STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

1410 North Hilton • Boise, Idaho 83706 • (208) 373-0502

C.L. "Butch" Otter, Governor
Curt Fransen, Director

January 27, 2014

Terry Geis, General Manager
US Ecology Idaho, Inc.
P.O. Box 400
Grand View, Idaho 83624

Re: US Ecology Idaho, Inc. (USEI)—EPA ID No. IDD073114654
DEQ Radiation Oversight Environmental Monitoring Report for 2013

Dear Mr. Geis:

The Department of Environmental Quality (DEQ) has completed its annual report on radiation oversight of US Ecology operations.

Please contact Dennis Meier at (208) 373-0482, if you have any questions or concerns regarding this matter.

Sincerely,

Robert E. Bullock
Hazardous Waste Permits Manager
Waste Management & Remediation Division

REB:DM:js

Enclosure: 2013 Idaho Radiation Monitoring Oversight Report for US Ecology Idaho Site B

cc: B. McCullough, EPA Region 10
Eileen Loerch, DEQ-BRO
ESbpfq 6/Kim Custer
COF

2013 Idaho
Annual Radiation Monitoring Oversight Report for US Ecology Idaho Site B

January 23, 2014

Prepared by
Dennis Meier, P.E.
1410 N. Hilton
Boise, Idaho 83706

Contents

1 Introduction

The Idaho Department of Environmental Quality (DEQ) performs radiation monitoring at the US Ecology Idaho (USEI) Site B facility located near Grand View Idaho. USEI Site B is a hazardous waste treatment, storage, and disposal facility that also takes in non-regulated radioactive waste for disposal.

While both USEI and DEQ perform radiation monitoring, DEQ's monitoring is for oversight purposes and is used to ensure that the facility complies with the IDAPA 58.01.10.20.01.(b) requirement regarding radiation dose to members of the public:

> "No owner or operator shall conduct operations, create, use or transfer radioactive materials in a manner such that any member of the public will receive an annual Total Effective Dose Equivalent (TEDE) in excess of one hundred (100) millirem per year (1 milliseivert/year) . . ."

Monitoring actions completed by DEQ under the oversight program include the following:

- Measurement of penetrating gamma radiation at six (6) locations, including four (4) locations on the perimeter fence, one (1) location at the USEI rail transfer facility (RTF) where shipments are transferred from railcars to trucks, and one (1) off-site location (the Steiner House)
- Measurement of radon concentrations at five (5) locations, including four (4) locations on the perimeter fence and one (1) off-site location (the Steiner House)
- Sampling and analysis of ground water samples for gross alpha and gross beta activity twice a year
- Sampling and analysis of soil for Ra-226, Th-232, U-234, U-238, Am-241, and Cs-137 concentrations twice a year

Requirements for these monitoring actions are summarized in Table 1.

Table 1. USEI Site B radiation oversight monitoring requirements[1].

Media	Sample Method	# of Locations	Frequency	Action level	Nuclides and Radiation type of Interest
Radon in air	DEQ-OP/Radon-01	5 total locations: 4 locations at USEI and 1 at Steiner House	Quarterly	2pCi/L	Radon
Penetration Radiation	DEQ-OP/Gamma-01	6 total locations: 4 locations at USEI, 1 at Steiner House, and 1 at RTF	Quarterly	25 mrem/Quarter	Gamma
Ground Water	DEQ-OP/GW-01	3 total locations: 3 locations co-sampled with USEI	Semi-annually	Gross alpha 5pCi/L Gross beta 50pCi/L	Gross Alpha, Gross Beta (Th-232, U-238, Ra-226, Ra-228, Am-241, and/or Cs-137 if Gross Alpha or Gross Beta is above the action level)
Soil	DEQ-OP/Soil-01	3 total locations: 2 locations downwind of cells 14 and 15, 1 background location	Semi-annually	Th-232: 4pCi/g U-238: 4pCi/g U-234: 4pCi/g Ra-226: 3pCi/g Am-241: 0.06pCi/g Cs-137: 1pCi/g	Th-232, U-238, U-234, Ra-226, Am-241, Cs-137/NA

This report presents the results and findings for monitoring data collected during the 2013 monitoring campaign.

