DOE Oversight Bureau, New Mexico Environment Department

Direct Penetrating Radiation Monitoring at the Waste Isolation Pilot Plant

Conducted by the
New Mexico Environment Department DOE Oversight Bureau
for Calendar Year 2014 Q-2

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Final Report

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The purpose of this communication is to transmit direct penetrating radiation (DPR) dose levels collected at the Waste Isolation Pilot Plant during the second quarter of calendar year 2014. The data measurements were obtained using the E-PERM® electret ionization chamber system from Rad Elec Inc.

Introduction

The purpose of this communication is to transmit direct penetrating radiation (DPR) dose levels, recorded at New Mexico Environment Department (NMED) Department of Energy (DOE) Oversight Bureau monitoring sites, collected during the first quarter of calendar year 2014 (January to March, 2014). The Bureau maintains fourteen (14) monitoring sites located in the Exclusive Use Area at the Waste Isolation Pilot Plant (WIPP), and six (6) sites at other locations in the WIPP region (Table 1, Figure 2 and Figure 4).

Table 1. Location and operational details of direct penetrating radiation monitoring stations located inside the WIPP Exclusive Use Area and in the WIPP vicinity.

Location	Location Description	Operational History
DPR 01	Exclusive Use Area, Parking lot	CY2006 Q-3 to present
DPR 02	Exclusive Use Area, Railroad Entrance	CY2006 Q-3 to present
DPR 03	Exclusive Use Area, Southwest Fence Corner	CY2007 Q-1 to present
DPR 04	Exclusive Use Area, South Fence Center	CY2007 Q-1 to present
DPR 05	Exclusive Use Area, Near Southeast Fence Corner	CY2006 Q-3 to present
DPR 06	Exclusive Use Area, Far Southeast Fence Corner	CY2006 Q-3 to present
DPR 07	Exclusive Use Area, East Fence Mid	CY2007 Q-1 to present
DPR 08	Exclusive Use Area, Northeast Fence Corner	CY2007 Q-1 to present
DPR 09	Exclusive Use Area, North-Northeast Fence	CY2007 Q-1 to present
DPR 10	Exclusive Use Area, North Fence Salt Pile	CY2007 Q-1 to present
DPR 11	Exclusive Use Area, Northwest Fence Corner	CY2006 Q-3 to present
DPR 12	Exclusive Use Area, Waste Handling Building, Loading Dock West	CY2006 Q-3 to present
DPR 13	Exclusive Use Area, Waste Handling Building, Loading Dock Center	CY2006 Q-3 to present
DPR 12	Exclusive Use Area, Waste Handling Building, Loading Dock East	CY2006 Q-3 to present
DPR 15	Carlsbad, NM - Canal St.	CY2006 Q-3 to CY2012 Q2
DPR 16	Loving Weigh Station	CY2007 Q3, CY2009 Q-3 to present
DPR 17	Malaga Volunteer Fire Department	CY2008 Q-1 to present
DPR 18	Hobbs Highway / North Access Road	CY2009 Q-1 to present
DPR 19	Southeast Control Tower	CY2011 Q-4 to present
DPR 20	Carlsbad, NM - Guadalupe St. (interior)	CY2012 Q-3 to present
DPR 21	Carlsbad, NM - Guadalupe St. (exterior)	CY2012 Q-3 to present

