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-1

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Final Report

9/30/2014

The purpose of this communication is to transmit direct penetrating radiation (DPR) dose levels collected at the Waste Isolation Pilot Plant during the first 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 New Mexico Environment Department DOE Oversight Bureau maintains sixteen (16) monitoring sites at the Waste Isolation Pilot Plant (WIPP) and the in the vicinity. Fourteen (14) monitoring sites are located on the exclusive use area boundary at WIPP (Figure 1). Six (6) monitoring sites are located in the surrounding WIPP region (Figure 2).

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

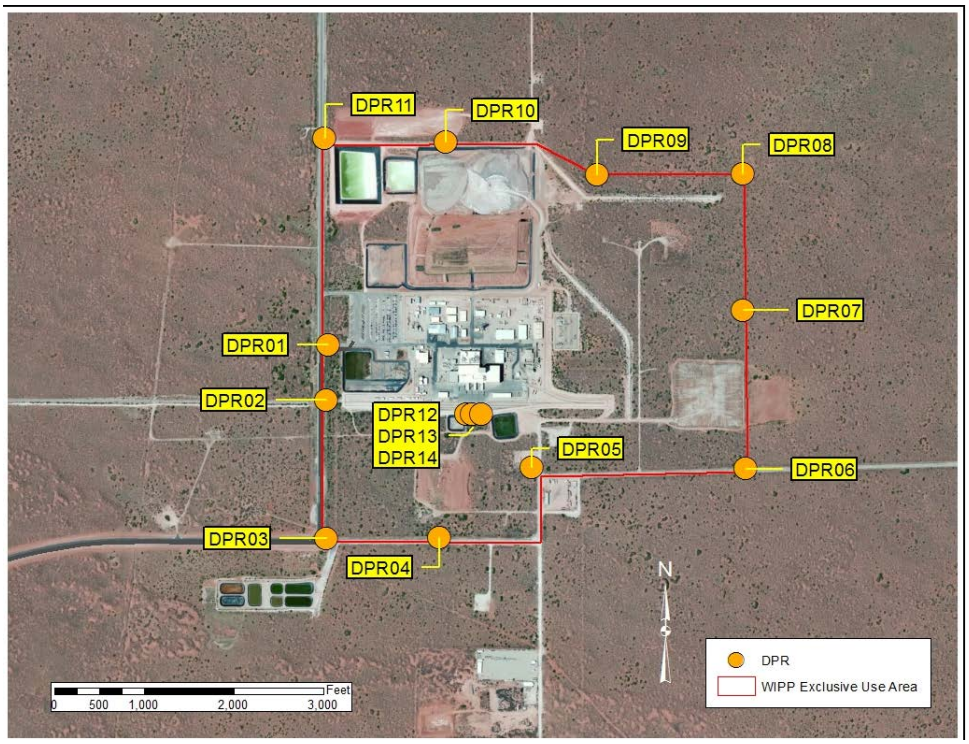

Figure 1. Location of DPR monitors maintained by the DOE Oversight Bureau at the WIPP.