2 Methods and Materials

The following sub-sections describe the methods and materials used by DEQ to monitor radiation at USEI. All monitoring is performed in accordance with the Quality Assurance Program Plan (QAPP) for USEI Site B radiation oversight (TRIM record 2011AAO32[v5]).

2.1 Measurement of Penetrating Radiation

Penetrating gamma radiation is measured using Rad Elec, Inc. electret ion chambers (EICs), consisting of short-term (ST) electrets coupled to L-chambers. Preparation, placement, and processing of the EICs are performed in accordance with SOP DEQ-OP/Gamma-01 (TRIM record 2011AAO73[v4]).

Three EICs are placed in a single aluminum canister and sealed to minimize additional dose caused by radon and its progeny. Each canister is placed at one of the designated locations.

[1] Source: USEI-B DEQ Radiation Oversight Quality Assurance Program Plan (QAPP), TRIM Record 2011AAO32[v5].

Each quarter, the EICs are exchanged for new ones. Previously deployed EICs are then taken back to the DEQ state office where the electret voltage is measured. Initial and final electret voltages are used to calculate exposure rate in micro-Roentgen per hour (μR/hr). The three data points for each location are averaged together to get the quarterly exposure for that location.

2.2 Measurement of Radon in the Air

Radon concentrations are measured similarly to penetrating radiation. Preparation, placement, and processing of the EICs is performed in accordance with SOP DEQ-OP/Radon-01 (TRIM record 2011AAO74[v4]).

The EIC configuration for radon consists of a long-term (LT) electret coupled to an intermediate S-chamber, which is placed in a sealed Tyvek®[2] bag to keep out dust while still allowing radon gas to enter. Three to five EICs are placed at each of the locations.

Each quarter, the EICs are exchanged and taken to the DEQ state office for voltage measurements. A concentration in units of picocuries per liter (pCi/L) is calculated by using the initial and final voltage and correcting for background penetrating radiation.

Prompted by apparent exceedances of the QAPP-defined action level for radon in 2012 and 2013, these exceedances were investigated, and the following changes were made in the monitoring and analysis of radon measurements:

- Most importantly, a change was made in the spreadsheet used to calculate radon exposure. Historically, this spreadsheet has used a constant 11.4 μR/hr gamma background, which is then subtracted from the radon detector reading. However, the actual gamma background in this region varies throughout the year, with typical background values being closer to 15 μR/hr (Figure 1). Even the Control measurement, which is kept at DEQ, averaged 12.2 μR/hr for the year, exceeding the 11.4 μR/hr gamma background used in the past.

  Clearly, the radon calculation was not accurately accounting for the actual gamma contribution. Because subtracting a gamma background that is too small results in a radon reading that is artificially too large, the spreadsheet has been corrected to use the average Steiner House gamma reading for the quarter as the background value.

- Additional radon detectors were placed in the locations—primarily southwest of the facility—that had showed exceedances. For the fourth quarter of 2013, five radon detectors were placed at the East Fence, South Fence, and Steiner House locations. It was hoped that additional detectors would help smooth out the effect of statistical variation in the readings. (With only three readings that consist of small numbers, it can be difficult to determine outliers.)

[2] Tyvek is a registered trademark of E. I. du Pont de Nemours and Company.

- Based upon information published by the manufacturer of the radon detectors, the Tyvek bags into which the detectors have historically been placed—to keep out dust—are now sealed. Tyvek is transparent to radon gas, so sealing the bag allows radon through but should keep out dust that might otherwise enter a folded-over bag. (Dust that touches the detector surface can cause a discharge that inflates the actual radon value.)

With these changes, the radon values should more accurately reflect actual conditions. In the event that radon exceedances continue to occur, DEQ may want to investigate using a measurement technology that does not require correction for gamma background and that is less susceptible to discharge by dust.

2.3 Measurement of Radioactivity in the Ground Water

Twice a year, DEQ co-samples up to three wells with USEI, in accordance with SOP DEQ-OP/GW-01 (TRIM record 2011AAO75[v4].) These wells are located at various locations around the facility. The ground water samples are sent to a commercial lab for analysis of gross alpha and gross beta levels.

