1	0	21	4.3
Class Ao3	0	0	0	0	0	0	0	0
Class Ao4	0	0	0	0	0	0	0	0
Class Ao5	0	0	0	0	0	0	0	0
Class Ah1	2	15	17	23	2	0	59	12.1
Class Ah2	1	6	4	10	1	0	22	4.5
Class Ah3	0	1	0	1	0	0	2	0.4
Class Ah4	0	0	0	0	0	0	0	0
Total A Class	5	45	43	103	25	6	227	46.5
Class B	17	53	28	31	5	0	134	27.5
Class Ca	0	0	5	9	5	3	22	4.5
Class Cb	0	0	0	6	3	2	11	2.3
Class Da	1	6	10	28	16	11	72	14.8
Class Db	1	3	1	6	0	4	15	3.1
Class E	0	0	0	0	1	6	7	1.4
Class F	0	0	0	0	0	0	0	0
Total by Sieve Size	24	107	87	183	55	32	488	–
Percent of Total	4.9	21.9	17.8	37.5	11.3	6.6	100	–
Total by Durability Class	–	–	–	–	–	–	488	100

Table 5. 2015 Durability Monitoring – Percent Durability Class By Sieve Size

Durability Class & Subclass	Percent by Sieve Size (Retained on Sieve)					
	4 Inch	3 Inch	2.5 Inch	1.5 Inch	1 Inch	< 1 Inch
Class Au	4.2	8.4	13.8	26.2	32.7	18.8
Class As	4.2	0.0	0.0	1.1	1.8	0.0
Class Ao1	0.0	5.6	2.3	8.2	3.6	0.0
Class Ao2	0.0	7.5	9.2	2.2	1.8	0.0
Class Ao3	0.0	0.0	0.0	0.0	0.0	0.0
Class Ao4	0.0	0.0	0.0	0.0	0.0	0.0
Class Ao5	0.0	0.0	0.0	0.0	0.0	0.0
Class Ah1	8.3	14.0	19.5	12.6	3.6	0.0
Class Ah2	4.2	5.6	4.6	5.5	1.8	0.0
Class Ah3	0.0	0.9	0.0	0.5	0.0	0.0
Class Ah4	0.0	0.0	0.0	0.0	0.0	0.0
Total A Class	20.9	42.0	49.4	56.3	45.3	18.8
Class B	70.8	49.5	32.2	16.9	9.1	0.0
Class Ca	0.0	0.0	5.7	4.9	9.1	9.4
Class Cb	0.0	0.0	0.0	3.3	5.4	6.3
Class Da	4.2	5.6	11.5	15.3	29.1	34.4
Class Db	4.2	2.8	1.2	3.3	0.0	12.5
Class E	0.0	0.0	0.0	0.0	1.8	18.8
Class F	0.0	0.0	0.0	0.0	0.0	0.0
Total Percent	100	100	100	100	100	100

Table 6. 2015 Durability Monitoring – Percentage Sieve Size By Durability Class

Durability Class & Subclass	Percent By Sieve Size (Retained on Sieve)						Total Percent
	4 Inch	3 Inch	2.5 Inch	1.5 Inch	1 Inch	< 1 Inch	
Class Au	1.1	9.6	12.8	51.1	19.1	6.4	100
Class As	25.0	0.0	0.0	50.0	25.0	0.0	100
Class Ao1	0.0	24.0	8.0	60.0	8.0	0.0	100
Class Ao2	0.0	38.1	38.1	19.0	4.8	0.0	100
Class Ao3	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ao4	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ao5	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ah1	3.4	25.4	28.8	39.0	3.4	0.0	100
Class Ah2	4.5	27.3	18.2	45.5	4.5	0.0	100
Class Ah3	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ah4	0.0	50.0	0.0	50.0	0.0	0.0	100
Total A Class	2.2	19.8	18.9	45.4	11.0	2.6	100
Class B	12.7	39.6	20.9	23.1	3.7	0.0	100
Class Ca	0.0	0.0	22.8	40.9	22.8	13.6	100
Class Cb	0.0	0.0	0.0	54.5	27.3	18.2	100
Class Da	1.4	8.3	13.9	38.9	22.2	15.3	100
Class Db	6.7	20.0	6.7	40.0	0.0	26.7	100
Class E	0.0	0.0	0.0	0.0	14.3	85.7	100
Class F	0.0	0.0	0.0	0.0	0.0	0.0	0