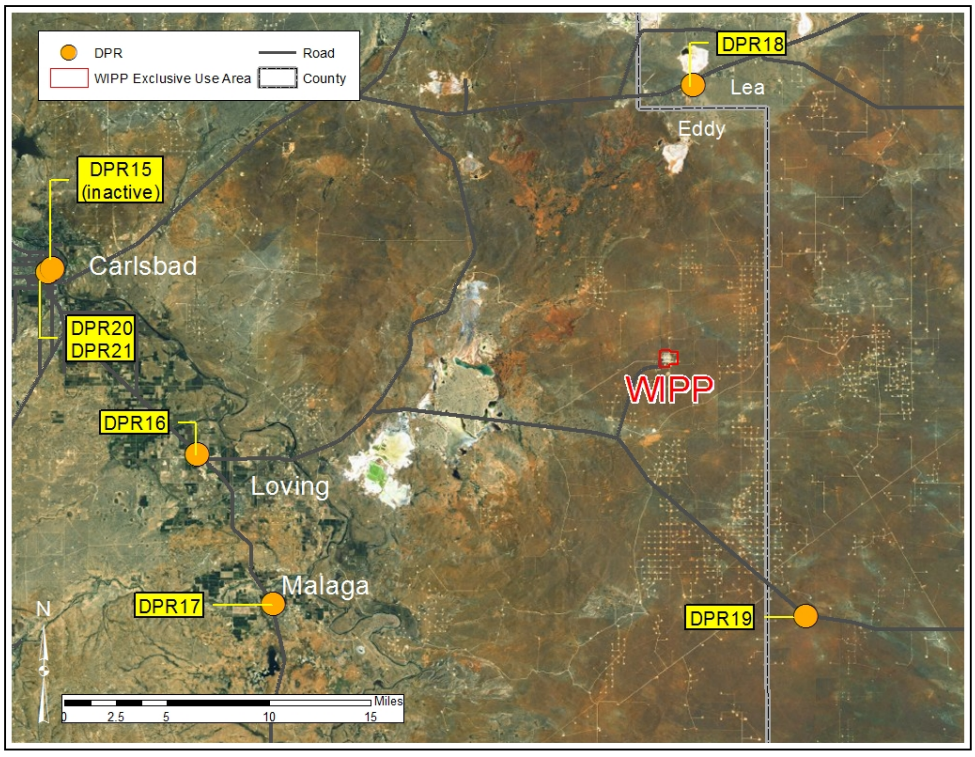

Figure 2. Location of DPR monitors maintained by the DOE Oversight Bureau in the area surrounding WIPP.

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 25.9 mrad at the WIPP Waste handling Building, Loading Dock East (DPR14), to a maximum average quarterly dose of 36.5 mrad at the Southwest Fence Corner (DPR03). The largest measurement in the vicinity of WIPP was 36.9 mrad, measured at the control site at the 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-1. Figure 4 shows the average dose calculations for each DPR monitor locations from CY2006 Q-3 to CY2014 Q-1.

Table 2. Direct Penetrating Radiation Quarterly Dose Rates for CY2014 Q-1

DPR01 Parking Lot Entrance

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 841	1/9/14 8:12	3/28/14 9:42 AM	50	31.3
SGJ 022	1/9/14 8:10	3/28/14 9:42 AM	44	28.0
SGJ 058	1/9/14 8:10	3/28/14 9:42 AM	44	28.1
		Average Quarterly Dose in mrad:		**29.2**

DPR02 Railroad Track Entrance

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 428	1/9/14 8:24	3/28/14 9:14 AM	48	31.9
SFK 437	1/9/14 8:24	3/28/14 9:14 AM	46	30.7
SFK 438	1/9/14 8:24	3/28/14 9:14 AM	48	31.4
		Average Quarterly Dose in mrad:		**31.4**

DPR03 Southwest Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 736	1/7/14 17:19	3/27/14 4:56 PM	87	54.2
SHC 673	1/7/14 17:19	3/27/14 4:56 PM	43	26.3
SHC 676	1/7/14 17:19	3/27/14 4:56 PM	47	28.9
		Average Quarterly Dose in mrad:		**36.5**

DPR04 South Fence Center

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 550	1/7/14 17:11	3/28/14 9:18 AM	24.7	28.2
SHC 704	1/7/14 17:11	3/28/14 9:18 AM	47	28.5
SHC 685	1/7/14 17:11	3/28/14 9:18 AM	42	25.6
		Average Quarterly Dose in mrad:		**27.5**

DPR05 Near Southeast Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGI 991	1/7/14 16:28	3/28/14 9:04 AM	49	30.5
SHC 816	1/7/14 16:28	3/28/14 9:04 AM	54	32.9
SHC 657	1/7/14 16:28	3/28/14 9:04 AM	48	29.1
		Average Quarterly Dose in mrad:		**30.8**

DPR06 **Far Southeast Fence Corner**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGI 982	1/7/14 4:19 PM	3/28/14 9:55 AM	48	29.6
SHC 667	1/7/14 4:19 PM	3/28/14 9:55 AM	50	30.5
SHC 665	1/7/14 4:19 PM	3/28/14 9:55 AM	43	26.5
		Average Quarterly Dose in mrad:		**28.9**

DPR07 **East Fence Mid**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 674	1/7/14 3:42 PM	3/28/14 8:53 AM	56	34.2
SGJ 037	1/7/14 3:42 PM	3/28/14 8:53 AM	43	26.3
SHC 755	1/7/14 3:42 PM	3/28/14 8:53 AM	53	32.3
		Average Quarterly Dose in mrad:		**30.9**