2.4 Measurement of Radioactivity in the Soil

Soil samples are collected twice a year, in accordance with SOP DEQ-OP/Soil-01 (TRIM record 2011AAO76[v4].) USEI has two sampling locations downwind of Cells 14 and 15 and a background sampling location as well. The samples are sent to a commercial lab for analysis for the indicator radionuclides listed in Table 1.

2.5 Calculation of Public Radiation Dose

A calculation of public radiation dose is performed using the data collected from measurements of penetrating radiation and radon. The following assumptions are used in calculating this dose:

- The exposed member of the public stands at the USEI Site B fence line 1,000 hours per year.

- The exposed person does not drink water from the ground water monitoring wells, nor does the person ingest soil at the site—actions considered to be unlikely—so local ground water and soil are not considered to contribute to internal dose.

- DEQ does not perform air monitoring, so it is impossible to give a calculated internal dose from inhalation of airborne particulates. However, USEI does perform air monitoring and routinely shows internal doses to be less than 1 millirem (mrem)[3]. The calculation of public dose therefore assumes an internal effective dose equivalent of 1 mrem for sources other than radon.

[3] In 2012, this component was estimated to be 0.19 mrem based on USEI air monitoring.

- The radiation dose from radon and its decay progeny is calculated using an equilibrium factor[4] of 0.6 and a dose conversion factor of 6.4 nano-Sievert per Becquerel/(m^3-hr).

The public Total Effective Dose Equivalent (TEDE) is then calculated using Equation 1:

$$TEDE = CEDE_{net} + DDE_{net}$$

Equation 1. Calculation of total dose.

Where:

$CEDE_{net}$ is the net internal dose caused by inhaling radon above the natural background concentration.

DDE_{net} is the net external dose caused by penetrating radiation above the natural background level.

$CEDE_{net}$, in units of mrem, is calculated using Equation 2:

$$CEDE_{net} = \left(R_{gross} - R_{bkg}\right)\left(\frac{1Ci}{10^{12}pCi}\right)\left(\frac{3.7x10^{10}Bq}{1Ci}\right)\left(\frac{1000L}{m^3}\right)\left(6.4nSv/Bq - m^3/hr\right)(T)(EF)\left(\frac{1mSv}{10^6 nSv}\right)\left(\frac{100m\,Rem}{1mSv}\right) + K$$

Equation 2. Calculation of internal dose, with units and conversions shown.

Where:

R_{gross} is the highest yearly average radon concentration, in picocuries per liter (pCi/L), measured at one of the monitoring locations besides the Steiner House.

R_{bkg} is the yearly average background radon concentration, in pCi/L, measured at the Steiner House.

T is 1,000 hours.

EF is a radon equilibrium factor of 0.6.

K is 1 mrem based on air monitoring measurements performed by USEI.

For use in the radiation monitoring spreadsheet used to perform calculations, Equation 2 is reduced to the simpler equivalent of Equation 3:

$$CEDE_{net} = \left(R_{gross} - R_{bkg}\right)\frac{(3.7)(6.4)(T)(EF)}{1000} + K$$

Equation 3. Simplified calculation of internal dose.

DDE_{net}, in units of mrem, is obtained using Equation 4:

[4] The equilibrium factor defines the fraction of the daughter products of radon (radon's *progeny*) that remain suspended in the air subject to inhalation. (Radon's progeny are solids rather than gases.)

$$DDE_{net} = (G_{gross} - G_{bkg})(T)\left(\frac{1 m\mathrm{Rem}}{1000 \mu\mathrm{Rem}}\right)$$

Equation 4. Calculation of external dose.

Where:

G_{gross} is the highest yearly average exposure rate, in μR/hr, from one of the locations besides the Steiner house.

G_{bkg} is the yearly average background exposure rate, in μR/hr, measured at the Steiner House.

T is 1,000 hours.

3 Results

Monitoring results for penetrating radiation, radon, ground water, and soil are given in the following.