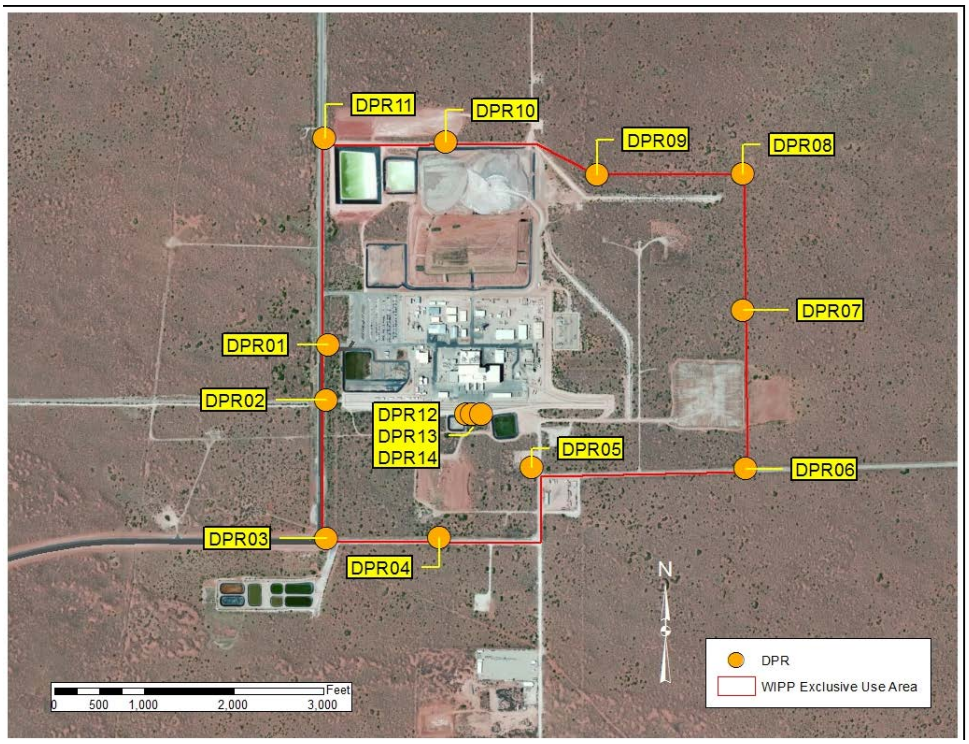

Figure 1. Location of DPR monitors maintained by the DOE Oversight Bureau at the WIPP.

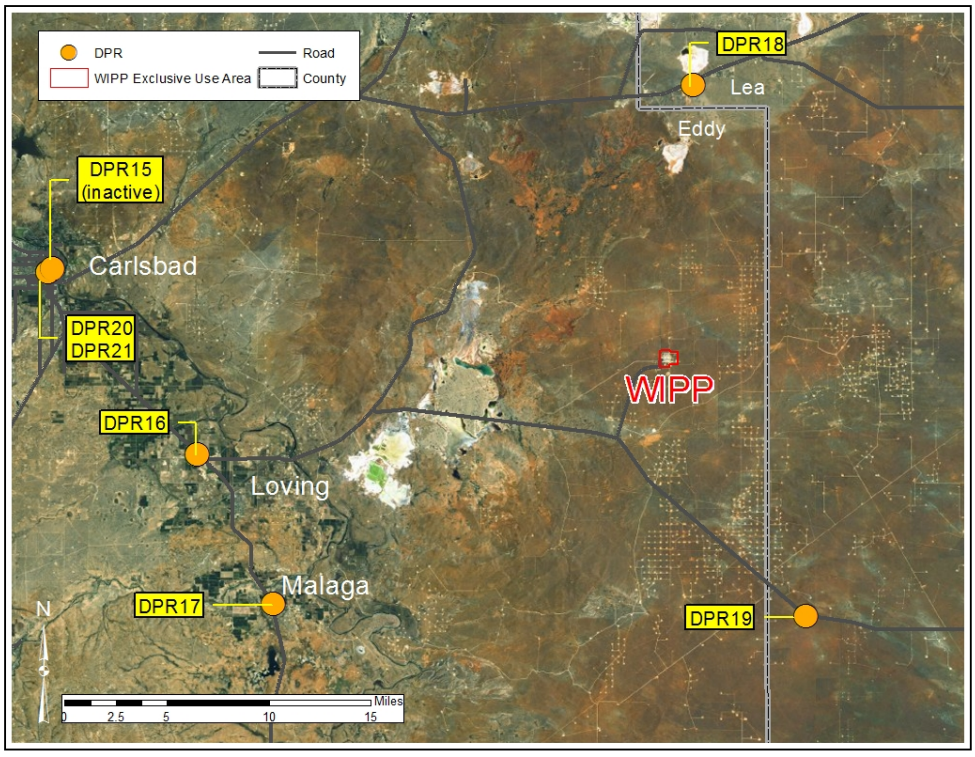

Figure 2. Location of DPR monitors maintained by the DOE Oversight Bureau in the area surrounding WIPP.

The data were obtained using the E-PERM® electret ionization chamber system from Rad Elec Inc. The chambers are housed in aluminum canisters designed to block gamma radiation from radon. The gamma ionizing dose is calculated from a voltage drop in the electret and is presented in the units of millirads (mrad). A rad is radiation absorbed dose, regardless of its source. The rem (Roentgen equivalent man) is a commonly used term of ionizing radiation dose that uses a quality factor based on the source of radiation as it interacts with human body tissue. In the case of gamma radiation, the quality factor is one, and thus one rad is equal to one rem.