DPR08 **Northeast Fence Corner**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 431	1/7/14 15:06	3/28/14 9:58 AM	47	30.4
SFK 510	1/7/14 15:06	3/28/14 9:58 AM	49	31.4
SFK 533	1/7/14 15:06	3/28/14 9:58 AM	48	30.4
		Average Quarterly Dose in mrad:		**30.7**

DPR09 **North-Northeast Fence**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFC 074	11/4/13 5:59 AM	3/28/14 9:32 AM	71	26.4
SFC 097	11/4/13 5:59 AM	3/28/14 9:32 AM	75	28.3
SFC 204	11/4/13 5:59 AM	3/28/14 9:32 AM	77	28.9
		Average Quarterly Dose in mrad:		**27.9**

DPR10 **North Fence Salt Pile**

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 658	10/11/13 6:38 AM	3/28/14 9:01 AM	99	29.7
SHC 765	10/11/13 6:38 AM	3/28/14 9:01 AM	94	28.1
SHC 793	10/11/13 6:38 AM	3/28/14 9:01 AM	93	28.2
		Average Quarterly Dose in mrad:		**28.7**

DPR11 Northwest Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGJ 083	1/7/14 3:15 PM	3/28/14 9:25 AM	45	27.9
SGJ 042	1/7/14 3:15 PM	3/28/14 9:25 AM	43	26.9
SGJ 986	1/7/14 3:15 PM	3/28/14 9:25 AM	46	28.6
		Average Quarterly Dose in mrad:		**27.8**

DPR12 Waste Handling Building Loading Dock (West)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 344	1/9/14 8:18 AM	3/28/14 8:58 AM	39	26.0
SFK 441	1/9/14 8:18 AM	3/28/14 8:58 AM	43	29.2
SFK 580	1/9/14 8:18 AM	3/28/14 8:58 AM	42	29.0
		Average Quarterly Dose in mrad:		**28.0**

DPR13 Waste Handling Building Loading Dock (Center)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFC 094	1/9/14 8:30 AM	3/28/14 4:45 PM	39	26.9
SGI 997	1/9/14 8:30 AM	3/28/14 4:45 PM	43	27.3
SGJ 041	1/9/14 8:30 AM	3/28/14 4:45 PM	42	26.9
		Average Quarterly Dose in mrad:		**27.0**

DPR14 Waste Handling Building Loading Dock (East)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 473	1/9/14 8:36 AM	3/28/14 9:07 AM	39	26.6
SFK 574	1/9/14 8:36 AM	3/28/14 9:07 AM	37	25.2
SFK 578	1/9/14 8:36 AM	3/28/14 9:07 AM	38	25.9
		Average Quarterly Dose in mrad:		**25.9**

DPR16 Loving Weigh Station

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFC 147	1/7/14 4:38 PM	3/28/14 4:58 PM	52	33.9
SFC 195	1/7/14 4:38 PM	3/28/14 4:58 PM	51	33.1
SFC 212	1/7/14 4:38 PM	3/28/14 4:58 PM	50	33.0
		Average Quarterly Dose in mrad:		**33.3**

DPR17 Malaga Volunteer Fire Department

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 380	1/7/14 5:02 PM	3/28/14 4:52 PM	47	28.8
SFK 543	1/7/14 5:02 PM	3/28/14 4:52 PM	55	34.1
SFK 524	1/7/14 5:02 PM	3/28/14 4:52 PM	56	34.3
		Average Quarterly Dose in mrad:		**32.4**

DPR18 Hobbs Hwy / North Access Rd

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGJ 001	1/7/14 4:47 PM	3/28/14 9:49 AM	50	30.9
SFK 581	1/7/14 4:47 PM	3/28/14 9:49 AM	45	29.4
SHC 767	1/7/14 4:47 PM	3/28/14 9:49 AM	58	35.6
		Average Quarterly Dose in mrad:		**32.0**

DPR19 Southeast Control

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 410	1/7/14 4:51 PM	3/28/14 4:48 PM	47	30.7
SFK 443	1/7/14 4:51 PM	3/28/14 4:48 PM	47	30.7
SFK 562	1/7/14 4:51 PM	3/28/14 4:48 PM	49	31.3
		Average Quarterly Dose in mrad:		**30.9**

DPR20 NMED Guadalupe St. Office Interior

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 364	1/9/14 8:48 AM	3/28/14 4:01 PM	51	35.9
SFK 514	1/9/14 8:48 AM	3/28/14 4:01 PM	54	38.5
SFK 542	1/9/14 8:48 AM	3/28/14 4:01 PM	50	34.8
		Average Quarterly Dose in mrad:		**36.4**