3.1 Penetrating Radiation Results

Table 2 gives the penetrating radiation measure results for 2013.

Table 2. 2013 Penetrating radiation measurement results.

Location	Quarter	Quarterly Average Exposure Rate (µR/hr)	Quarterly Uncertainty (+/-) µR/hr	Yearly Average Exposure Rate (µR/hr)	Yearly Uncertainty (+/-) µR/hr
East Fence	1	19.13	2.42	17.80	3.98
	2	17.38	2.21		
	3	17.81	2.26		
	4	16.88	2.13		
North Fence	1	15.99	2.04	15.95	3.65
	2	18.76	2.38		
	3	14.48	1.86		
	4	14.56	1.87		
West Fence	1	19.70	2.48	18.6	4.34
	2	19.65	2.48		
	3	20.31	2.56		
	4	14.75	1.87		
South Fence	1	17.45	2.22	18.27	4.06
	2	18.21	2.31		
	3	19.81	2.5		
	4	17.62	2.22		
Steiner House	1	13.37	1.73	15.25	3.26
	2	14.79	1.91		
	3	15.52	1.99		
	4	17.34	2.19		
RTF	1	15.26	1.95	16.55	3.59
	2	15.98	2.04		
	3	17.48	2.22		
	4	17.48	2.21		

3.2 Radon Results

Table 3 reports the radon concentrations measured at each location in 2013, along with the averages for the year.

Table 3. 2013 radon measurement results.

Location	Quarter	Quarterly Average Radon Concentration (pCi/L)	Quarterly Uncertainty (+/-) pCi/L	Yearly Average Radon Conc. (pCi/L)	Yearly Uncertainty (+/-) pCi/L
East Fence	1	0.41	0.18	1.1	0.64
	2	1.06	0.22		
	3	1.94	0.3		
	4	1.0	0.3		
North Fence	1	0.31	0.15	0.6	0.68
	2	0.45	0.16		
	3	1.17	0.4		
	4	0.5	0.3		
West Fence	1	0.58	0.21	0.6	0.55
	2	0.39	0.19		
	3	0.35	0.15		
	4	1.2	0.2		
South Fence	1	0.86	0.19	0.6	0.33
	2	0.32	0.15		
	3	0.62	0.2		
	4	0.7	0.3		
Steiner House	1	0.68	0.28	0.8	0.55
	2	0.92	0.13		
	3	1.35	0.59		
	4	0.9	0.3		

* Meets or exceeds the Action Level defined in Table 1.

3.3 Ground Water Results

Table 4 presents gross alpha and beta activities measured in ground water during 2013. Table 5 presents soil sample results.

Table 4. 2013 ground water gross alpha and gross beta.

Sample ID	Well Location	Collection Date	Gross Alpha (pCi/L)	Uncertainty (+/-pCi/L)	Alpha MDC (pCi/L)	Gross Beta (pCi/L)	Uncertainty (+/-pCi/L)	Beta MDC (pCi/L)
DEQ-GW-522-L01	Trip blank, distilled water	5/22/2013	-0.18	0.74	2.03	-0.70	1.30	3.00
DEQ-GW-522-L29	L29	5/22/2013	2.70	1.90	2.90	19.20	4.20	4.10
DEQ-GW-522-L33	L33	5/22/2013	1.30	1.50	2.40	18.20	3.50	2.80
DEQ-GW-522-L38	L38	5/22/2013	-0.70	2.30	4.10	14.90	4.20	5.30
DEQ-GW-522-L44	L44	5/22/2013	1.60	2.00	3.30	17.80	4.00	4.20
DEQ-GW-522-L45	L45	5/22/2013	2.60	1.70	2.50	16.80	3.40	3.10
DEQ-GW-1030-L75	Field blank, distilled water	10/30/2013	1.04	0.97	1.81	0.30	1.30	2.90
DEQ-GW-1030-L41	L41	10/30/2013	1.80	1.50	2.40	20.50	4.00	3.20
DEQ-GW-1030-L38	L38	10/30/2013	0.00	1.20	2.10	12.80	2.80	2.80
DEQ-GW-1030-L33	L33	10/30/2013	1.70	1.40	2.20	18.10	3.50	2.80
		Action Level:	**5.00**			**50.00**		

Table 5. 2013 soil monitoring results.

