

ADDENDUM 2.9-C
BASELINE RADIOLOGICAL MONITORING RESULTS
AND FINAL CONCLUSIONS
(1ST QTR 2015)

2.9.2.8-C: Supplement to Results and Conclusions – Direct Radiation – Long Term Studies

Results

The data presented below in Tables 1 through 5 provide quarterly results for the long-term gamma exposure rate study completed with optically stimulated luminescence (OSL) dosimeters for the purpose of characterizing the average exposure rate across the Kendrick Expansion Area (KEA). These results are provided as addendum to Section 2.9.2.8 of the KEA Technical Report (TR). Note that results for all quarters have been included in this Addendum for ease of comparison; however, the results for the 2nd, 3rd, and 4th quarters do not differ from those previously reported in Tables 2.9-13 through 2.9-15. Lab reports for the 1st quarter of the direction radiation study are included in Appendix A of this addendum.

Conclusions

The long-term gamma radiation monitoring program commenced between December 20, 2012 and January 9, 2013. A total of 11 OSL dosimeters were installed at locations consistent with the radon monitor locations including the air particulate stations and additional locations across the proposed KEA.

LANDAUER OSL dosimeters were exchanged on a quarterly basis. After approximately a 90 day exposure period in the field, the dosimeters were replaced with “unexposed” units. The exposed units were returned to the vendor for analysis.

In general, results were consistent with the results from the direct gamma exposure rate field survey reported in Section 2.9.2.7 of the KEA TR. Table 5 summarizes the long-term gamma radiation monitoring program results by quarter. All data in this table are in units of $\mu\text{R/hr}$. One site, Burch, consistently measured dose rates above 20 $\mu\text{R/hr}$ for the four quarters. As described in Section 2.9.2.6 of the KEA TR, the Burch site also measured elevated radium-226 in soil at both the 0-5 and 0-15 centimeter depths.

Table 1. First Quarter OSL Results

Detector Description	Exposure Dates	Total Days Exposed	Reported Dose (mrem)	Environmental Dose¹ (mrem)	Daily Dose Rate (mrem/day)	Dose Rate (µrem/hr)
Deploy Control			26.4	17.5	0.179	7.4
Met Station	Not monitored in 1Q15 since previously monitored as part of Ross ISR Project					
Wesley	Not monitored in 1Q15 since previously monitored as part of Ross ISR Project					
OCH	12/19/14-3/27/15	98	33.8	24.9	0.254	10.6
Berger Hill	12/19/14-3/27/15	98	30.7	21.8	0.222	9.3
Burch	12/19/14-3/27/15	98	57.6	48.7	0.497	20.7
Deadman	12/19/14-3/27/15	98	34.7	25.8	0.263	11.0
D-Road	12/19/14-3/27/15	98	30.3	21.4	0.218	9.1
Site 18	12/19/14-3/27/15	98	32.8	23.9	0.244	10.2
Site 19	12/19/14-3/27/15	98	32.5	23.6	0.241	10.0
Site 20	12/19/14-3/27/15	98	35.6	26.7	0.272	11.4
Site 21	12/19/14-3/27/15	98	31.2	22.3	0.228	9.5

¹ Environmental Dose= Reported Dose - Transit Control
 Transit Control = 8.9 mrem

Table 2. Second Quarter OSL Results

Detector Description	Exposure Dates	Total Days Exposed	Reported Dose (mrem)	Environmental Dose¹ (mrem)	Daily Dose Rate (mrem/day)	Dose Rate (µrem/hr)
Deploy Control			27.4	23.9	0.225	9.4
Met Station	4/2/13-7/17/13	106	37.5	34.0	0.321	13.4
Wesley	4/2/13-7/17/13	106	36.2	32.7	0.308	12.9
OCH	4/2/13-7/17/13	106	40.3	36.8	0.347	14.5
Berger Hill	4/2/13-7/17/13	106	38.6	35.1	0.331	13.8
Burch	4/2/13-7/17/13	106	61.4	57.9	0.546	22.8
Deadman	4/2/13-7/17/13	106	41.3	37.8	0.357	14.9
D-Road	4/2/13-7/17/13	106	34.9	31.4	0.296	12.3
Site 18	4/2/13-7/17/13	106	37.4	33.9	0.320	13.3
Site 19	4/2/13-7/17/13	106	37.5	34.0	0.321	13.4
Site 20	4/2/13-7/17/13	106	38.1	34.6	0.326	13.6
Site 21	4/2/13-7/17/13	106	37.5	34.0	0.321	13.4

¹ Environmental Dose= Reported Dose - Transit Control
 Transit Control = 3.5 mrem

Table 3. Third Quarter OSL Results

Detector Description	Exposure Dates	Total Days Exposed	Reported Dose (mrem)	Environmental Dose¹ (mrem)	Daily Dose Rate (mrem/day)	Dose Rate (µrem/hr)
Deploy Control			27.9	22.1	0.266	11.1
Met Station	7/17/13-10/8/13	83	37.4	31.6	0.381	15.9
Wesley	7/17/13-10/8/13	83	34.5	28.7	0.346	14.4
OCH	7/17/13-10/8/13	83	37.4	31.6	0.381	15.9
Berger Hill	7/17/13-10/8/13	83	32.0	26.2	0.316	13.2
Burch	7/17/13-10/8/13	83	49.7	43.9	0.529	22.0
Deadman	7/17/13-10/8/13	83	35.5	29.7	0.358	14.9
D-Road	7/17/13-10/8/13	83	34.2	28.4	0.342	14.3
Site 18	7/17/13-10/8/13	83	34.2	28.4	0.342	14.3
Site 19	7/17/13-10/8/13	83	33.4	27.6	0.333	13.9
Site 20	7/17/13-10/8/13	83	32.6	26.8	0.323	13.5
Site 21	7/17/13-10/8/13	83	32.1	26.3	0.317	13.2