The quarterly dose rates have been normalized to reflect an actual quarter of 91.25 days.

Results

DPR results at the WIPP ranged from a minimum average quarterly dose of 22.6 mrad at the WIPP Far Southeast Fence Corner (DPR06), to a maximum average quarterly dose of 34.5 mrad at the North Fence Salt Pile (DPR10). The largest measurement in the vicinity of WIPP was 32.5 mrad, measured at NMED Carlsbad Guadalupe Street Office – Interior location (DPR20).

Table 2 shows the individual results from each electret and the normalized average quarterly dose in mrad at each location.

Figure 3 displays the quarterly dose calculations for each DPR monitoring location from CY2006 Q-3 to CY2014 Q-2. Figure 4 shows the average dose calculations for each DPR monitor locations from CY2006 Q-3 to CY2014 Q-2.

Table 2. Direct Penetrating Radiation Quarterly Dose Rates for CY2014 Q-2

DPR01 Parking Lot Entrance

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 650	3/25/14 16:42	7/2/14 2:28 PM	53	27.8
SHC 659	3/25/14 16:42	7/2/14 2:28 PM	52	27.1
SHC 726	3/25/14 16:42	7/2/14 2:28 PM	48	25.2
		Average Quarterly Dose in mrad:		**26.7**

DPR02 Railroad Track Entrance

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 754	3/25/14 16:49	7/2/14 2:26 PM	67	35.4
SHC 835	3/25/14 16:49	7/2/14 2:26 PM	56	29.3
SHC 856	3/25/14 16:49	7/2/14 2:26 PM	53	27.7
		Average Quarterly Dose in mrad:		**30.8**

DPR03 Southwest Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 330	3/25/14 16:53	7/2/14 2:24 PM	49	26.9
SFK 351	3/25/14 16:53	7/2/14 2:24 PM	52	29.1
SFK 458	3/25/14 16:53	7/2/14 2:24 PM	52	29.2
		Average Quarterly Dose in mrad:		**28.4**

DPR04 South Fence Center

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 527	3/25/14 16:57	7/2/14 2:21 PM	44	25.9
SGI 976	3/25/14 16:57	7/2/14 2:21 PM	48	25.8
SHC 768	3/25/14 16:57	7/2/14 2:21 PM	59	31.2
		Average Quarterly Dose in mrad:		**27.7**

DPR05 Near Southeast Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGJ 044	3/25/14 17:02	7/2/14 2:19 PM	58	31.0
SGJ 109	3/25/14 17:02	7/2/14 2:19 PM	49	26.2
SHC 688	3/25/14 17:02	7/2/14 2:19 PM	60	31.7
		Average Quarterly Dose in mrad:		**29.6**

DPR06 **Far Southeast Fence Corner**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 477	3/25/14 5:11 PM	7/2/14 2:13 PM	42	24.7
SFK 478	3/25/14 5:11 PM	7/2/14 2:13 PM	38	21.0
SFK 512	3/25/14 5:11 PM	7/2/14 2:13 PM	40	22.2
		Average Quarterly Dose in mrad:		**22.6**

DPR07 **East Fence Mid**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 481	3/25/14 5:15 PM	7/2/14 2:16 PM	55	30.6
SFK 500	3/25/14 5:15 PM	7/2/14 2:16 PM	52	28.8
SFK 533	3/25/14 5:15 PM	7/2/14 2:16 PM	54	29.9
		Average Quarterly Dose in mrad:		**29.8**

DPR08 **Northeast Fence Corner**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFC 049	3/25/14 17:19	7/2/14 2:12 PM	48	26.9
SFC 084	3/25/14 17:19	7/2/14 2:12 PM	51	29.2
SFC 103	3/25/14 17:19	7/2/14 2:12 PM	47	26.7
		Average Quarterly Dose in mrad:		**27.6**

DPR09 **North-Northeast Fence**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGJ 046	3/25/14 5:21 PM	7/2/14 2:10 PM	57	30.5
SGJ 055	3/25/14 5:21 PM	7/2/14 2:10 PM	52	27.9
SGJ 061	3/25/14 5:21 PM	7/2/14 2:10 PM	64	34.4
		Average Quarterly Dose in mrad:		**31.0**