Sample ID	Sample Location	Collection Date	Am-241 (pCi/g)	Cs-137 (pCi/g)	Ra-226 (pCi/g)	Th-232 (pCi/g)	U-234 (pCi/g)	U-238 (pCi/g)
DEQ-SOIL-522-NW500-1N	NW Wind Rose offsite location	5/22/2013	-0.0120	0.2900	1.0000	1.1300	0.6700	0.7100
DEQ-SOIL-522-NW500-1S	NW Wind Rose offsite location	5/22/2013	-0.0070	0.3000	1.2300	1.1300	0.6000	0.5400
DEQ-SOIL-522-NW500-50N	NW Wind Rose offsite location	5/22/2013	0.0010	0.5200	1.2200	1.0100	0.6900	0.6700
DEQ-SOIL-522-NW500-50S	NW Wind Rose offsite location	5/22/2013	0.0000	0.3500	1.2100	1.1300	0.7500	0.8800
DEQ-NW500-2E	NW Wind Rose offsite location	10/30/2013	-0.0020	0.2700	1.2300	1.1400	0.7300	0.7900
DEQ-NW500-50N	NW Wind Rose offsite location	10/30/2013	0.0000	0.2800	1.4300	1.1000	0.9200	0.9400
DEQ-NW500-2S	NW Wind Rose offsite location	10/30/2013	0.0060	0.6300	1.5400	1.1200	0.6700	0.6400
DEQ-NW500-50S	NW Wind Rose offsite location	10/30/2013	-0.0020	0.1000	1.2600	1.2600	0.6500	0.7200
DEQ-SW-50W	NW Wind Rose offsite location	10/30/2013	0.0030	0.8900	1.4700	1.1200	0.6600	0.7600
		Action Level:	**0.06**	**1.00**	**3.00**	**4.00**	**4.00**	**4.00**

4 Discussion of Results

In the following, the results of the monitoring program are analyzed and discussed in terms of public radiation dose and the monitoring action levels defined for ground water and soils.

4.1 Public Radiation Dose from USEI-B Operations (2013 and Amended 2012)

For 2013, the highest average penetrating radiation measurement was 18.6 μR/hr, and the highest average radon concentration was 1.1 pCi/L. Based on these results, the net external (DDE_{net}), internal ($CEDE_{net}$), and total dose ($TEDE_{net}$) were determined to be as follows:

- 2013 DDE_{net} = 3.35 mrem
- 2013 $CEDE_{net}$ =5.79 mrem
- 2013 $TEDE_{net}$ = 9.15 mrem

Both values are well below the IDAPA 58.01.10.20.01.(b) requirement that excess TEDE from operations of the facility cannot exceed 100 mrem.

With proper accounting for gamma background in the radon measurements, the radiation doses for 2012 were amended as follows:

- 2012 DDE_{net} = 3.61 mrem
- 2012 $CEDE_{net}$ =2.26 mrem
- 2012 $TEDE_{net}$ = 5.87 mrem

4.2 Ground Water Impacts

For 2013, there were no exceedances of the QAPP action level for either gross alpha or gross beta in ground water samples.

4.3 Soil Impacts

For 2013, there were no action level exceedances for soil samples.

5 Data Validation

In accordance with the requirements of the QAPP, hand checks have been performed on 5 percent of the spreadsheet calculations. The penetrating field data sheet contains about

21 rows of data, and 5 percent of 21 is 1.05, so one hand calculation was performed for each field data sheet—whether penetrating radiation or radon.

The monitoring data spreadsheets and a copy of the hand calculations can be found as follows:

- The 2013 monitoring data spreadsheet is TRIM record 2013BCQ140.
- The hand checks are contained in TRIM record 2013BCQ2.

6 Data Trends From 2005-2013

Trends for gross penetrating radiation and radon are presented in Figure 1 and Figure 2, respectively. The drop in penetrating radiation levels in the third quarter of 2011 can be attributed to the incorrect use of EICs with their protective covers on[5].