9/11/2014

201~~4~~5 Lakeview Riprap Gradation and Durability Monitoring

*Non-Random Grid Sampling in Select Area of West Side Slope

Gradation Monitoring – Kyle Turley
Durability Monitoring – Craig Goodknight

Work Performed Sept. 16 and 17, 2015

	random numbers pairs (x,y)		multiplier		sample locations*			number retained					
	long (x)	trans (y)	long (ft)	trans (ft)	long distance (ft)	trans distance (ft)	# painted	4"	3"	2½"	1½"	1"	< 1"
I	NA* ~~0.52~~	NA ~~0.79~~	NA ~~100x~~	NA ~~270y~~	675* ~~52.0~~	25 ~~213.3~~	25	B		Au · B · B · Ao_2 B	C_A · Ao_1 – Au – Ah_1 · Au Au – B – B ·	B · C_A · C_A · D_A · D_A C_B · C_A – D_A · D_A – C_B	C_A ·
II	NA* ~~0.24~~	NA ~~0.35~~	NA ~~100x~~	NA ~~270y~~	675 ~~24.0~~	125 ~~94.5~~	24		B – Ah_1 – Ao_1 – Au – Ah_1 D_A –	Au – Ao_1 – B – B · Ah_1 Au	D_A – C_A – Ah_1 – Ah_1 – Au D_A – D_A – D_A – Ah_1 –	Au –	E –
2	NA* ~~0.82~~	NA ~~0.73~~	NA ~~100x+100~~	NA ~~270y~~	625 ~~182.0~~	25 ~~197.1~~	24	B	B · B · B · Ao_2 · Ah_1 Ah_2 – Ao_2 B	Ao_2 · B · Ah_2 – C_A · D_A	C_A · Ao_1 · B · B · B D_A – Ao_2	B ·	D_A · D_b ·
12	NA* ~~0.49~~	NA ~~0.53~~	NA ~~100x+100~~	NA ~~270y~~	625 ~~149.0~~	125 ~~143.1~~	25			B –	D_A – B – D_A – B – Au Au · D_A – D_A – Ah_1 – Ao_1 Ao_1 – Ah_2 – D_A	Ah_1 – Au – D_A – C_A – Au	Au · D_A – E · D_A – D_A Au –
3	NA* ~~0.43~~	NA ~~0.84~~	NA ~~100x+200~~	NA ~~270y~~	575 ~~243.0~~	25 ~~226.8~~	24		B – B · B B Ah_1 B · B	B – Ah_1 – B · B – D_A B C_A	~~Au~~ – Au – Ao_1 – B – D_A – C_A B Ah_1	E · D_A –	C_A –
13	NA* ~~0.46~~	NA ~~0.95~~	NA ~~100x+200~~	NA ~~270y~~	575 ~~246.0~~	125 ~~256.5~~	24	B	B – Ah_2 – Ah_2 – B – Ah_1		Au – Au – Au – Ao_2 – C · B Ao_1 – Ah_2 – D_A – Ah_1 – Ah_1 B Au	Ao_1 – Au –	Au · D_b · Au D_A
4	NA* ~~0.05~~	NA ~~0.55~~	NA ~~100x+300~~	NA ~~270y~~	525 ~~305.0~~	25 ~~148.5~~	25	B –	Au · B · D_A – B – B Au · Au – Ah_2 – B – Ah_2	Ao_2 · Ah_1 – D_b – D_A – C_A	D_A – Ah_1 – Ao_1 – Ah_1 – B · Ah_2 – D_A	Au – B –	C_A –

