

Environmental Management - Grand Junction Office



Environmental Air Monitoring Data  
Quarterly Report for the Moab and  
Crescent Junction, Utah, Sites  
Fourth Quarter 2011  
(October through December 2011)

March 2012



U.S. Department  
of Energy

**Office of Environmental Management**

**Moab UMTRA Project  
Environmental Air Monitoring Data Quarterly Report  
for the Moab and Crescent Junction, Utah, Sites  
Fourth Quarter 2011  
(October through December 2011)**

**March 2012**

**Moab UMTRA Project  
Environmental Air Monitoring Data Quarterly Report  
for the Moab and Crescent Junction, Utah, Sites  
Fourth Quarter 2011**

---

Revision 0

---

**Review and Approval**

  
\_\_\_\_\_  
Edward B. Baker  
RAC Environmental Compliance Manager

*March 21, 2012*  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Craig Niemeyer  
RAC Deputy Project Manager

*21 MAR 12*  
\_\_\_\_\_  
Date

In concurrence:

  
\_\_\_\_\_  
Donald R. Metzler  
Moab Federal Project Director

*3-26-2012*  
\_\_\_\_\_  
Date

## Revision History

<b>Revision No.</b>	<b>Date</b>	<b>Reason/Basis for Revision</b>
0	March 2012	Initial issue.

## Table of Contents

Section	Page
Acronyms and Abbreviations .....	iv
<b>1.0 Summary of Results.....</b>	<b>1</b>
1.1 Moab, Utah, Site .....	1
1.2 Crescent Junction, Utah, Site .....	5
1.3 Employee Monitoring for Job Site Radiation Exposure .....	7
<b>2.0 Data Assessment.....</b>	<b>10</b>
2.1 Data Assessment Summary.....	10
2.2 Employee Radiological Monitoring.....	11
<b>3.0 Environmental Air Monitoring Data .....</b>	<b>12</b>
3.1 Environmental Air Monitoring Data Summary .....	12
3.2 Employee Radiological Monitoring Data Summary.....	13
<b>4.0 Environmental Air Monitoring Field Activities Verification Checklist .....</b>	<b>14</b>
<b>5.0 References.....</b>	<b>16</b>

### Figures

Figure 1. Off-Site Radon, Direct Gamma, and Radioparticulate Monitoring Locations .....	3
Figure 2. On-Site Radon, Direct Gamma, and Radioparticulate Monitoring Locations .....	4
Figure 3. Sampling Location Map for the Crescent Junction Site .....	8
Figure 4. Moab Radioparticulate Concentration (Po-210).....	17
Figure 5. Moab Radioparticulate Concentration (Th-230).....	18
Figure 6. Moab Radioparticulate Concentration (Ra-226).....	19
Figure 7. Moab Radioparticulate Concentration (Uranium) .....	20
Figure 8. Moab Atmospheric Radon-222 Concentration .....	21
Figure 9. Moab Direct Gamma Radiation Dose.....	22
Figure 10. Crescent Junction Radioparticulate Concentration (Po-210).....	23
Figure 11. Crescent Junction Radioparticulate Concentration (Th-230) .....	24
Figure 12. Crescent Junction Radioparticulate Concentration (Ra-226) .....	25
Figure 13. Crescent Junction Radioparticulate Concentration (Uranium).....	26
Figure 14. Crescent Junction Atmospheric Radon-222 Concentration.....	27
Figure 15. Crescent Junction Direct Gamma Radiation Dose.....	28

### Tables

Table 1. Moab Environmental Air Monitoring Locations with Samples that Exceeded Applicable Regulatory Standards, Limits, or Guidelines During the Past Year.....	1
Table 2. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Moab Site for the Past Year Through Fourth Quarter 2011 .....	2
Table 3. Summary of Radioparticulate Air Monitoring Data for the Moab Site for the Past Year Through Fourth Quarter 2011.....	6
Table 4. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Crescent Junction Site for the Past Year Through Fourth Quarter 2011.....	9
Table 5. Summary of Radioparticulate Air Monitoring Data for the Crescent Junction Site or the Past Year Through Fourth Quarter 2011 .....	9

## Acronyms and Abbreviations

ALARA	as low as reasonably achievable
DCG	derived concentration guideline
DOE	U.S. Department of Energy
DOE O	U.S. Department of Energy Order
EPA	U.S. Environmental Protection Agency
MEI	maximally exposed individual
mrem/qtr	millirems per quarter
mrem/yr	millirems per year
pCi/L	picocuries per liter
RIN	report identification number
TLD	thermoluminescent dosimeter
UMTRA	Uranium Mill Tailings Remedial Action

## 1.0 Summary of Results

### 1.1 Moab, Utah, Site

**Sampling Period:** October through December 2011

#### Atmospheric Radon-222

U.S. Department of Energy (DOE) Order (O) 458.1, "Radiation Protection of the Public and Environment," establishes a guideline for atmospheric emissions of radon-222 that is applicable to the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project. This guideline is 3.0 picocuries per liter (pCi/L) above background. Based on 5 years of data from 2003 through 2008, background concentrations of radon-222 in the Moab area have been established at 0.7 pCi/L; therefore, the guideline for radon-222 emissions at the Moab site is 3.7 pCi/L. Monitoring data collected during the fourth quarter of 2011 indicate that this guideline was exceeded at four on-site locations. In general, fourth quarter results were higher than previous quarterly data for locations near or on the millsite with stations 0106, 0107, 0108, and 0109 near excavation activity exceeding guideline. Remote locations were similar to historical data. Refer to Tables 1 and 2 for a review of radon-222 data for the Moab site. Sample locations for the Moab site are presented in Figures 1 and 2.

#### Direct Environmental Gamma Radiation

DOE O 458.1 establishes a dose limit of 100 millirems per year (mrem/yr) above naturally occurring gamma levels (background). Background gamma radiation for the Moab area has been established at 82 mrem/yr; therefore, the gamma dose limit for the Moab site is 182 mrem/yr (45.5 mrem/quarter [qtr]). Based on the monitoring data collected during the fourth quarter of 2011, four on-site monitoring locations exceeded the quarterly gamma dose limit, and no off-site monitoring location exceeded the quarterly gamma radiation dose limit.

Fourth quarter analytical results were slightly higher than the third quarter. The results have been elevated since pile excavation started in the second quarter of 2009, and results indicate tailing pile influence within the DOE property as expected. Refer to Tables 1 and 2 for a review of gamma data for the Moab site.

*Table 1. Moab Environmental Air Monitoring Locations with Samples that Exceeded Applicable Regulatory Standards, Limits, or Guidelines During the Past Year*

Analyte	Standard/Guideline	Sampling Locations Exceeding Quarterly Standards/Guidelines During 4th Quarter 2011	Sampling Locations Exceeding Annual Standards/Guidelines During 2011 (1st, 2nd, 3rd, and 4th Quarters)
Radon-222	3.7 pCi/L	0106, 0107, 0108	0106, 0107, 0108, 0109
Direct Gamma Radiation	182 mrem/yr (45.5 mrem/qtr)	0108, 0109, 0110, 0112	0109, 0110, 0112

mrem/yr = millirems per year; mrem/qtr = millirems per quarter

Table 2. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Moab Site for the Past Year Through Fourth Quarter 2011

Station Number	1st Quarter 2011		2nd Quarter 2011		3rd Quarter 2011		4th Quarter 2011		2011 Annual	
	Radon pCi/L	Gamma mrem/91 d <sup>3</sup>	Radon pCi/L	Total Gamma mrem/yr						
<b>On-Site Locations</b>										
0101	1.8	36.3	0.7	32.0	1.9	37.8	2.6	37.9	1.8	144
0102	0.7	25.6	0.6	23.1	0.5	23.2	1.5	27.7	0.83	99.6
0103	1.0	26.2	0.5	21.5	0.7	24.0	1.8	26.2	1	97.9
0104	1.4	29.2	NDA	25.5	0.9	28.3	2.8	30.6	1.7	113.6
0105	1.4	25.9	2.0	25.4	1.3	24.4	2.8	28.4	1.9	104.1
0106	2.8	36.9	1.4	34.6	1.8	35.7	3.9	41.8	2.5	149
0107	1.9	30.0	1.4	28.8	1.6	27.9	4	34.7	2.2	121.4
0108	1.4	40.6	1.6	40.0	2.7	40.0	3.8	47.6	2.3	168.2
0109	1.0	119.2	3.9	144.9	2.8	157.1	2.9	169.4	2.7	590.6
0110	1.2	85.7	1.2	81.2	1.2	94.4	2	89.4	1.4	350.7
0111	0.7	37.5	1.1	32.8	1.0	38.5	1	35.2	1	144
0112	1.0	46.5	1.2	43.5	1.8	48.3	2.3	49.8	1.6	188.1
0113	1.9	30.2	1.7	30.6	2.4	29.0	3.4	33.7	2.4	123.5
<b>Off-Site Locations</b>										
0117 <sup>1</sup>	<0.3	24.3	0.4	21.3	0.4	23.6	0.4	23.8	0.4	93
0118	0.4	23.1	0.4	21.8	0.4	20.8	0.8	24.7	0.5	90.4
0119 <sup>2</sup>	0.6	23.2	0.3	22.4	0.5	19.1	1	25.6	0.6	90.3
0120	0.3	21.9	<0.3	22.1	<0.4	18.8	0.7	24.9	0.4	87.7
0121	0.6	24.1	0.4	21.0	0.4	20.0	0.5	24.3	0.5	89.4
0122	<0.3	22.8	<0.3	18.6	<0.4	19.7	0.4	22.2	0.4	83.3
0123 <sup>1</sup>	<0.3	23.0	<0.3	19.2	<0.4	20.1	0.5	21.7	0.4	84
0124	0.9	26.3	0.6	25.7	0.4	23.4	1.4	30.0	0.8	105.4
0125	1.2	30.1	1.0	29.3	0.9	27.4	1.8	33.5	1.2	120.3
0126	1.2	27.3	0.7	22.7	1.1	24.6	2.7	29.5	1.4	104.1
0127	0.7	26.7	0.3	23.8	0.4	23.3	1.2	27.4	0.7	101.2
0128	1.5	28.1	1.3	22.1	1.0	25.5	3	27.5	1.7	103.2
0129	1.1	26.8	1.0	25.5	1.8	24.9	2	29.2	1.5	106.4
MEI <sup>2</sup>	<0.3	23.0	0.4	19.2	0.8	19.4	1.5	22.3	0.8	88.8

NDA = no data available (found on ground).

<sup>1</sup>Designated background monitoring locations. Background locations are sufficiently distant from the millsite to be free of any influences from potential site contaminants.

<sup>2</sup>The MEI is the continually occupied residential property that is closest to the DOE property boundary.

<sup>3</sup>mrem value is prorated to a 91-day exposure period.