DPR10 **North Fence Salt Pile**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGI 957	3/25/14 5:24 PM	7/2/14 2:08 PM	55	29.4
SHC 689	3/25/14 5:24 PM	7/2/14 2:08 PM	69	36.2
SHC 778	3/25/14 5:24 PM	7/2/14 2:08 PM	72	37.9
		Average Quarterly Dose in mrad:		**34.5**

DPR11 Northwest Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 666	3/25/14 5:32 PM	7/2/14 2:05 PM	52	28.0
SHC 678	3/25/14 5:32 PM	7/2/14 2:05 PM	45	24.0
SHC 780	3/25/14 5:32 PM	7/2/14 2:05 PM	52	27.8
		Average Quarterly Dose in mrad:		**26.6**

DPR12 Waste Handling Building Loading Dock (West)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 644	3/25/14 5:36 PM	7/2/14 2:02 PM	54	28.2
SHC 743	3/25/14 5:36 PM	7/2/14 2:02 PM	50	26.2
SHC 777	3/25/14 5:36 PM	7/2/14 2:02 PM	71	37.3
		Average Quarterly Dose in mrad:		**30.6**

DPR13 Waste Handling Building Loading Dock (Center)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 672	3/25/14 5:41 PM	7/2/14 1:57 PM	54	28.3
SHC 799	3/25/14 5:41 PM	7/2/14 1:57 PM	51	26.7
SHC 863	3/25/14 5:41 PM	7/2/14 1:57 PM	62	32.4
		Average Quarterly Dose in mrad:		**29.1**

DPR14 Waste Handling Building Loading Dock (East)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 645	3/25/14 5:44 PM	7/2/14 1:50 PM	46	24.0
SHC 715	3/25/14 5:44 PM	7/2/14 1:50 PM	47	24.5
SHC 849	3/25/14 5:44 PM	7/2/14 1:50 PM	48	25.1
		Average Quarterly Dose in mrad:		**24.6**

DPR16 Loving Weigh Station

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 488	3/25/14 5:47 PM	7/2/14 1:34 PM	58	32.2
SFK 526	3/25/14 5:47 PM	7/2/14 1:34 PM	57	31.6
SFK 539	3/25/14 5:47 PM	7/2/14 1:34 PM	57	31.9
		Average Quarterly Dose in mrad:		**31.9**

DPR17 Malaga Volunteer Fire Department

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 519	3/25/14 5:50 PM	7/2/14 1:59 PM	49	26.6
SFK 525	3/25/14 5:50 PM	7/2/14 1:59 PM	52	28.0
SFK 559	3/25/14 5:50 PM	7/2/14 1:59 PM	54	29.8
		Average Quarterly Dose in mrad:		**28.1**

DPR18 Hobbs Hwy / North Access Rd

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 354	3/25/14 5:54 PM	7/2/14 1:48 PM	95	53.4
SFK 406	3/25/14 5:54 PM	7/2/14 1:48 PM	11	6.1
SFK 502	3/25/14 5:54 PM	7/2/14 1:48 PM	56	31.4
		Average Quarterly Dose in mrad:		**30.3**

DPR19 Southeast Control

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGI 958	3/25/14 5:57 PM	7/2/14 1:46 PM	53	28.4
SGJ 103	3/25/14 5:57 PM	7/2/14 1:46 PM	52	27.9
SGJ 104	3/25/14 5:57 PM	7/2/14 1:46 PM	51	27.4
		Average Quarterly Dose in mrad:		**27.9**

DPR20 NMED Guadalupe St. Office Interior

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 542	3/27/14 4:01 PM	7/2/14 1:36 PM	51	29.6
SHC 656	3/27/14 4:01 PM	7/2/14 1:36 PM	64	33.1
SHC 812	3/27/14 4:12 PM	7/2/14 1:36 PM	67	34.7
		Average Quarterly Dose in mrad:		**32.5**

DPR21 NMED Guadalupe St. Office Exterior

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 450	3/27/14 4:12 PM	7/2/14 1:52 PM	51	29.7
SFK 466	3/27/14 4:12 PM	7/2/14 1:52 PM	51	29.4
SFK 486	3/27/14 4:12 PM	7/2/14 1:52 PM	55	31.6
		Average Quarterly Dose in mrad:		**30.3**