201~~4~~5 Lakeview Riprap Gradation and Durability Monitoring

	random numbers pairs (x,y)		multiplier		sample locations*			number retained					
	long (x)	trans (y)	long (ft)	trans (ft)	long distance (ft)	trans distance (ft)	# painted	4"	3"	2½"	1½"	1"	< 1"
5 ~~14~~	NA* ~~0.16~~	NA ~~0.95~~	NA ~~100x+300~~	NA ~~270y~~	475 ~~316.0~~	25 ~~256.5~~	24	B-B-B	Au-Ao1-Au-Ah1-B B-B	B-	Au-Db-Ao1-CA-Cb Ao1-Au-Db-B-	Ao2-Au-Ah1-Da	
14 ~~5~~	NA* ~~0.69~~	NA ~~0.90~~	NA ~~100x+400~~	NA ~~270y~~	525 ~~469.0~~	125 ~~243.0~~	24	B-B	B-Ao1-B-Ao1-B	B-Ah1-	B-B-DA-CA-DA Ah1-Au-DA-B-B	DA	DA- E. E. DA
15	NA* ~~0.56~~	NA ~~0.06~~	NA ~~100x+400~~	NA ~~270y~~	475 ~~456.0~~	125 ~~16.2~~	25	B	DA-B-B-Ao2-Ah1- B-	B-Ah1-Ao1-Au-Ah1 Au-Au	Ab-B-B-Au-B	B-Au-Au-	Au Au
6	NA* ~~0.79~~	NA ~~0.14~~	NA ~~100x+500~~	NA ~~270y~~	675 ~~579.0~~	75 ~~37.8~~	25	Db-	Ah2-DA-Ao2-B Ah1	B-B-DA-Ah1-Ao2	Ah2-Ah1-Au-CA-Au Ah1-Ah2-Ao1-DA-DA Ah2-Ah1-		DA-DA
16	NA* ~~0.02~~	NA ~~0.11~~	NA ~~100x+500~~	NA ~~270y~~	675 ~~502.0~~	175 ~~29.7~~	25		Ao2-B-Ah1-B-Au B-Ah	Au-B-B-Au-DA	Db-Au-Au-Au-Ah1 Au-Au-B-CA-B	Au-Au-Au	
7	NA* ~~0.60~~	NA ~~0.27~~	NA ~~100x+600~~	NA ~~270y~~	625 ~~660.0~~	75 ~~72.9~~	24	DA-	B-Ao1-Ah1-B-B B-B-DA-B-B Ao2-B B	Ah1-Au-CA-B	Ah2-Au-DA-B-CB DA-		
17	NA* ~~0.26~~	NA ~~0.31~~	NA ~~100x+600~~	NA ~~270y~~	625 ~~626.0~~	175 ~~83.7~~	25	B	B	B-Ah1-DA-Ah2-B Ah2-B-Ah1	Au-Ao1-Ao1-DA Au-Au-Au-DA DA-Ah1	Au-Ao1-CA-Au-DA	