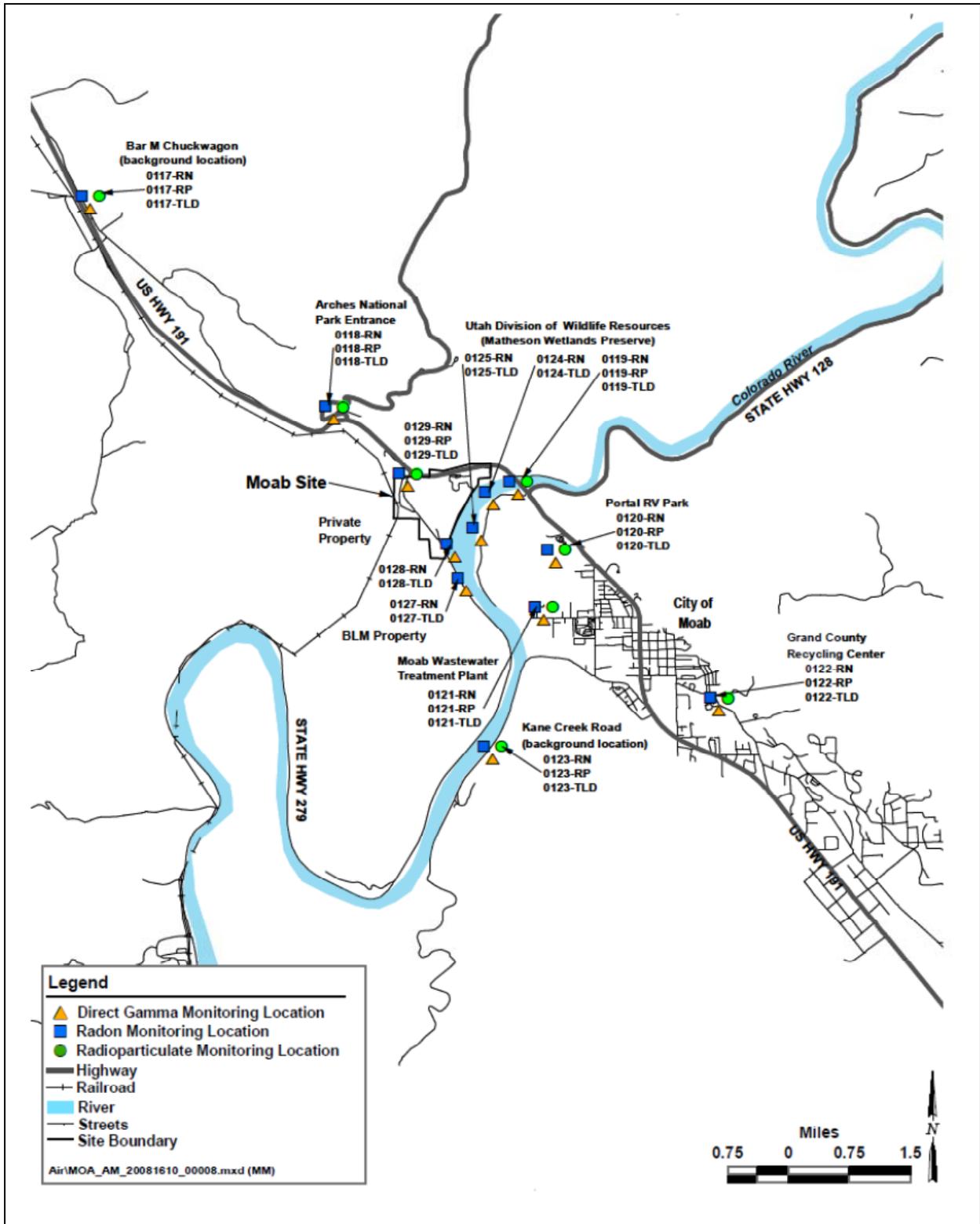


Figure 1. Off-Site Radon, Direct Gamma, and Radioparticulate Monitoring Locations

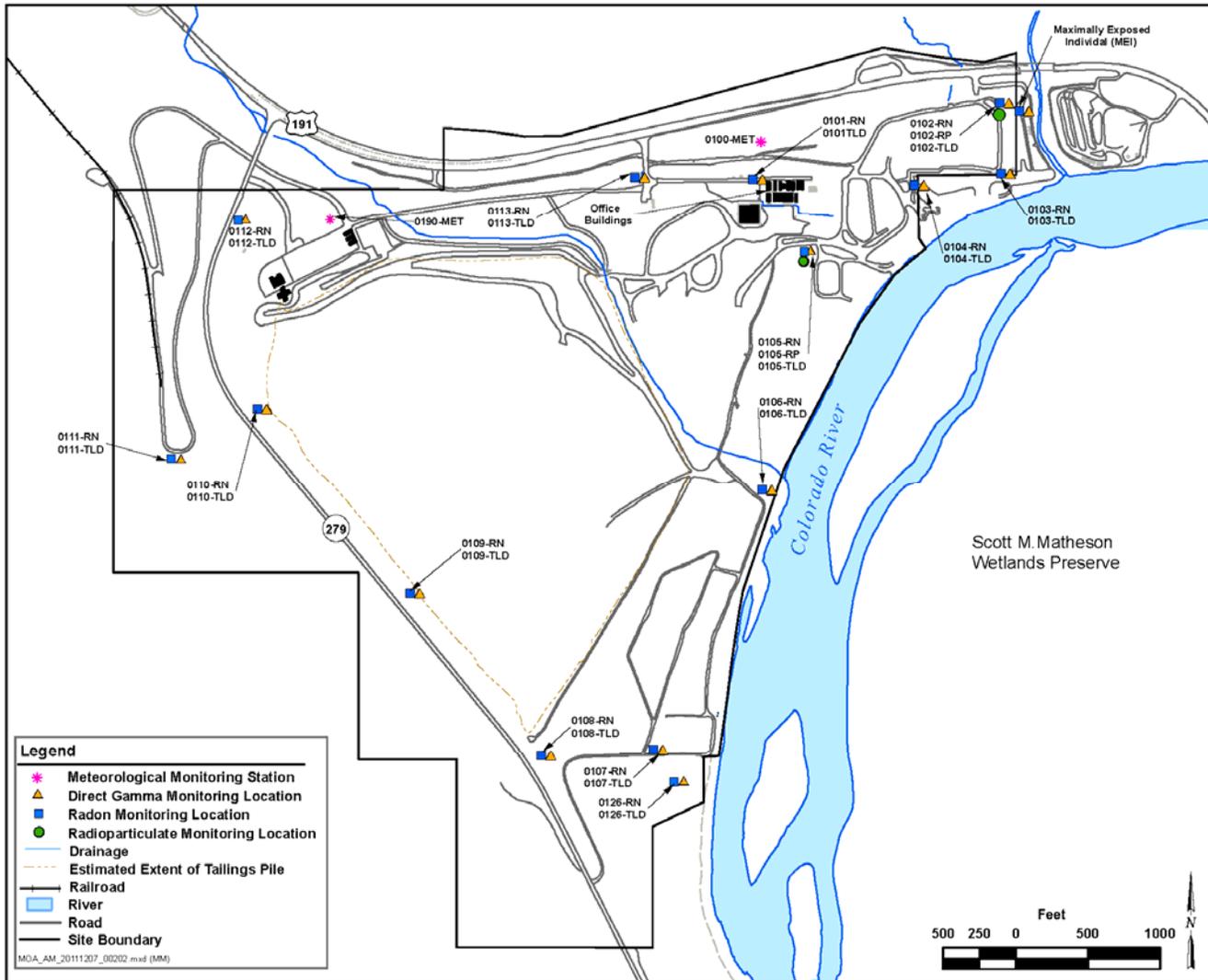


Figure 2. On-Site Radon, Direct Gamma, and Radioparticulate Monitoring Locations

### **Radon-222 and Direct Gamma Conclusion**

Although radon and direct gamma exposure rates exceeded the quarterly and annual standards/guidelines at four locations on the DOE property, this does not reflect elevated doses to the public. These data represent the exposure that a member of the public could receive if he or she resided at the point where the data were collected for an entire year. This is not a realistic representation of actual or expected public exposure conditions, because no member of the public permanently resides at or near these locations. Monitoring data observed at the maximally exposed individual (MEI) location, just east of the Moab site, represent the greatest potential exposure to a member of the public. Radon and gamma dose limits established by DOE were not exceeded at the MEI location.

### **Radioparticulates**

No standards or radiological exposure limits were exceeded at any of the 10 radioparticulate monitoring locations at or near the Moab site during the fourth quarter of 2011. Analytical data for all analytes (radium-226, thorium-230, polonium-210, and total uranium) were below their respective derived concentration guidelines (DCGs), as found in DOE O 458.1. Concentrations of the radioparticulates have been consistently below DCGs since DOE assumed ownership of the site in 2001. DOE O 458.1 also requires that the radiological dose resulting from airborne emissions is less than 10 mrem/yr. All on-site and off-site sampling results were lower than the DOE dose limit of 10 mrem/yr.

During the fourth quarter of 2011, the on-site dose resulting from airborne emissions, excluding background, was 0.31 mrem/qtr (1.19 mrem/yr) at location 0102 and 0.44 mrem/qtr (2.59 mrem/yr) at location 0105. Nearby off-site locations 0117 and 0129 were 0.19 mrem/qtr (0.80 mrem/yr) and 0.73 mrem/qtr (4.56 mrem/yr), respectively. Station 0129 is immediately downwind of the operations. Although results are below the guideline, stations closer to the operations (0105 and 0129) indicate higher results than more remote stations (0102 and 0117), as would be expected. The trend is down during the last year. Refer to Table 3 for radioparticulate air monitoring data for the Moab site.

## **1.2 Crescent Junction, Utah, Site**

**Sampling Period:** October through December 2011

### **Atmospheric Radon-222**

DOE O 458.1 establishes a guideline for atmospheric emissions of radon-222 that will be applicable to the Crescent Junction site (3.0 pCi/L above background). Shipment of uranium mill tailings to the Crescent Junction disposal cell commenced in the second quarter of 2009. Based on 3 years of data from 2006 to 2009, background concentrations of radon-222 in the Crescent Junction area have been established at 0.9 pCi/L; therefore, the guideline for radon-222 emissions at the Crescent Junction site is 3.9 pCi/L. During the fourth quarter of 2011, none of the on-site or off-site stations exceeded the guideline. Sample locations for the Crescent Junction site are presented in Figure 3. Radon-222 and direct gamma radiation for the Crescent Junction site are summarized in Table 4, and radioparticulate data for the Crescent Junction site are summarized in Table 5.

Table 3. Summary of Radioparticulate Air Monitoring Data  
for the Moab Site for the Past Year Through Fourth Quarter 2011