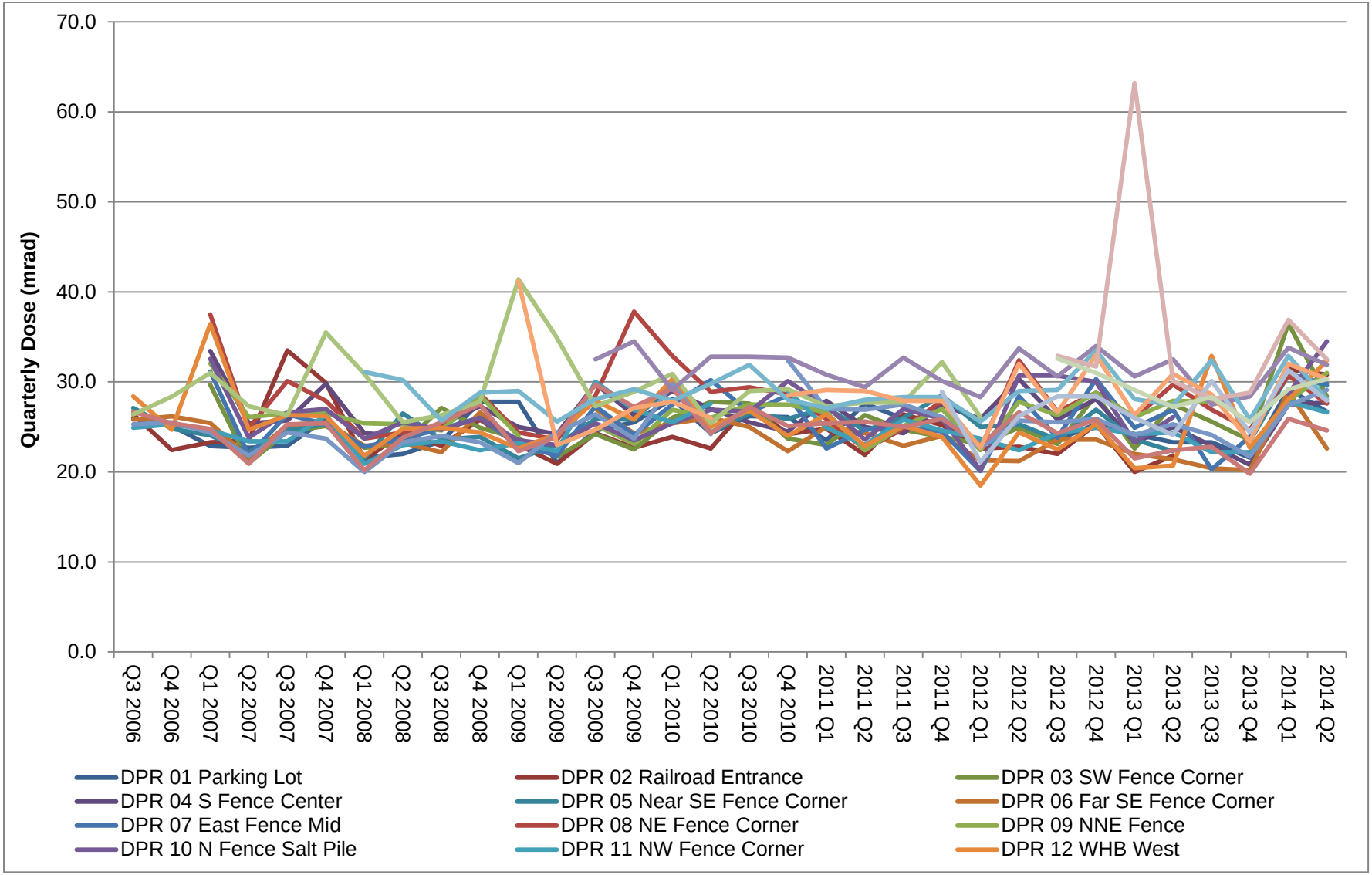

Figure 3. DPR Measurements for all monitoring stations by quarter.