[5] To provide better guidance regarding how the EICs are to be prepared in the future, the SOPs for penetrating radiation and radon measurements have been updated to show pictures of the correct chambers.

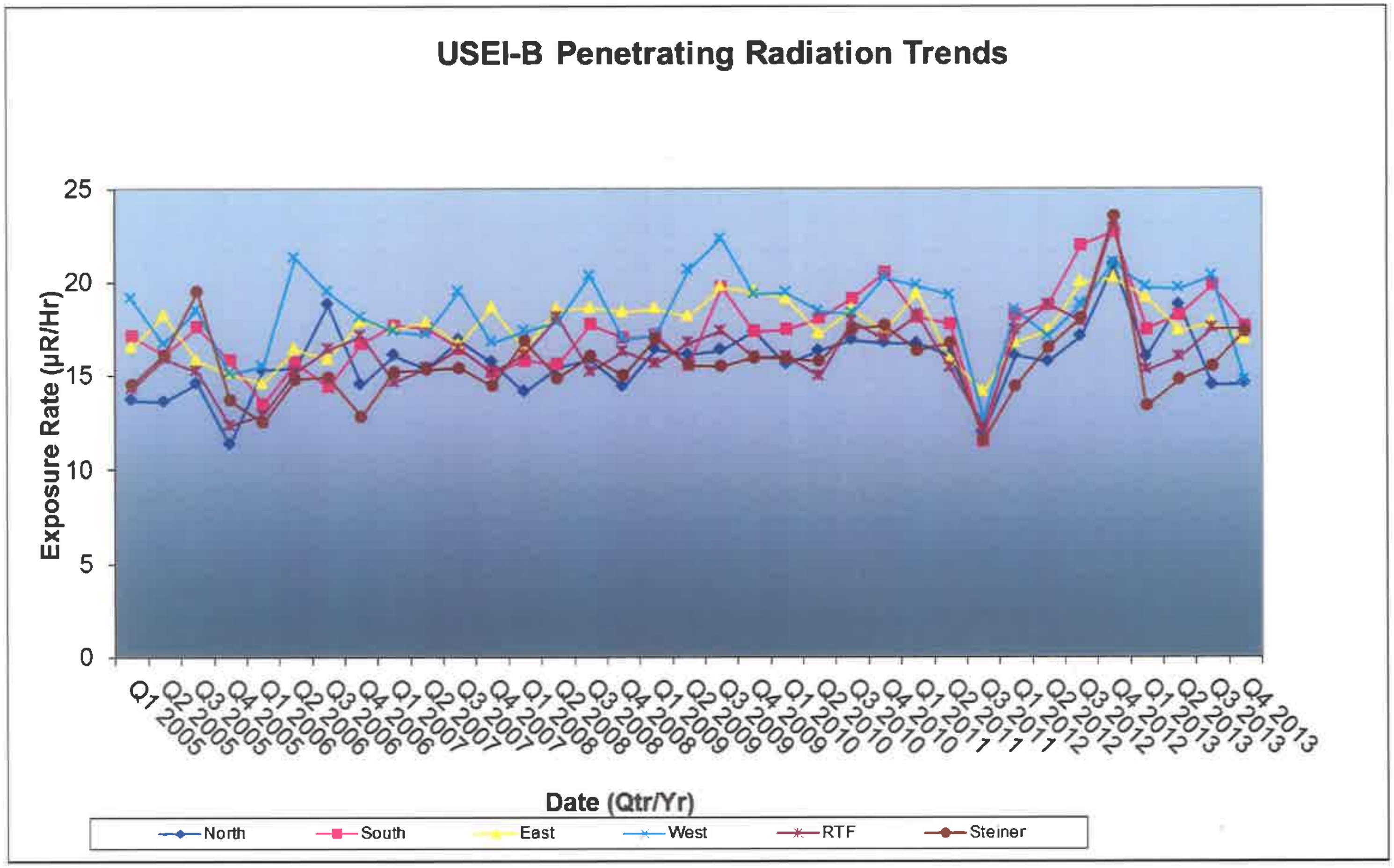

Figure 1. Penetrating radiation trends, 2005-2011.