Station Number	Isotope	1st Quarter 2011 (μCi/mL)	2nd Quarter 2011 (μCi/mL)	3rd Quarter 2011 (μCi/mL)	4th Quarter 2011 (μCi/mL)	Annual Average (μCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
<b>On-Site Locations</b>							
0102-RP	Uranium <sup>1</sup>	1.8E-16	2.30E-16	1.5E-16	1.20E-16	1.7E-16	1.19
	Thorium-230 <sup>2</sup>	2.8E-16	2.40E-16	2.2E-16	1.30E-16	2.2E-16	
	Radium-226 <sup>3</sup>	1.2E-16	9.10E-17	6.4E-17	6.20E-17	8.4E-17	
	Polonium-210 <sup>4</sup>	1.1E-14	9.10E-17	4.8E-15	9.10E-15	6.20E-15	
0105-RP	Uranium <sup>1</sup>	4.2E-16	4.90E-16	3.0E-16	1.8E-16	3.5E-16	2.59
	Thorium-230 <sup>2</sup>	1.0E-15	9.00E-16	5.8E-16	3.0E-16	7.00E-16	
	Radium-226 <sup>3</sup>	2.5E-16	5.80E-16	3.0E-16	1.2E-16	3.1E-16	
	Polonium-210 <sup>4</sup>	1.1E-14	5.50E-15	5.9E-15	9.9E-15	8.2E-15	
<b>Off-Site Locations</b>							
0117-RP	Uranium <sup>1</sup>	9.6E-17	1.70E-16	1.3E-16	1.5E-16	1.4E-16	0.8
	Thorium-230 <sup>2</sup>	6.5E-17	8.50E-17	6.8E-17	3.7E-17	6.4E-17	
	Radium-226 <sup>3</sup>	6.8E-17	1.20E-16	5.6E-17	4.0E-17	7.2E-17	
	Polonium-210 <sup>4</sup>	9.6E-15	4.50E-15	4.4E-15	6.5E-15	6.2E-15	
0118-RP	Uranium <sup>1</sup>	1.6E-16	2.50E-16	1.6E-16	1.1E-16	1.7E-16	1.72
	Thorium-230 <sup>2</sup>	2.9E-16	7.00E-16	4.3E-16	1.6E-16	3.9E-16	
	Radium-226 <sup>3</sup>	2.2E-16	4.80E-16	2.8E-16	1.2E-16	2.7E-16	
	Polonium-210 <sup>4</sup>	1.1E-14	5.20E-15	4.7E-15	7.1E-15	7.0E-15	
0119-RP	Uranium <sup>1</sup>	1.5E-16	1.70E-16	1.4E-16	1.3E-16	1.5E-16	1.09
	Thorium-230 <sup>2</sup>	1.7E-16	1.70E-16	1.9E-16	9.4E-17	1.6E-16	
	Radium-226 <sup>3</sup>	1.3E-16	2.10E-16	1.3E-16	2.0E-17	1.2E-16	
	Polonium-210 <sup>4</sup>	1.0E-14	4.80E-15	4.5E-15	8.0E-15	6.80E-15	
0120-RP	Uranium <sup>1</sup>	1.4E-16	1.80E-16	1.5E-16	1.1E-16	1.5E-16	0.89
	Thorium-230 <sup>2</sup>	9.6E-17	1.70E-16	1.3E-16	6.7E-17	1.1E-16	
	Radium-226 <sup>3</sup>	1.1E-16	7.20E-17	2.1E-16	5.0E-17	1.1E-16	
	Polonium-210 <sup>4</sup>	9.3E-15	4.00E-15	3.6E-15	6.2E-15	5.8E-15	
0121-RP	Uranium <sup>1</sup>	1.30E-16	1.70E-16	1.3E-16	1.1E-16	1.4E-16	1.01
	Thorium-230 <sup>2</sup>	1.5E-16	1.80E-16	1.7E-16	7.0E-17	1.4E-16	
	Radium-226 <sup>3</sup>	7.6E-17	1.40E-16	4.6E-17	9.5E-17	9.0E-17	
	Polonium-210 <sup>4</sup>	9.6E-15	4.60E-15	4.2E-15	7.0E-15	6.3E-15	
0122-RP	Uranium <sup>1</sup>	1.2E-16	1.50E-16	1.4E-16	1.0E-16	1.3E-16	0.83
	Thorium-230 <sup>2</sup>	7.2E-17	1.20E-16	1.6E-16	4.0E-17	9.80E-17	
	Radium-226 <sup>3</sup>	1.9E-16	1.90E-16	1.1E-16	1.2E-16	1.5E-16	
	Polonium-210 <sup>4</sup>	7.2E-15	4.50E-15	4.4E-15	6.4E-15	5.6E-15	
0123-RP	Uranium <sup>1</sup>	1.2E-16	1.60E-16	1.2E-16	9.6E-17	1.2E-16	0.92
	Thorium-230 <sup>2</sup>	6.9E-17	1.50E-16	9.9E-17	3.1E-17	8.8E-17	
	Radium-226 <sup>3</sup>	7.5E-17	1.30E-16	1.8E-16	4.6E-17	1.1E-16	
	Polonium-210 <sup>4</sup>	1.0E-14	5.00E-15	4.5E-15	7.8E-15	6.9E-15	

*Table 3. Summary of Radioparticulate Air Monitoring Data  
for the Moab Site for the Past Year Through Fourth Quarter 2011 (continued)*

Station Number	Isotope	1st Quarter 2011 (µCi/mL)	2nd Quarter 2011 (µCi/mL)	3rd Quarter 2011 (µCi/mL)	4th Quarter 2011 (µCi/mL)	Annual Average (µCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
<b>Off-Site Locations (continued)</b>							
<b>0129-RP</b>	Uranium <sup>1</sup>	3.2E-16	5.20E-16	4.2E-16	2.3E-16	3.7E-16	4.56
	Thorium-230 <sup>2</sup>	8.7E-16	2.30E-15	1.9E-15	7.9E-16	1.5E-15	
	Radium-226 <sup>3</sup>	5.3E-16	2.60E-15	6.7E-16	5.3E-17	9.6E-16	
	Polonium-210 <sup>4</sup>	8.6E-15	6.30E-15	6.9E-15	9.4E-15	7.8E-15	

<sup>1</sup>DOE DCG for total uranium = 2.E-12

<sup>2</sup>DOE DCG for thorium-230 = 4.E-14

<sup>3</sup>DOE DCG for radium-226 = 1.E-12

<sup>4</sup>DOE DCG for polonium-210 = 1.E-12

µCi/mL = microcuries per milliliter

### **Direct Environmental Gamma Radiation**

DOE O 458.1 establishes a dose limit of 100 mrem/yr above naturally occurring gamma levels (background). Therefore, the gamma dose limit for the Crescent Junction site is 192.5 mrem/yr (48.1 mrem/qtr) based on background data from stations for 2006 to 2009. During the fourth quarter of 2011, none of the on-site or off-site stations exceeded the annual or quarterly gamma radiation dose limit. Refer to Table 5 for a review of gamma data for the Crescent Junction site.

### **Radioparticulates**

DOE O 458.1 establishes DCGs for concentrations of radioparticulates in air. Concentrations of the radioparticulates have been consistently below DCGs since DOE assumed ownership of the site in 2006. During the fourth quarter of 2011, the on-site dose resulting from airborne emissions, including background, was 0.3 mrem/qtr or 3.86 mrem/yr at location 0308. An increase was noted at 0308 beginning in the second quarter of 2010 during extensive disposal activities conducted near this station. This elevated dose was not an exceedance, based on four quarters of data. The trend has been downward for the past two quarters. Engineering controls were implemented to reduce the level of radioparticulates. All other Crescent Junction station results were similar to past data (i.e., 0.20 mrem/qtr), and 0.82 mrem/yr was noted at off-site location 0306 or the MEI. Refer to Table 5 for a review of radioparticulate air monitoring data for the Crescent Junction site.

### **1.3 Employee Monitoring for Job Site Radiation Exposure**

In addition to the environmental air monitoring program around the perimeter of the work sites, an employee monitoring program is also conducted. External radiation monitoring of employees who enter the contamination area is performed using a thermoluminescent dosimeter (TLD). Personal electronic dosimeters are also used to give real-time monitoring of the workers in the radiological contamination area.



Table 4. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Crescent Junction Site for the Past Year Through Fourth Quarter 2011

Station Number	1st Quarter 2011		2nd Quarter 2011		3rd Quarter 2011		4th Quarter 2011		2011 Annual	
	Radon pCi/L	Gamma mrem/91 d <sup>1</sup>	Average Radon pCi/L	Total Gamma mrem/yr						
0301	0.7	24.7	0.5	26.9	<0.4	19.9	0.9	24.7	0.6	96.2
0302	0.7	23.0	0.6	29.9	0.5	21.1	1	25.7	0.7	99.7
0303	0.4	24.8	0.6	30.0	0.4	23.2	0.8	28	0.6	104
0304	0.7	26.5	0.7	28.1	0.8	24.6	0.6	25.6	0.7	104.8
0305	0.4	26.8	0.6	30.2	0.4	25.9	1	27.3	0.6	110.2
0306	0.4	26.4	0.4	30.0	<0.4	23.9	0.6	27.5	0.5	107.8
0307	0.5	27.0	0.3	32.2	<0.4	24.6	1	28.3	0.6	112.1
0308	0.8	21.9	1.1	28.5	1.7	20.7	1.6	25.4	1.3	96.5
0309	0.7	22.7	0.8	29.3	0.5	20.8	1.2	27	0.8	99.8

<sup>1</sup>mrem value is prorated to a 91-day exposure period.

Table 5. Summary of Radioparticulate Air Monitoring Data for the Crescent Junction Site for the Past Year Through Fourth Quarter 2011

Station Number	Isotope	1st Quarter 2011 (µCi/mL)	2nd Quarter 2011 (µCi/mL)	3rd Quarter 2011 (µCi/mL)	4th Quarter 2011 (µCi/mL)	Annual Average (µCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
0306-RP	Uranium <sup>1</sup>	1.1E-16	1.20E-16	1.1E-16	8.1E-17	1.0E-16	0.82
	Thorium-230 <sup>2</sup>	8.5E-17	1.10E-16	4.6E-17	4.6E-17	7.1E-17	
	Radium-226 <sup>3</sup>	1.3E-16	1.50E-16	4.8E-17	8.6E-17	1.0E-16	
	Polonium-210 <sup>4</sup>	8.9E-15	5.10E-15	4.2E-15	6.8E-15	6.2E-15	
0307-RP	Uranium <sup>1</sup>	1.1E-16	1.40E-16	1.2E-16	7.7E-17	1.1E-16	0.74
	Thorium-230 <sup>2</sup>	5.8E-17	1.00E-16	1.1E-16	4.0E-17	7.7E-17	
	Radium-226 <sup>3</sup>	3.8E-17	9.50E-17	9.0E-17	2.9E-17	6.3E-17	
	Polonium-210 <sup>4</sup>	8.0E-15	4.10E-15	3.6E-15	5.9E-15	5.4E-15	
0308-RP	Uranium <sup>1</sup>	4.2E-16	6.10E-16	1.7E-16	1.5E-16	3.4E-16	3.86
	Thorium-230 <sup>2</sup>	1.3E-15	2.80E-15	4.8E-16	2.7E-16	1.2E-15	
	Radium-226 <sup>3</sup>	6.8E-16	2.60E-15	2.8E-16	1.1E-16	9.2E-16	
	Polonium-210 <sup>4</sup>	9.5E-15	8.20E-15	4.6E-15	6.7E-15	7.2E-15	
0309-RP	Uranium <sup>1</sup>	1.7E-16	2.60E-16	1.3E-16	1.1E-16	1.7E-16	1.57
	Thorium-230 <sup>2</sup>	3.0E-16	8.40E-16	2.3E-16	1.0E-16	3.7E-16	
	Radium-226 <sup>3</sup>	1.4E-16	6.70E-16	4.9E-17	9.8E-17	2.4E-16	
	Polonium-210 <sup>4</sup>	8.1E-15	5.30E-15	4.2E-15	7.1E-15	6.2E-15	

<sup>1</sup>DOE DCG for Total Uranium = 2.E-12

<sup>2</sup>DOE DCG for Thorium-230 = 4.E-14

<sup>3</sup>DOE DCG for Radium-226 = 1.E-12

<sup>4</sup>DOE DCG for Polonium-210 = 1.E-12

µCi/mL = microCuries per milliliter

The project's as low as reasonably achievable (ALARA) goal for individual exposure is 700 mrem/yr. The project ALARA goal is very conservative when compared to the DOE exposure limit of 2,000 mrem/yr and the Nuclear Regulatory Commission limit of 5,000 mrem/yr. Initial radiation results indicate that with proper personal protective equipment and limiting exposure, employees can safely work within the contamination area. Employees will continue to be carefully monitored to ensure safe working conditions are maintained. On-site radiation readings are higher than off-site locations; therefore, the contamination area workers represent the highest potentially exposed individuals.

The 2011 monitoring results were well below the ALARA goal, with the highest individual radiological worker dose being approximately 348 mrem/yr. The highest individual dose in the fourth quarter of 2011 TLD dose was 107 mrem. The highest individual dose in the fourth quarter of 2011 that was assigned to person wearing a personnel air sampler was 25 mrem, which equates to a dose of 77 mrem/yr. The average individual dose in the fourth quarter of 2011 that was assigned to person wearing a personnel air sampler was 7.7 mrem. The average individual TLD (all employees) dose in the fourth quarter of 2011 was 18.3 mrem.