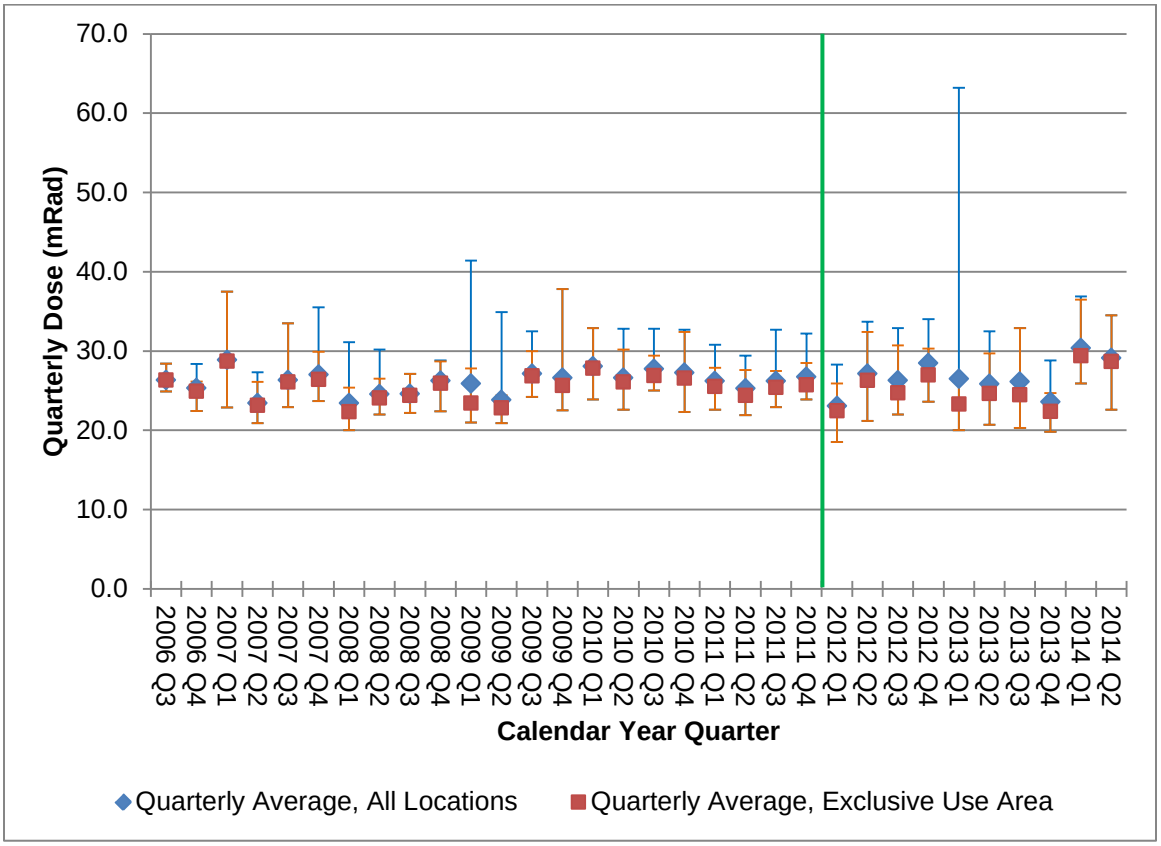

Figure 4. Average DPR Results for all monitoring locations by quarter. The error bars represent maximum and minimum results for the quarter. The green line denotes the implementation of 2012 program changes, most significantly, the application of temperature and pressure correction factors and correcting for the inherent discharge of electrets.

Conclusions

These calculated doses from DPR are comparable with past results obtained by the Bureau. There is a decrease in calculated dose from CY2014 Q-1 to CY2014 Q-2.

On average, Americans receive a radiation dose of about 620 mrem each year. Half of this dose (310 mrem) comes from natural background radiation: radon in the air, cosmic rays and the Earth itself. The other half comes from man-made sources of radiation: medical, commercial, and industrial sources (Doses in our Daily Lives, NRC website http://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html, accessed August 4, 2014).

The environmental dose standard for the WIPP facility is established in Title 40 Code of Federal Regulations (CFR) Part 191, Subpart A, “Environmental

Standards for Management and Storage." The standard sets the regulatory limit for external radiation to a member of the public outside the exclusive use area boundary is 25 mrem per year to the whole body and 75 mrem to any critical organ.

In a 1995 memorandum of understanding between the EPA and the DOE, the DOE agreed that the WIPP facility would comply with 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities." The National Emissions Standards for Hazardous Air Pollutants (NESHAP) standard for radionuclides requires that the emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent (EDE) of 10 mrem per year.

If you extrapolate the quarterly dose rate for an entire year, the annual direct penetrating radiation dosages measured by the NMED at the WIPP range from 90.4 to 138.0 mrem. These observed dose rates are less than the average U.S. natural background annual dose of 310 mrem.