	random numbers pairs (x,y)		multiplier		sample locations*			number retained					
	long (x)	trans (y)	long (ft)	trans (ft)	long distance (ft)	trans distance (ft)	# painted	4"	3"	2½"	1½"	1"	< 1"
8	NA* ~~0.19~~	NA ~~0.07~~	NA ~~100x+700~~	NA ~~255y~~	575 ~~719.0~~	75 ~~47.9~~	25	B B	B Au	Ao2- Ah1- Ah2- Ah1	B- Ah2- Au- Ah1- Db Db- Ao1- B- DA- B CA	Au- DA- DA- Ah2	E Db
18	NA* ~~0.97~~	NA ~~0.13~~	NA ~~100x+700~~	NA ~~255y~~	575 ~~797.0~~	175 ~~33.2~~	24	B - ~~Au~~	Ah1 - Ah1 - Ah1 B - B - DA - B - B	B - B - CA	DA - Au - B - Au - As Au - Au - Au - Ah1 Ah2 - An	As	
9	NA* ~~0.76~~	NA ~~0.89~~	NA ~~100x+800~~	NA ~~215y~~	525 ~~876.0~~	75 ~~191.4~~	25	B-B	Ah2- B- Ao2- DA- Db	DA- B- Ah1- Ao2- Ah1	Au- Ah1- Ah1- Cb- Cb Au- B- B-	DA- ~~DA~~- Au - DA	Db-
19	NA* ~~0.00~~	NA ~~0.77~~	NA ~~100x+800~~	NA ~~215y~~	525 ~~800.0~~	175 ~~165.6~~	25	As - Ah1	DA - Ah1 - B	Ao2 - DA - B - Ao2	DA - Ao2 - Au - Cb Au - Au - Ah1 - Ah1 Au - B - Au	DA - DA - Cb - Au	E
10	NA* ~~0.55~~	NA ~~0.86~~	NA ~~50x+900~~	NA ~~130y~~	475 ~~927.5~~	75 ~~111.8~~	25	Au	Ao2 - B	Au- Ah1- Au- B- DA	Ah1 - Ao1- Au- Au- Ao2 Db - Ah1- DA- B- Au	Au- Au- B-	Db Db DA DA
20	NA* ~~0.93~~	NA ~~0.67~~	NA ~~50x+900~~	NA ~~130y~~	475 ~~946.5~~	175 ~~87.1~~	22	Ah1 - B - Ah2	Ao2 - B - B - B - B B - Au	Ah1 - B - Au - Ah1 DA	Au - Au - B - Ao1 Au - Au - Ah1		

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Department of Energy
Washington, DC 20585

March 2, 2015

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Deputy Director
Mail Stop: T8F5
Washington, DC 20555-0001

Subject: Lakeview, Oregon, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site's West Side Slope Rock Degradation Assessment

To Whom It May Concern:

This letter provides follow-up information to the U.S. Nuclear Regulatory Commission (NRC) letter dated November 12, 2014, which requested information about rock riprap monitoring on the west-facing side slope of the Lakeview, Oregon, UMTRCA Title I disposal cell. This letter also summarizes the U.S. Department of Energy's (DOE's) assessment of the 18 years of rock monitoring and establishes why DOE proposes to replace the annual gradation and durability rock monitoring with a more effective method for addressing any potential vulnerability of erosion on the cell's west side slope.

Response to NRC's November 12, 2014, Letter Item 3:
DOE sent NRC a partial response to Item 3 in a letter dated December 19, 2014, which transmitted the 2014 rock monitoring data and results. DOE has compiled the requested historical monitoring data and results for 1997 through 2014 and is including the available information as attachments to this letter.

- Attachment 1 provides summary data results and information, including (1) a graph plotting values for the mean diameter (D_{50}) results of the annual gradation monitoring conducted over the past 18 years; (2) tables identifying the various rock types, with descriptions, and durability classes/codes of rock present on the side slope; (3) a table summarizing the 6 years of rock durability monitoring results by durability class; and (4) a map showing the local reference to which the monitoring sample location coordinates apply.
- Available rock gradation monitoring data and results are provided by year for 1997 (Attachment 2) through 2014 (Attachment 19). Gradation monitoring in 1997 was performed by weight instead of rock count because it predated the gradation monitoring procedure established in the 1998 update to DOE's *Long-Term Surveillance Plan for the Collins Ranch Disposal Site, Lakeview, Oregon* (August 1994; LTSP).
- Durability monitoring data and results, including the field data logs, are provided for the 6-year period of 2009 (Attachment 14) through 2014 (Attachment 19) when durability monitoring was performed.

Response to NRC's November 12, 2014, Letter Item 4:

The use of Global Positioning System (GPS) to retain sample locations was not included in the LTSP gradation monitoring procedure, and the requested GPS data are therefore not available. However, sample location coordinates using a local site reference (see Attachment 1) have been compiled for each year and are included in Attachments 2 through 19 when available. Some locating precision may have been lost during the field locating of these randomly generated sample locations.