## **2.0 Data Assessment**

### **2.1 Data Assessment Summary**

#### **Atmospheric Radon-222 Analyses**

Radon detectors were analyzed by Landauer Inc., in accordance with Landauer's *Quality Assurance Manual for Radon Monitoring Services* (March, 2004). Fourth quarter 2011 analytical radon-222 data were received in a report dated January 11, 2012. Unlike radioparticulate analyses, radon-222 data are not reported with qualifiers from the laboratory. When detectors were either missing, damaged, or could not be read, the laboratory noted an explanation for the stations. After the data report was received, the data were evaluated for consistency with other data points and sample duplicates.

#### **Direct Environmental Gamma Radiation Analyses**

TLDs are used for continuous dose measurements and are analyzed by Environmental, Inc., Midwest Laboratory in accordance with their analytical procedure *Preparation and Readout of Teledyne Isotopes TLD Card, TIML-TLD-01* (Teledyne Isotopes, 2001). Fourth quarter 2011 environmental gamma radiation data were received in a report dated January 30, 2012. After the laboratory results were received, the data were evaluated for consistency and compared to historic data and duplicates.

#### **Radioparticulate Analyses**

ALS Laboratory Group in Fort Collins, Colorado, analyzed the radioparticulate samples for radium-226, thorium-230, polonium-210, and total uranium. Results for the fourth quarter 2011 sampling period are in report identification number (RIN) 1201061. Polonium-210 and isotopic thorium (includes thorium-230) were analyzed by alpha spectroscopy, method PA-SOP714R10. Radium-226 was analyzed by radon emanation methods, U.S. Environmental Protection Agency (EPA) method 903.1(m). Total uranium was analyzed by inductively coupled plasma-mass spectrometry, EPA method SW-846 6020A, procedure PA SOP827, Revision 5.

Radioparticulate analytical data for samples collected during the fourth quarter of 2011 were received January 30, 2012, and were reviewed, validated, and summarized in the *Data Review and Validation Report for RIN 1201061* dated February 13, 2012.

### **Field Activities**

Duplicate samples for radon-222 monitoring were collected at three locations: (1) 0108, an on-site location at the southern property line of the Moab site; (2) 0111, an on-site location at the western property line near the rail load-out location; and (3) 0121, a background monitoring location approximately 2 miles southeast of the Moab site. Duplicate measurements of direct gamma were made at two Moab locations: (1) 0108, an on-site location with consistently elevated readings; and (2) 0129, an off-site location near the property boundary. Duplicate radon-222 measurements were made at Crescent Junction locations 0303 and 0308. Duplicate direct gamma measurements were made at Crescent Junction locations 0301 and 0305.

Duplicates are not being collected for radioparticulate samples per the *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan for the Moab Project Site and Crescent Junction Disposal Site, Utah* (DOE-EM/GJRAC1434). All of the radioparticulate isotopes collected to date are below their respective DCGs. Consequently, the costs associated with purchasing a duplicate sampler, providing additional electrical power, and incurring additional analytical expenses are not justified.

### **Suspected Anomalies**

All analytical data are reviewed for anomalous or outlying data points. No anomalous data was noted for the fourth quarter. Direct gamma data was similar to historic data. The only significant data results for the fourth quarter were normal high winter radon readings at 0106, 0107, and 0108 and continued elevated gamma readings for stations 0108, 0109, 0110, and 0112 (since excavation started), which are close to the tailings pile excavation activity. The quarterly review consists of evaluating monitoring data against historical and minimum/maximum values to determine if the reported data are within reasonable expected ranges. In addition, radioparticulate validation was performed by a third party (Pro2Serve) prior to data entry (into the SeePro database).

### **Summary**

Data collected during the fourth quarter of 2011 met the applicable laboratory control criteria for their respective analyses, and all data were reviewed by qualified personnel. The results were found to be within the acceptable limits associated with each matrix. Data reported in this environmental air monitoring report are considered validated and may be treated as final results. The checklist protocol summary of field observation for the fourth quarter of 2011 is shown in the Environmental Air Monitoring Field Activities Verification Checklist in Section 5.0.

## **2.2 Employee Radiological Monitoring**

Currently, the Moab UMTRA Project external dosimetry program utilizes a TLD from Mirion Dosimetry Service. The TLDs are submitted to the analytical laboratory on a quarterly basis. The employee monitoring results presented in this report is only for the external dosimetry program. Bioassay measurements are also performed to ensure employees are not at risk. Approximately 160 employees who work directly with the mill tailings were participants in the external dosimetry program.

## 3.0 Environmental Air Monitoring Data

### 3.1 Environmental Air Monitoring Data Summary

Radon-222 and direct gamma radiation for the Moab site are summarized in Table 2 (Section 1.0), and radioparticulate data for the Moab site are summarized in Table 3 (Section 1.0). Radon-222 and direct gamma radiation for the Crescent Junction site are summarized in Table 4 (Section 1.0), and radioparticulate data for the Crescent Junction site are summarized in Table 5 (Section 1.0).

Time-concentration graphs for each analyte sampled at select Moab sites are presented in Figures 4 through 7 and radon and gamma in Figures 8 and 9. Time-concentration graphs for each analyte sampled at the Crescent Junction sites are presented in Figures 10 through 13 and radon and gamma in Figures 14 and 15. After mill tailings disposal began, location 0308 became the closest to operations, and 0306 became the MEI location. Location 0307, approximately 5 miles east of the disposal site, will represent the second greatest risk to the public (second to the MEI location), and locations 0301 through 0305 and 0309 will provide property line data for the disposal site.

Time-concentration graphs have been plotted only for selected locations for each matrix. The rationale used for selecting each location is summarized below.

#### **Radon-222 and Direct Gamma Radiation**

Radon-222 and gamma radiation data have been graphed (Figures 8 and 9) for the following Moab site locations: (1) location MEI, which represents the greatest potential exposure scenario to a member of the public; (2) location 0108, which is on the southern property boundary of the Moab site and occasionally has high radon levels; (3) location 0106, which is along the southeastern property boundary and has recorded high direct gamma radiation; (4) location 0129 directly downwind of operations; (5) location 0117, which is approximately 5 miles northwest of the Moab site property and is a background monitoring location; and (6) location 0120, which is near the Portal RV Park, approximately 1 mile southeast of the Moab site, and represents a second potential exposure to the public. At Crescent Junction locations 0302 (close to northern side of operations), 0306 and 0307 (closest to members of the public) and 0308 and 0309 (close to southern side of operations and downwind respectively) are graphed in Figures 14 and 15.

#### **Radioparticulates**

Radioparticulate monitoring data have been graphed (Figures 4 through 7) for the following Moab site locations: (1) location 0102, one of two on-site radioparticulate monitoring locations, is the radioparticulate sampling location closest to the MEI; (2) location 0105, which is closest to the emissions source (i.e., the mill tailings pile) and is on site near freshwater pond adjacent to the Colorado River and the Matheson Wetlands Preserve; (3) location 0129 is directly downwind of operations; (4) location 0117 (near the Bar-M Chuckwagon), which is a background monitoring location approximately 5 miles northwest of the Moab site property and represents ambient or naturally occurring conditions; and (5) location 0120 (near the Portal RV Park), which is approximately 1 mile southeast of the Moab site and represents a location between the site and Moab for off-site exposure to the public.

At Crescent Junction, locations 0306 and 0307 are off-site stations closest to members of the public (see Figures 10 through 13). On-site locations 0308 and 0309 are graphed in Figures 10 through 13.

### 3.2 Employee Radiological Monitoring Data Summary

<b>Moab UMTRA Project Employee Dose/mrem</b>	<b>2010</b>	<b>4th Quarter 2011</b>
Number of Employees Monitored Using Personnel Air Sampling	<b>88</b>	<b>45</b>
Highest Individual Dose Assigned to Personnel Air Sampling	<b>91</b>	<b>25</b>
Average Moab UMTRA Project Dose for Personnel Air Sampling	<b>8</b>	<b>7.7</b>
Number of Employees Monitored Using TLDs	<b>313</b>	<b>160</b>
Highest Individual Dose Wearing a TLD	<b>100</b>	<b>107</b>
Average Moab UMTRA Project Dose Wearing a TLD	<b>11</b>	<b>18.3</b>

## 4.0 Environmental Air Monitoring Field Activities Verification Checklist

Project	Moab/Crescent Junction, Utah	Date(s) of Air Sampling	October through December 2012
Date(s) of Verification	February 28, 2012	Name of Verifier	Ed Baker
	Response (Yes, No, NA)	Comments	
1. Is the Sampling and Analysis Plan the primary document directing field procedures?	Yes		
2. Were the sampling locations specified in the Sampling and Analysis Plan?	Yes		
3. Were low-volume air samplers on and operating at or near 60 liters/minute $\pm$ 10%?	Yes		
4. Did any of the samplers require airflow adjustment?	No	All pumps were recalibrated to 60 liters/minute both at the beginning and the end of the sampling period.	
5. Were detectors (radon cups, TLDs) and monitoring equipment found to be undisturbed and in operable condition upon arrival?	Yes		
6. Were the hourly clocks on the low-volume air samplers operational upon arrival?	No	The timer failed at 0129 and was replaced.	
7. Were the run times recorded for each radioparticulate monitoring location?	Yes		
8. Were duplicates (for radon-222 and gamma radiation) taken at a frequency of one per 20 samples?	Yes		
9. Were filter blanks (for radioparticulates) taken at a frequency of one per 20 samples?	No	Not required per the Sampling and Analysis Plan.	
10. Were trip blanks (for radon-222 and gamma radiation) included with each shipment?	No	A trip blank is not used for the radon-222 monitoring because units are sealed; however, a trip blank was used for the direct gamma radiation monitoring.	
11. Was the identity of the quality-control sample locations protected?	Yes		
12. Were the true locations of the quality-control samples recorded in the Field Log Book?	Yes		
13. Were all samples collected as specified in the Sampling and Analysis Plan?	Yes		
14. Were chain of custody records completed, and was sample custody maintained?	Yes		
15. Are field data sheets signed and dated by sampling personnel?	Yes		
16. Was all other pertinent information documented on the field data sheets?	Yes		

## 4.0 Environmental Air Monitoring Field Activities Verification Checklist (continued)

<b>Project</b>	<u>Moab/Crescent Junction, Utah</u>	<b>Date(s) of Air Sampling</b>	<u>October through December 2012</u>
<b>Date(s) of Verification</b>	<u>February 28, 2012</u>	<b>Name of Verifier</b>	<u>Ed Baker</u>
		<b>Response (Yes, No, NA)</b>	<b>Comments</b>
17. Were the true locations of the quality-control samples recorded in the Field Log Book?		<u>Yes</u>	
18. Were all samples collected as specified in the Sampling and Analysis Plan?		<u>Yes</u>	
19. Were chain of custody records completed, and was sample custody maintained?		<u>Yes</u>	
20. Are field data sheets signed and dated by sampling personnel?		<u>Yes</u>	
21. Was all other pertinent information documented on the field data sheets?		<u>Yes</u>	

## 5.0 References

*Data Review and Validation Report for RIN 1201061*, ALS Laboratory Group, Fort Collins, Colorado, February 13, 2012.

DOE (U.S. Department of Energy). *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (DOE-EM/GJRAC1434), July, 2010.

DOE (U.S. Department of Energy) Order 458.1, "Radiation Protection of the Public and Environment."

*Preparation and Readout of Teledyne Isotopes TLD Card, TIML-TLD-01, Revision 7*  
Environmental, Inc., Midwest Laboratory, Teledyne Isotopes, 2001.

*Quality Assurance Manual for Radon Monitoring Services*, Revision Number 9, Landauer, Inc., March, 2004.