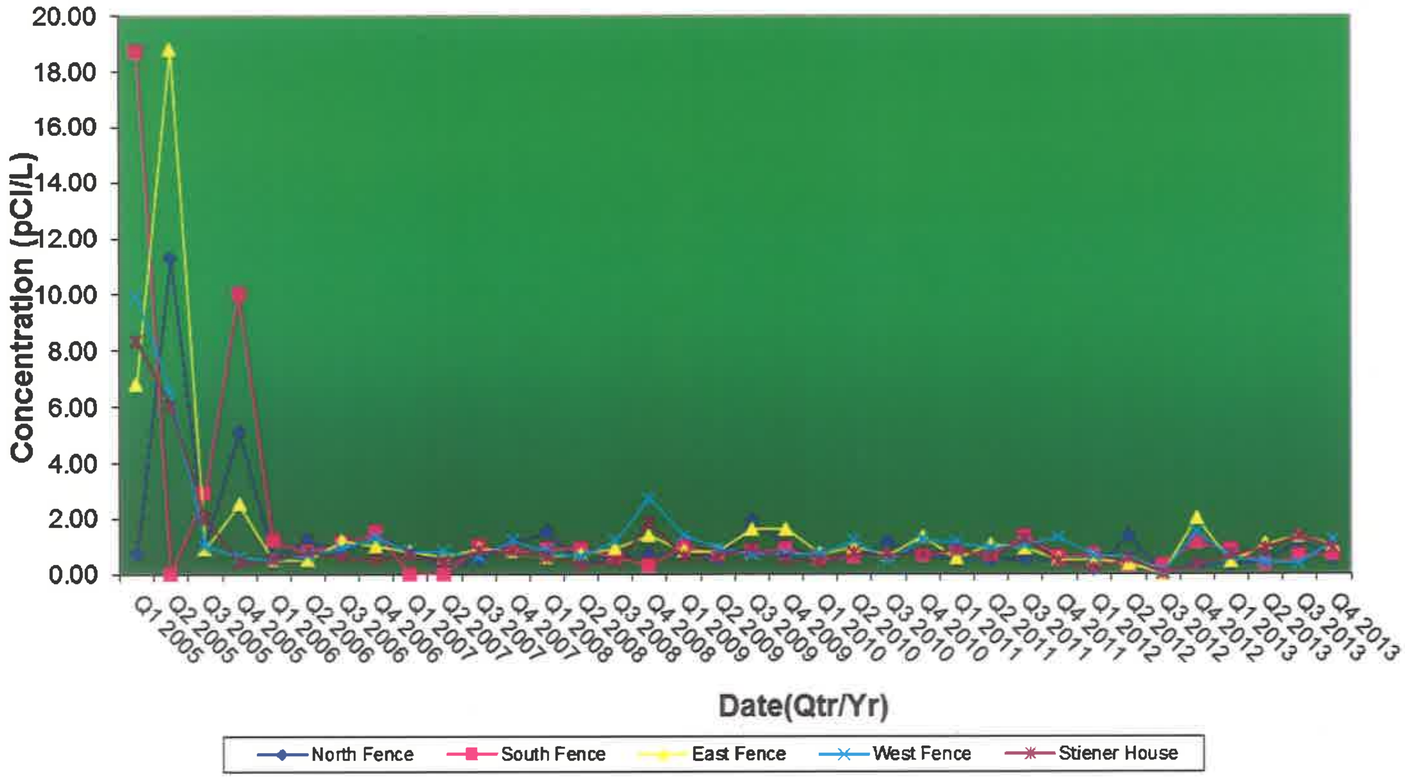

Figure 2. Radon concentration trends[6].

[6] Data collected during 2005 is not representative of the radon levels around Site B because the E-PERMs experienced significant amounts of dust loading on the electrets causing the electrets to discharge. In 2006, E-PERMs were placed in aluminum housings that allow air in while keeping down dust entry.