¹ Environmental Dose= Reported Dose - Transit Control
 Transit Control = 5.8 mrem

Table 4. Fourth Quarter OSL Results

Detector Description	Exposure Dates	Total Days Exposed	Reported Dose (mrem)	Environmental Dose¹ (mrem)	Daily Dose Rate (mrem/day)	Dose Rate (µrem/hr)
Deploy Control	10/8/13-1/9/14	93	30.6	26.6	0.286	11.9
Met Station	10/8/13-1/9/14	93	41.1	37.1	0.399	16.6
Wesley	10/8/13-1/9/14	93	40.2	36.2	0.389	16.2
OCH	10/8/13-1/9/14	93	40.3	36.3	0.390	16.3
Berger Hill	10/7/14-12/19/14	73	24.2	20.2	0.277	11.5
Burch	10/8/13-1/9/14	93	62.3	58.3	0.627	26.1
Deadman	10/8/13-1/9/14	93	40.2	36.2	0.389	16.2
D-Road	10/8/13-1/9/14	93	39.7	35.7	0.384	16.0
Site 18	10/7/14-12/19/14	73	24.0	20.0	0.274	11.4
Site 19	10/8/13-1/9/14	93	38.4	34.4	0.370	15.4
Site 20	10/7/14-12/19/14	73	22.1	18.1	0.248	10.3
Site 21	10/8/13-1/9/14	93	36.6	32.6	0.351	14.6

¹ Environmental Dose= Reported Dose - Transit Control
 Transit Control = 4.0 mrem

Table 5. Summary of Gamma Results for All Four Quarters

Location ID	Average Exposure Rate ($\mu\text{R/hr}$) 1Q	Average Exposure Rate ($\mu\text{R/hr}$) 2Q	Average Exposure Rate ($\mu\text{R/hr}$) 3Q	Average Exposure Rate ($\mu\text{R/hr}$) 4Q	Location Average¹ for ALL Quarters ($\mu\text{R/hr}$)
Met Station	12.5 ²	13.4	15.9	16.6	14.6
Wesley	13.8 ²	12.9	14.4	16.2	14.3
OCH	10.6	14.5	15.9	16.3	14.3
Berger Hill	9.3	13.8	13.2	11.5	12.0
Burch	20.7	22.8	22.0	26.1	22.9
Deadman	11.0	14.9	14.9	16.2	14.3
D-Road	9.1	12.3	14.3	16.0	12.9
Site 18	10.2	13.3	14.3	11.4	12.3
Site 19	10.0	13.4	13.9	15.4	13.2
Site 20	11.4	13.6	13.5	10.3	12.2
Site 21	9.5	13.4	13.2	14.6	12.7
Average ³ of all locations by Quarter	11.6	14.4	15.0	15.5	14.1 ⁴
Standard Deviation	3.3	2.9	2.5	4.2	3.2
Approximate Range	9.1 - 20.7	12.3 - 22.8	13.2 - 22.0	10.3 - 26.1	N/A

¹ Values represent the average of all 4 quarters of data for each location; all exposure rates are based on “environmental exposure” as previously defined

² Values based on 1Q10 monitoring completed as part of the Ross ISR Project baseline gamma monitoring

³ Values represent the average from all locations during that quarter

⁴ Average exposure rate for all location over the four quarter study period

APPENDIX A

Direct Radiation Lab Reports

IML AIR SCIENCE
ATTN RONN SMITH
555 ABSARAKA ST
SHERIDAN, WY 82801

Report Date (YYYY-MM-DD)	2015-04-02
Page	1 of 1
Dosimeter Received	2015-04-01
QC Release	LCA
Analytical Work Order	1509110100

LANDAUER®

Landauer, Inc., 2 Science Road
Glenwood, Illinois 60425-1586
www.landauer.com
Telephone: (708) 755-7000
Facsimile: (708) 755-7016
Customer Service: (800) 323-8830
Technical: (800) 438-3241

Environmental Dosimetry Report

Account : 291503 Subaccount : 1405707 Series: X9

Location ID Number	Dosimeter Type	Identifier (Client Supplied)	Exposure (Ambient Dose mrem)		Net Cumulative Totals (mrem)			Inception Date (YYYY-MM)	Serial Number
			Gross	Net	Quarter to Date	Year to Date	Permanent		
Monitoring Period:			2015-01-01 to	2015-03-31	Q1	2015			
00000	V03NH	Deploy Control						2011-01	EX00020172A
	V03NH	Control Dose Used	26.4						
00080	V03NH		33.8	7.4				2014-10	EX00056322Z
00081	V03NH		30.7	4.3				2014-10	EX00063370Z
00082	V03NH		57.6	31.2				2014-10	EX00051921U
00083	V03NH		34.7	8.3	8.3	8.3	8.3	2015-01	EX00070106Z
00084	V03NH		30.3	3.8	3.8	3.8	3.8	2015-01	EX00026890S
00085	V03NH		32.8	6.4	6.4	6.4	6.4	2015-01	EX000240364
00086	V03NH		32.5	6.1	6.1	6.1	6.1	2015-01	EX00057814L
00087	V03NH		35.6	9.1	9.1	9.1	9.1	2015-01	EX00043843Q
00088	V03NH		31.2	4.8	4.8	4.8	4.8	2015-01	EX000518000