### Moab Radioparticulate Concentration (Po-210)

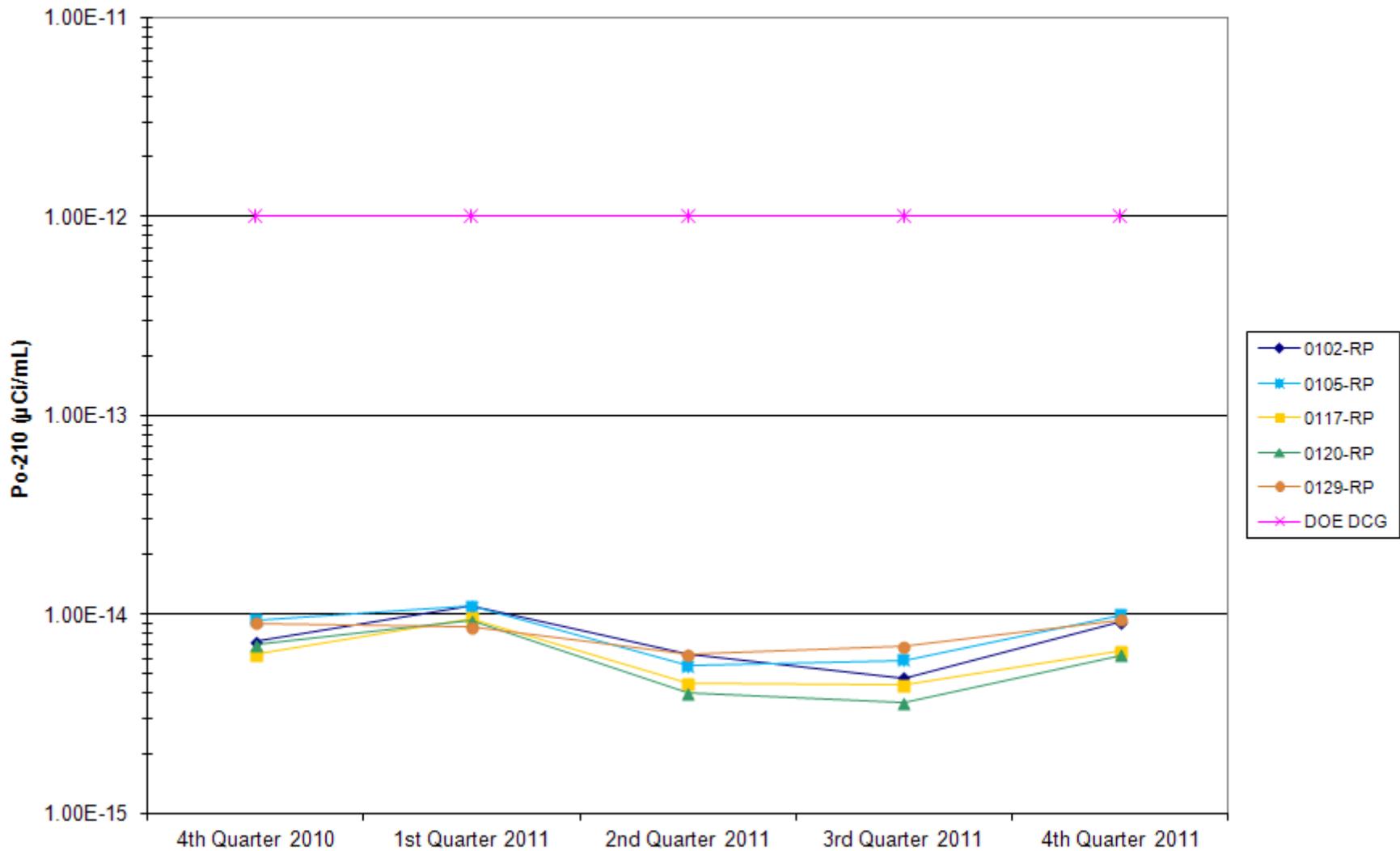


Figure 4. Moab Radioparticulate Concentration (Po-210)

### Moab Radioparticulate Concentration (Th-230)

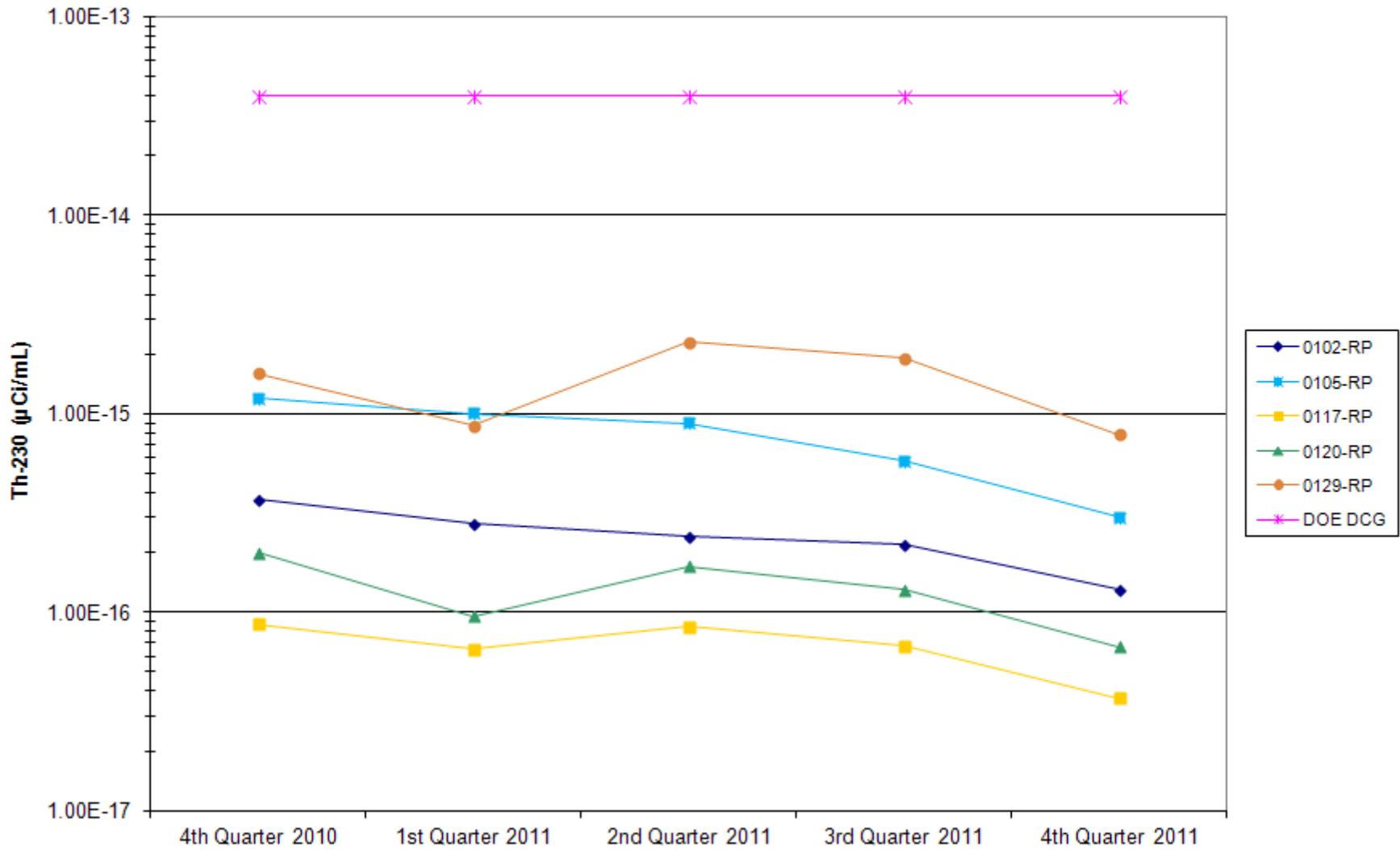


Figure 5. Moab Radioparticulate Concentration (Th-230)

### Moab Radioparticulate Concentration (Ra-226)

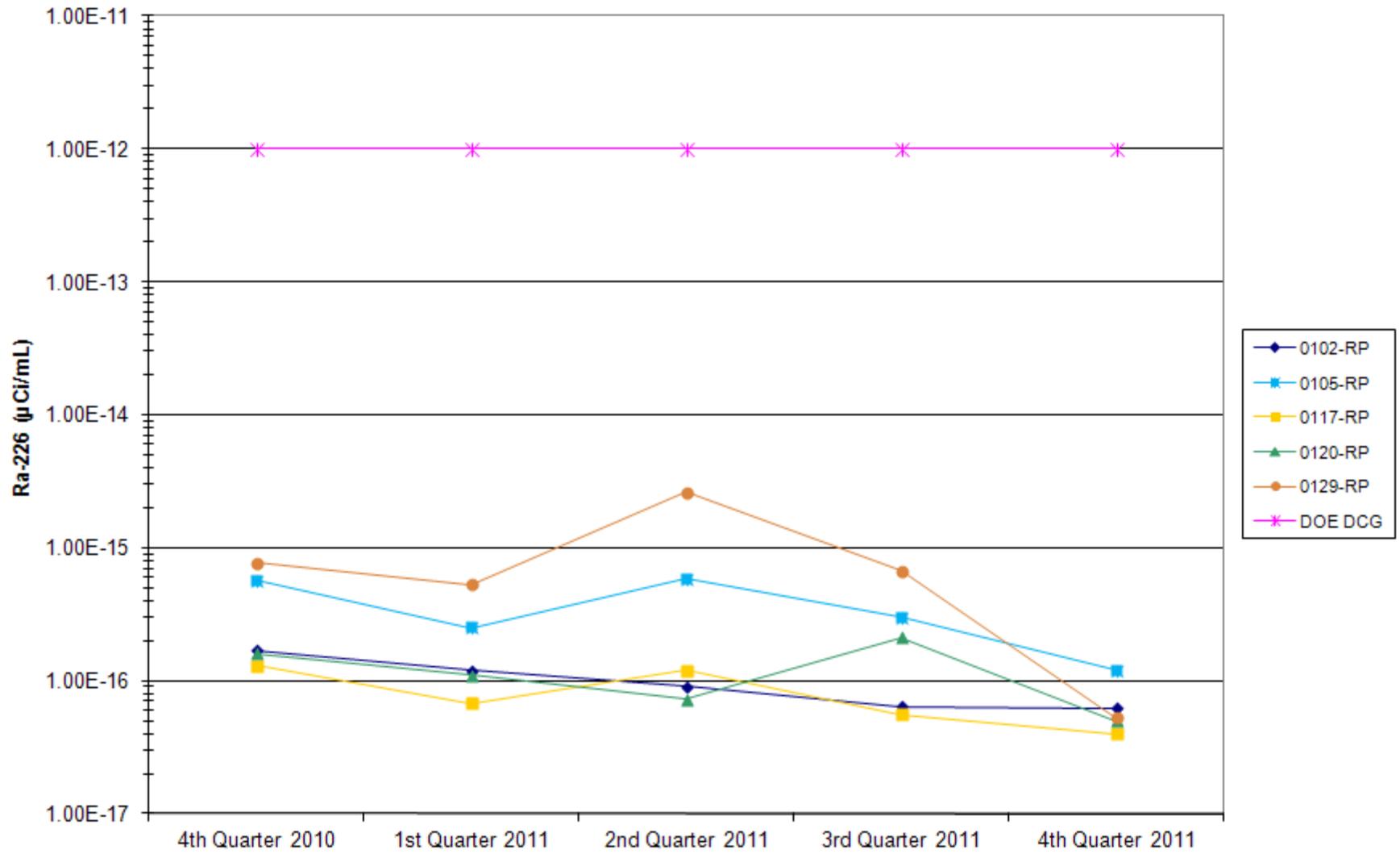


Figure 6. Moab Radioparticulate Concentration (Ra-226)