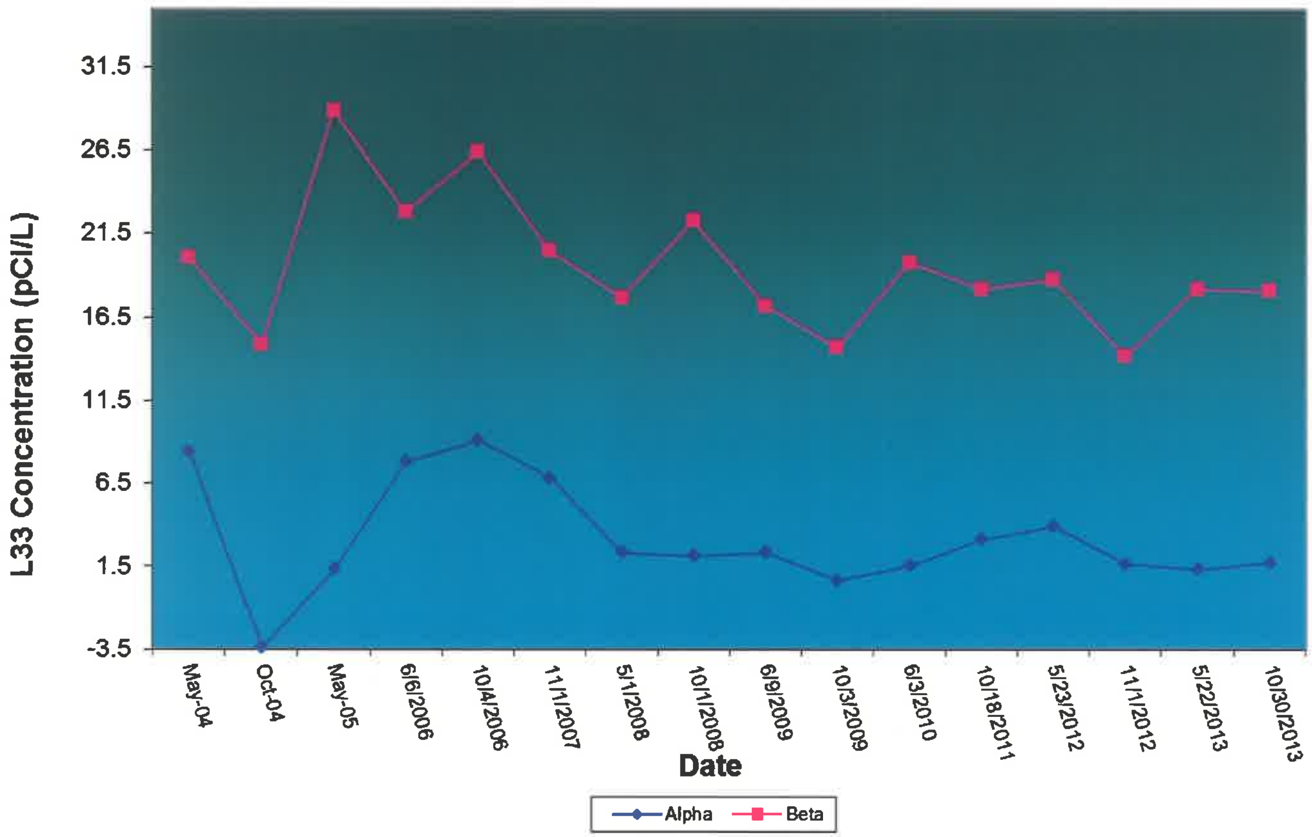

Figure 3. Well L33 gross alpha and beta trends.

7 Conclusions and Recommendations

Conclusions regarding public radiation dose from USEI Site B operations in 2013 are that the net additional radiation dose to a person who spent 1,000 hours at the fence of the USEI facility would be 9.15 mrem. This dose is well below the 100 mrem dose limit of IDAPA 58.01.10.20.01.(b), and the dose is calculated on the basis of conservative assumptions (no person is likely to actually spend 1,000 hours at the site fence line).

Overall, based on the data provided by the monitoring program, there is no reason to suspect that USEI Site B operations have a negative impact on human health or the environment.