Response to NRC's November 12, 2014, Letter Items 1 and 2:

The Type B size side-slope riprap used to construct the cell met the original computed D_{50} design size range of 2.7 to 3.9 inches. However, all parties involved at the time of construction (1987 and 1988) acknowledged that weathering would likely accelerate degradation of the available rock.

DOE has performed gradation monitoring in accordance with the procedure (a surrogate gradation analysis method) since 1998. The objectives of the monitoring were to provide a method for generally quantifying rock degradation over time. It was acknowledged when the rock gradation monitoring procedure was developed that the procedure had inherent limitations, including:

- The surrogate monitoring procedure method identified D_{50} by rock count, not by weight, which is the standard method for determining D_{50} in the laboratory.
- Only surface rocks were included in the monitoring instead of the entire riprap thickness profile. The more-exposed surface rocks may be more susceptible to accelerated weathering, thus conservatively skewing the data (i.e., provides a smaller D_{50} result).
- The method conservatively measures the minimum rock dimension for sieve sizing, thus also conservatively skewing the data (i.e., provides a smaller D_{50} result).

DOE has made field observations of the erosion protectiveness of the side-slope rock since completion of the disposal cell in 1989 and has performed rock gradation monitoring since 1997, including 6 years of rock durability monitoring. Relevant conclusions about the rock degradation include:

- The D_{50} measurements obtained since 1997 (see graph in Attachment 1) indicate that degradation of the Type B size riprap is inconsistent but that it has occurred.
- Gradation monitoring results shown on the graph in Attachment 1 for the years 1997 to 2014 indicate variability in the D_{50} measurement. Some of this variability is natural randomness, and some could result from different personnel performing the procedure. However, a rate of rock degradation cannot be determined.
- The annual gradation monitoring results shown on the graph in Attachment 1 indicate that the average D_{50} value for the 18-year monitoring period is 2.55 inches. Without the 1997 value, which was atypically performed by weight instead of rock count, the 17-year average D_{50} value is 2.53 inches. This is less than 0.2 inches below the calculated size range lower

limit of 2.7 inches, and represents a less than 6.5 percent size decrease. These values represent D_{50} based on rock count instead of weight, which is the standard method for determining D_{50} in the laboratory.

- Other layers of conservatism associated with the calculated D_{50} size range of 2.7 to 3.9 inches include:
  - The vegetation present on the cell cover top slope provides flow resistant properties during storms and reduces the potential for erosion. This was not factored into the calculated D_{50} value; if it had been factored in, the required size range would be smaller.
  - More geographically precise weather data (Hydrometeorological Report 581[1]) have become available since the original D_{50} value was calculated.
  - New methods for calculating the D_{50} value (Apt-Johnson[2]) became available after construction of the Lakeview disposal cell.
- Observations made at the site during the past 6 years since rock durability monitoring began indicate that the various classifications of durable rock and rock types are randomly distributed over the cell's west side slope (see Attachment 1 for general durability information and Attachments 14 through 19 for specific monitoring year information).
- Of the rocks monitored each year during the 6-year durability monitoring period, the sum of all Class A (highly durable) and Class B (durable) rocks, ranged from 56.4 percent to 71.8 percent (see the Summary of 2009 through 2014 Rock Durability Monitoring Results by Durability Class table in Attachment 1).
- Field observations indicate that large rocks are present throughout the riprap profile and are present at depth.
- Multiple visits to the two rock source quarries (Pepperling and Sheer's quarries) over the years have helped DOE understand the rock weathering mechanisms that have occurred at the disposal site and have provided evidence that the rock placed on the disposal cell will undergo similar weathering processes.
- Augur Hill, located immediately north of the disposal site, represents a good analog site for the disposal cell's west side slope because it is of similar slope and aspect and has historically undergone the same local weather conditions. This analog slope can be useful for predicting how the cell's west side slope will respond to storm events. Pleistocene-age glacial deposits identified on the top of Augur Hill indicate that the hilltop has remained in place without erosional compromise for thousands of years.