### Moab Radioparticulate Concentration (Uranium)

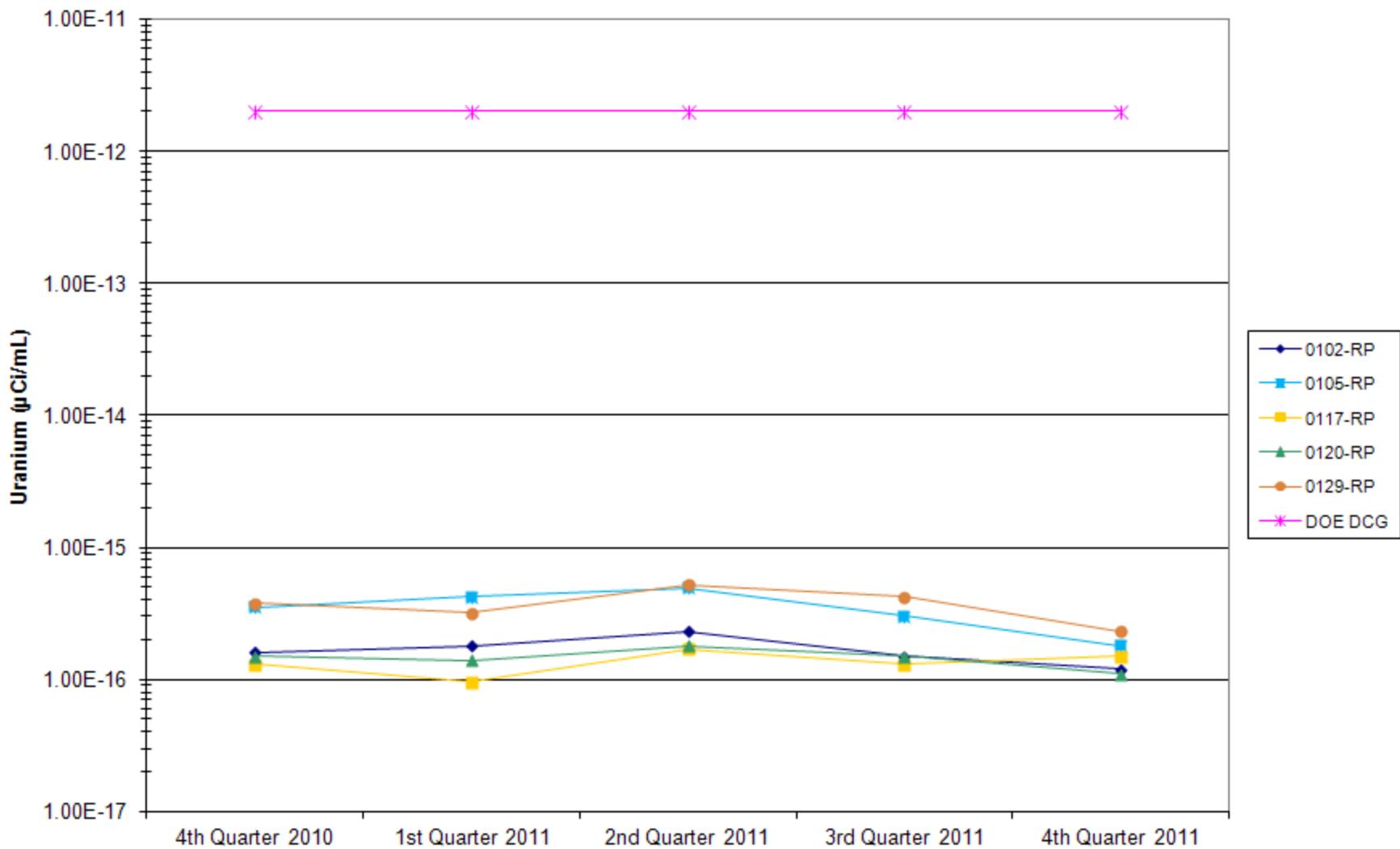


Figure 7. Moab Radioparticulate Concentration (Uranium)