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[1] U.S. Department of Commerce, 1998. *Hydrometeorological Report No. 58, Probable Maximum Precipitation Estimates for California*, October.

[2] Abt, S.R., T.L. Johnson, C.I. Thornton, and S.C. Trabant, 1998. "Riprap Sizing at the Toe of Embankment Slopes," *Journal of Hydraulic Engineering* 124(7): 672–677. This method is also published in NUREG-1623.

- The Lakeview disposal cell continues to meet the criteria in Title 40 *Code of Federal Regulations* Part 192, specifically Subpart A, which requires the cell to manage radon flux and remain protective for at least 200 years. This determination is based on the following:
  - — Observations made during the 2014 annual inspection indicated that the cell's erosion protection is currently intact and functioning properly.
  - — The 2010 Geoprobe technical borehole investigation demonstrated that water infiltration is not an issue, as identified in DOE's letter to NRC dated August 25, 2010. DOE initiated the investigation to assess potential saturated conditions within the cell.
  - — Annual inspections have identified no changes in the cell cover to suggest that radon flux from the cell would exceed the design specifications.

Engineering principles suggest that, if erosion of the side slope occurs, it would originate near the top-slope/side-slope interface[3, 4]. Any rilling on the top slope near this interface could channelize water flow. However, two conditions on the disposal cell would restrict the size of rills formed on the top slope, thus limiting any potential extent of water channelization: (1) the limited quantity of soil available to form a rill (4-inch-thick layer at the time of construction), and (2) the riprap rock cover is continuous beneath the top-slope soil cover, the slope crests, and the side slopes.

To verify continued protectiveness of the erosion control on the west side slope, DOE proposes to augment the current inspection plan by modifying the inspection checklist. Modifications would include adding a more rigorous, focused inspection of all rills that may form along the interface between the vegetated soil/rock top-slope cover and the rock-covered west side slope. The more focused inspection would include photographing any erosion rills annually, mapping locations of the features, inspecting the condition of erosion protection rock immediately downslope of a rill, and making repairs, as warranted, in accordance with the LTSP. Focusing on these areas will enable DOE to more proactively assess and mitigate potential failure points of the side-slope erosion protection. Because this augmented inspection approach more directly focuses on the potential development of vulnerabilities on the side slope, DOE will discontinue the annual rock gradation and durability monitoring.

In response to Item 1 of NRC's November 12, 2014, letter, which suggested that DOE consider plotting the monitoring data to draw conclusions about potential side-slope vulnerabilities, DOE believes that the original gradation and durability monitoring data were not intended to be used in this way, and such use could result in magnifying the data limitations identified in this letter.

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[3] Horton, R.E., 1945. "Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology," *Bulletin of the Geological Society of America* 56: 275–370.

[4] Mosley, M.P., 1974. "Experimental study of rill erosion," *Transactions of the American Society of Agricultural Engineers* 17(5): 909–916.

Additionally, isolated areas of rock degradation have less significance because, as indicated previously, erosion of the side slope would likely originate near the top-slope/side-slope interface.

DOE acknowledges that all rock will naturally degrade, that the rock on the Lakeview cell west side slope is degrading, and that the future effects of natural weather events and performance of the rock erosion protection at the site will always have inherent uncertainties. However, these uncertainties are partly why the LTSP requires both annual inspections and corrective actions. DOE believes that adding the proposed rill monitoring during annual inspections is the most effective method for addressing any potential vulnerability of erosion on the side slope. This added inspection element would obviate the need for continued rock gradation and durability monitoring.

Upon NRC's acceptance of this proposed change, DOE will update the site's LTSP.

Please call me at (970) 248-6016, or Terry Petrosky at (970) 248-6041, if you have any questions. Please send any correspondence to:

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Sincerely,

Jalena Dayvault
Site Manager

Enclosure

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