### Moab Atmospheric Radon-222 Concentration

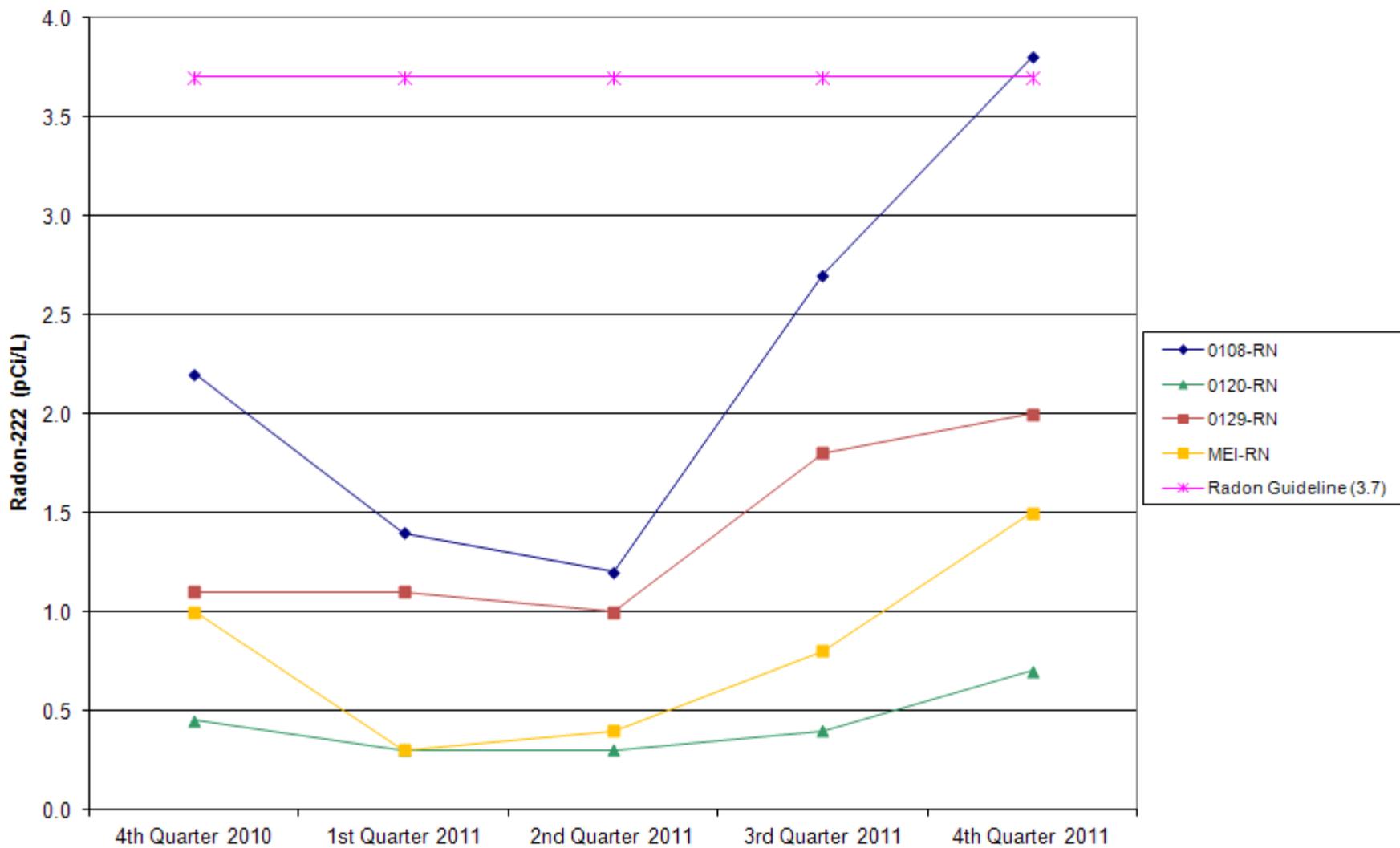


Figure 8. Moab Atmospheric Radon-222 Concentration

### Moab Direct Gamma Radiation Dose

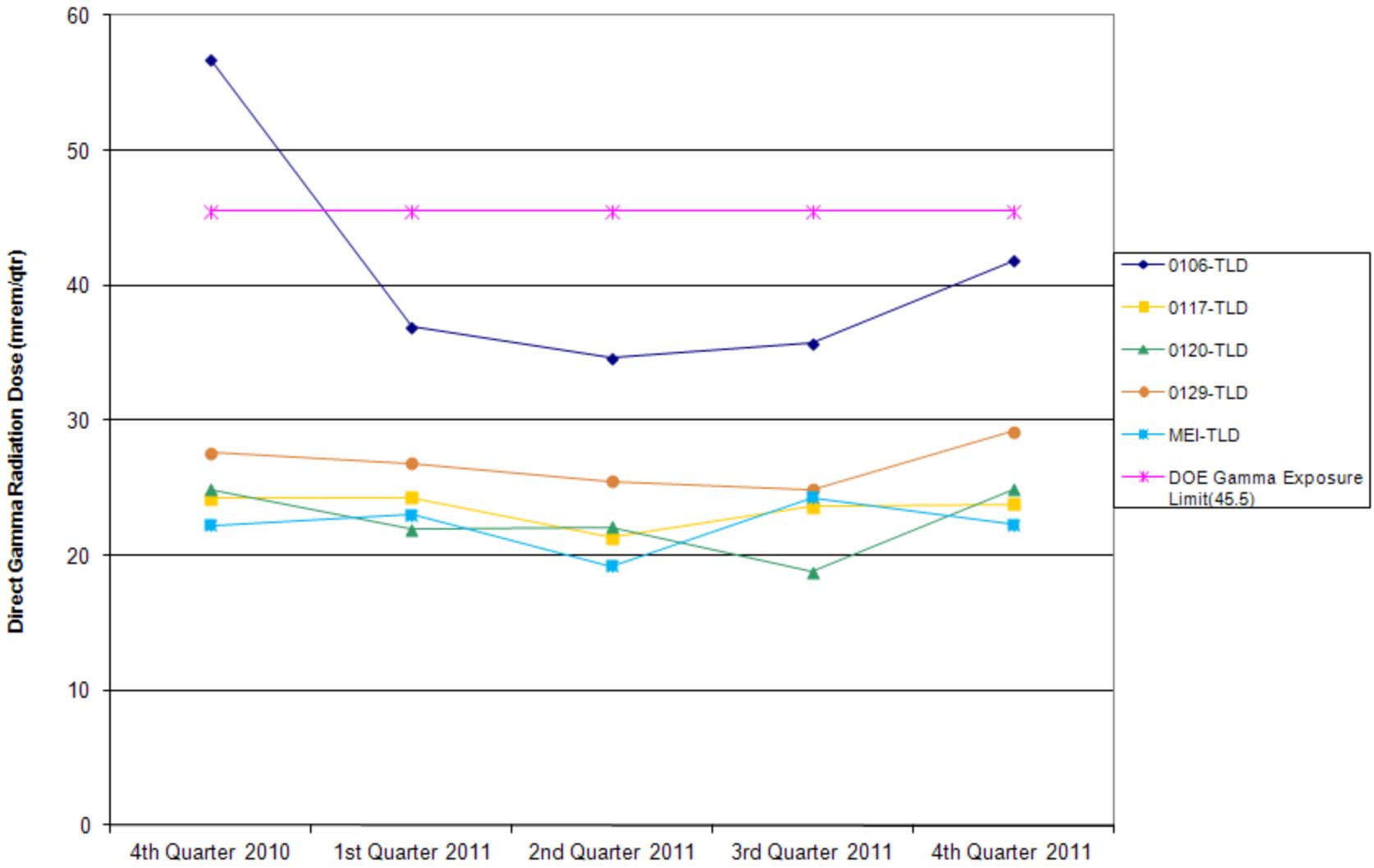


Figure 9. Moab Direct Gamma Radiation Dose

### Crescent Junction Radioparticulate Concentration (Po-210)

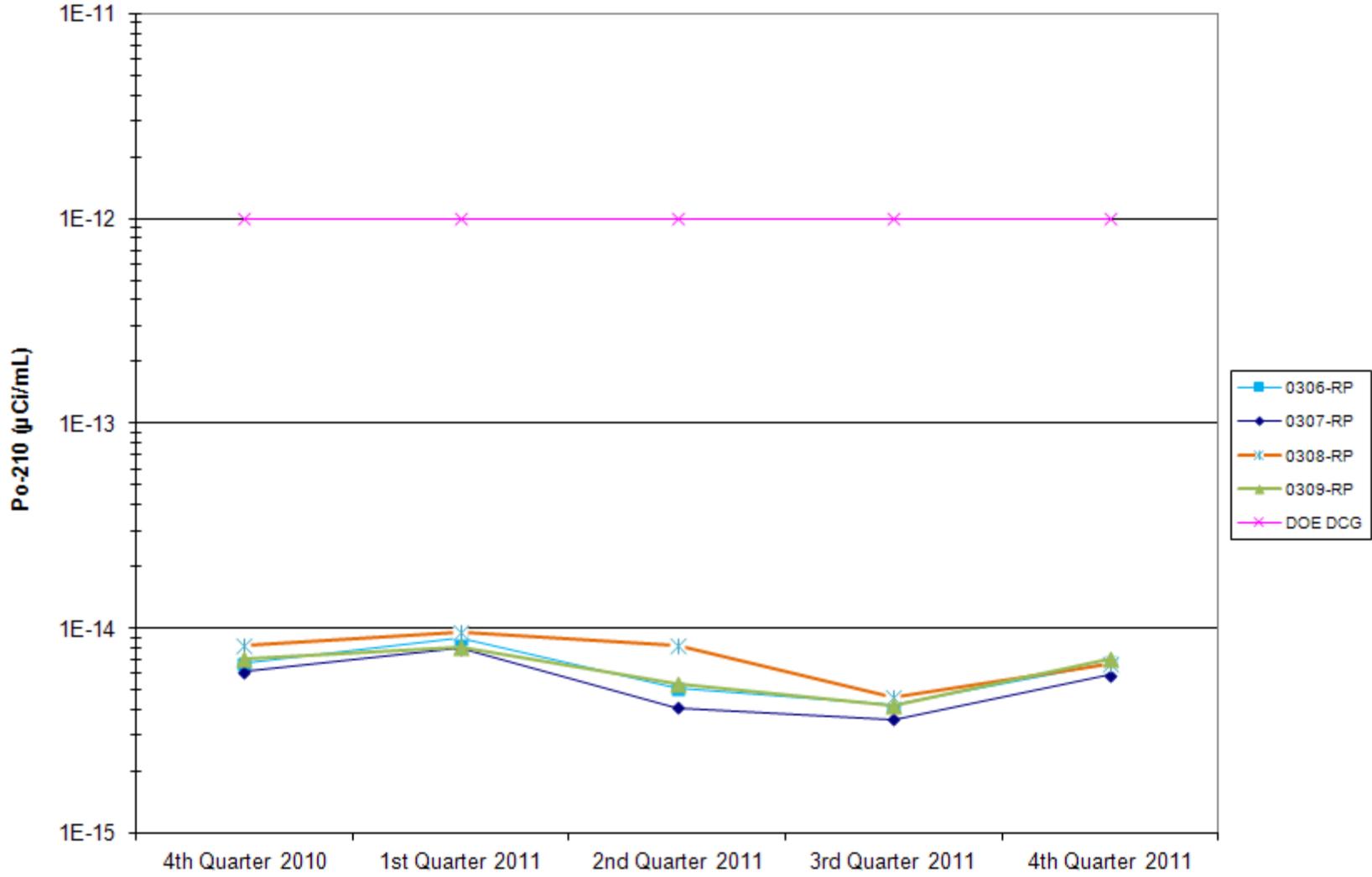


Figure 10. Crescent Junction Radioparticulate Concentration (Po-210)

### Crescent Junction Radioparticulate Concentration (Th-230)

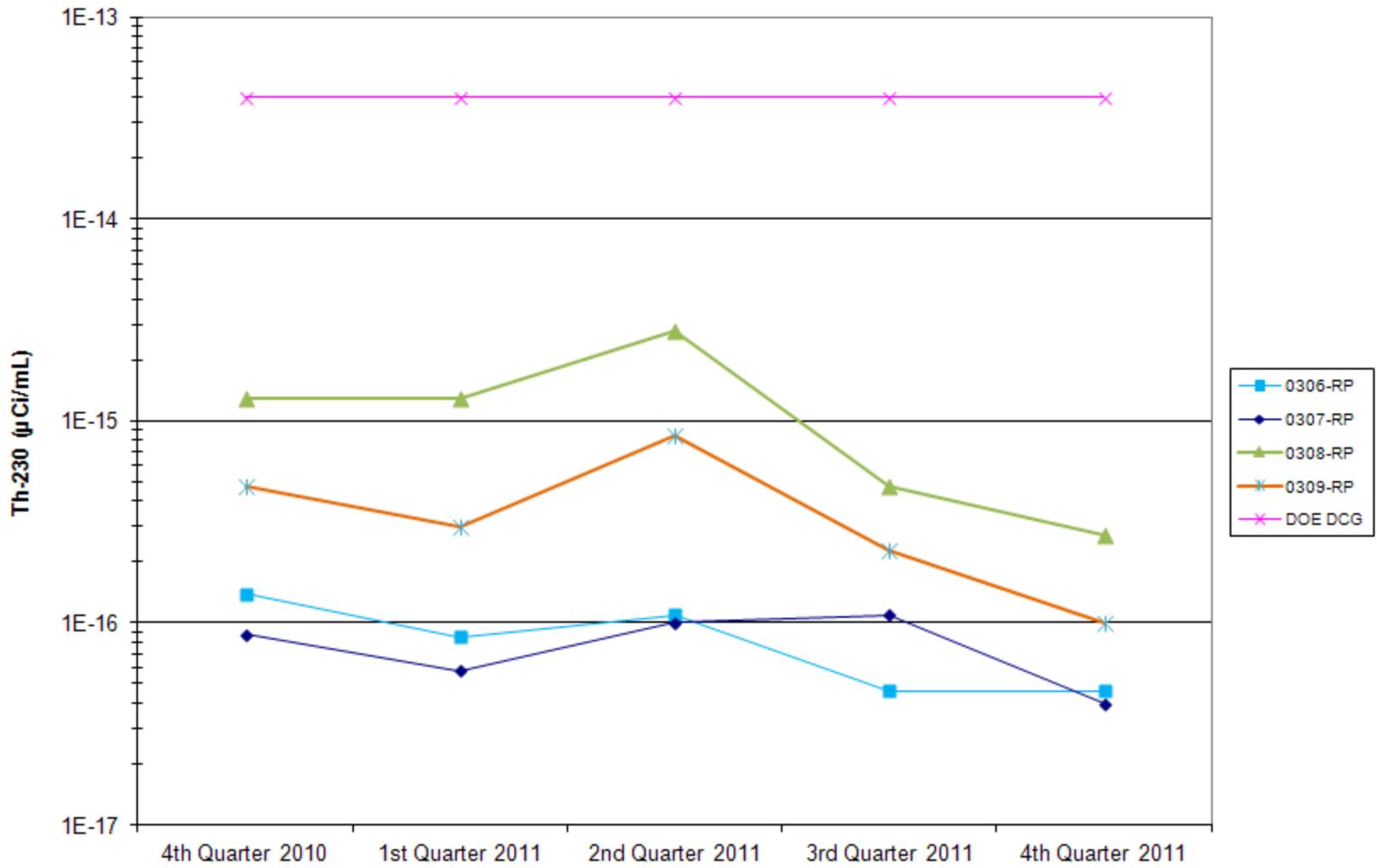


Figure 11. Crescent Junction Radioparticulate Concentration (Th-230)

### Crescent Junction Radioparticulate Concentration (Ra-226)

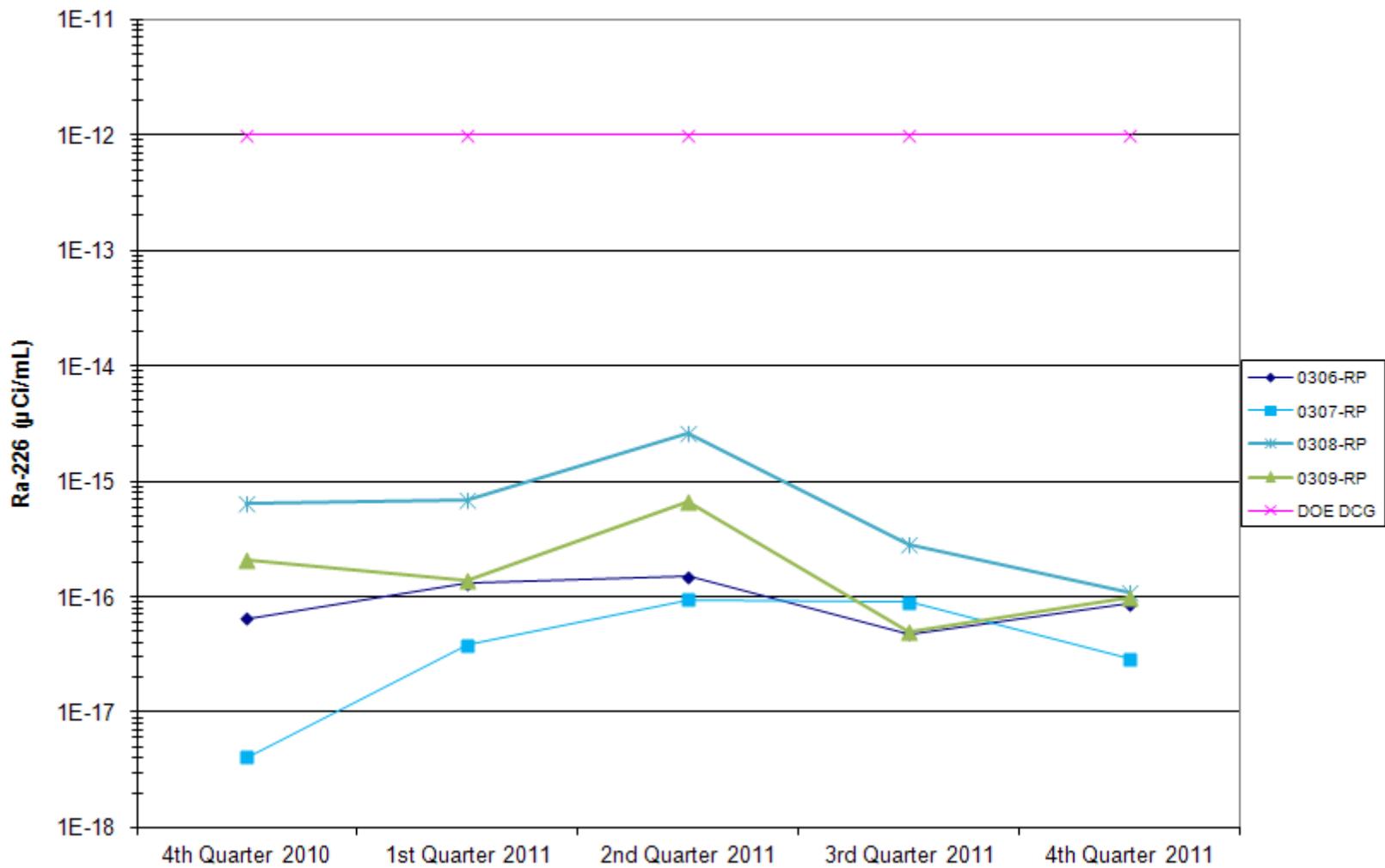


Figure 12. Crescent Junction Radioparticulate Concentration (Ra-226)

### Crescent Junction Radioparticulate Concentration (Uranium)

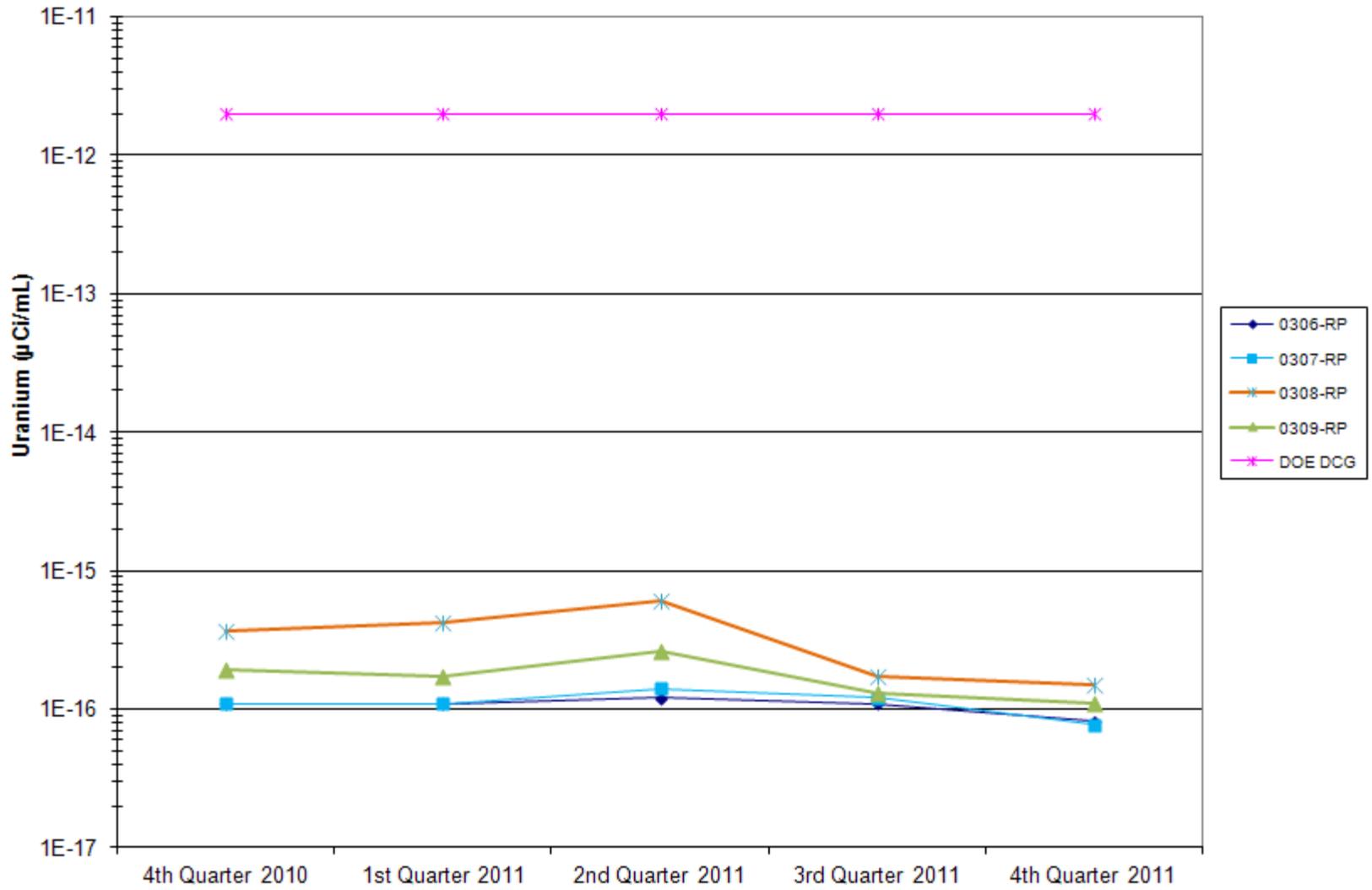


Figure 13. Crescent Junction Radioparticulate Concentration (Uranium)

### Crescent Junction Atmospheric Radon-222 Concentration

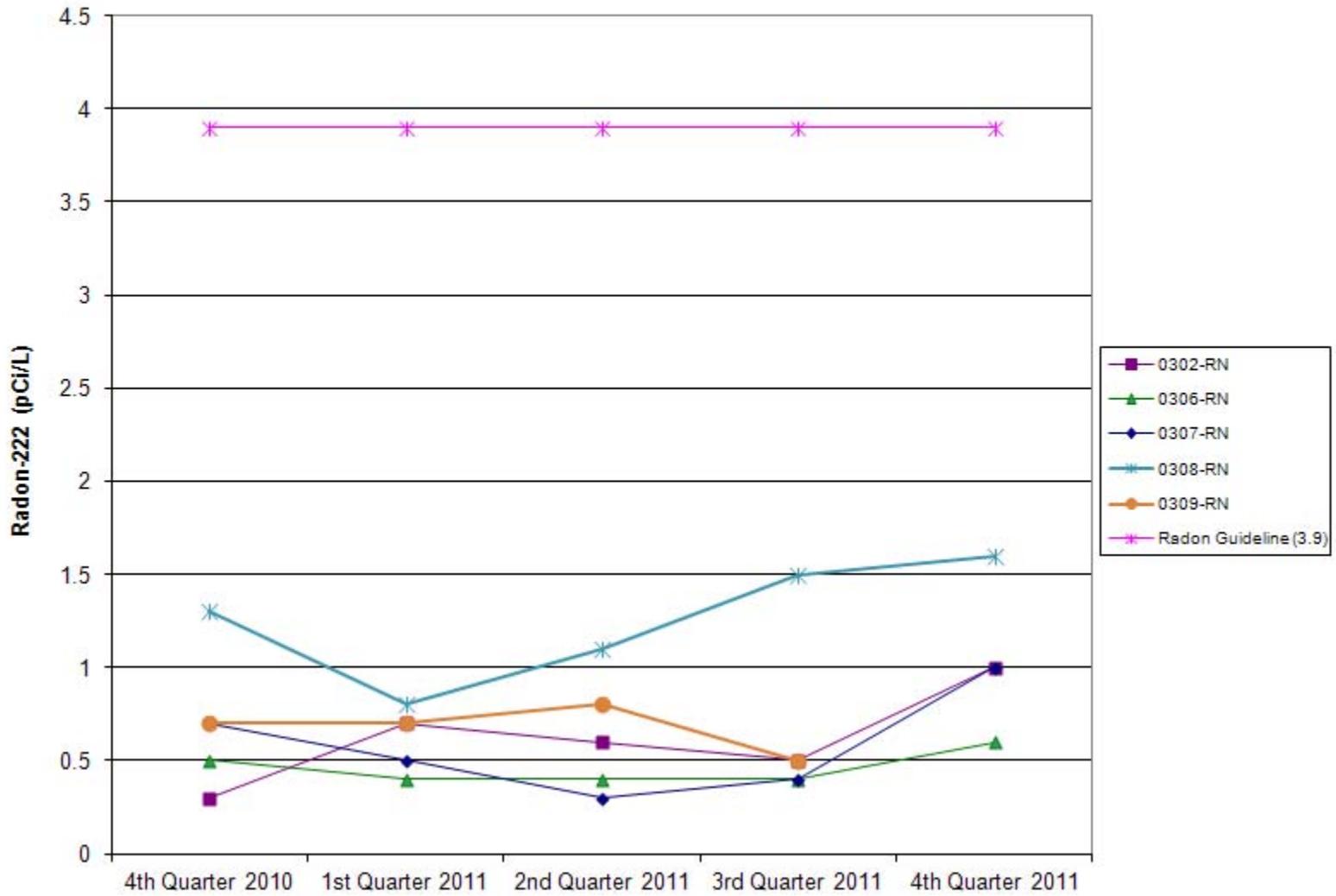


Figure 14. Crescent Junction Atmospheric Radon-222 Concentration

### Crescent Junction Direct Gamma Radiation Dose

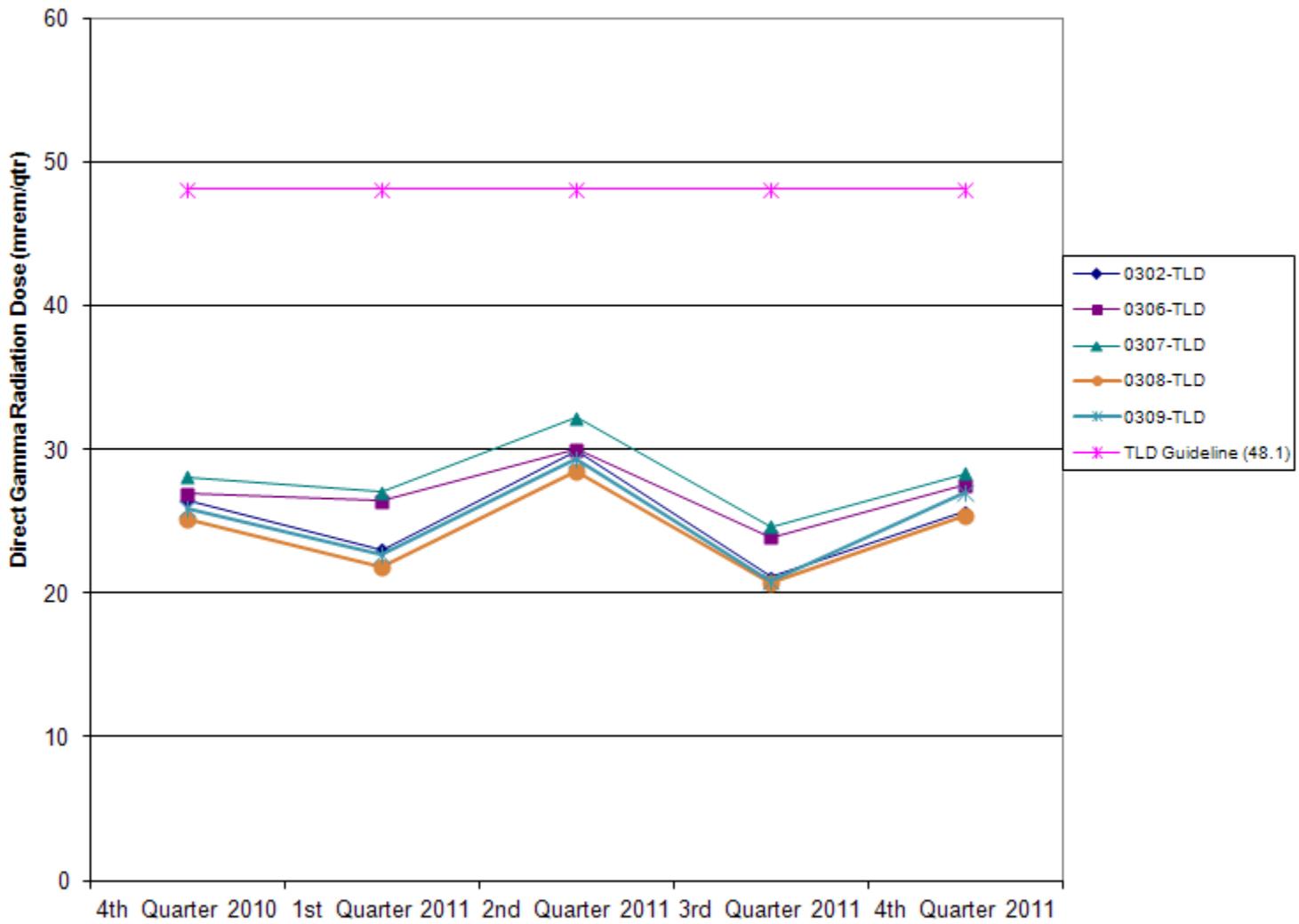


Figure 15. Crescent Junction Direct Gamma Radiation Dose