DPR21 NMED Guadalupe St. Office Exterior

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 450	1/9/14 9:20 AM	3/28/14 4:12 PM	37	24.9
SFK 466	1/9/14 9:20 AM	3/28/14 4:12 PM	45	30.1
SFK 486	1/9/14 9:20 AM	3/28/14 4:12 PM	47	31.3
		Average Quarterly Dose in mrad:		**28.8**

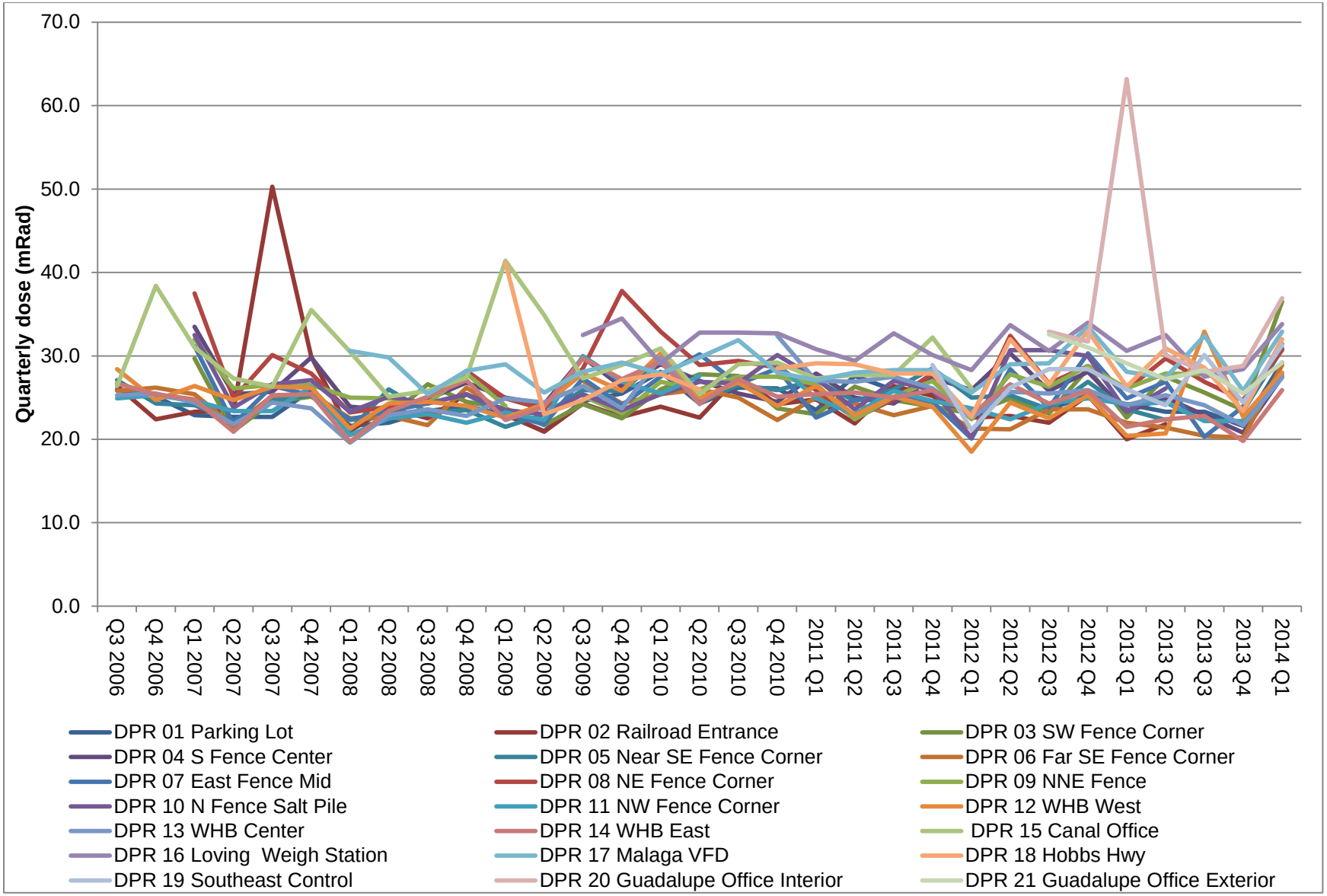

Figure 3. Quarterly DPR measurements for all monitoring stations.

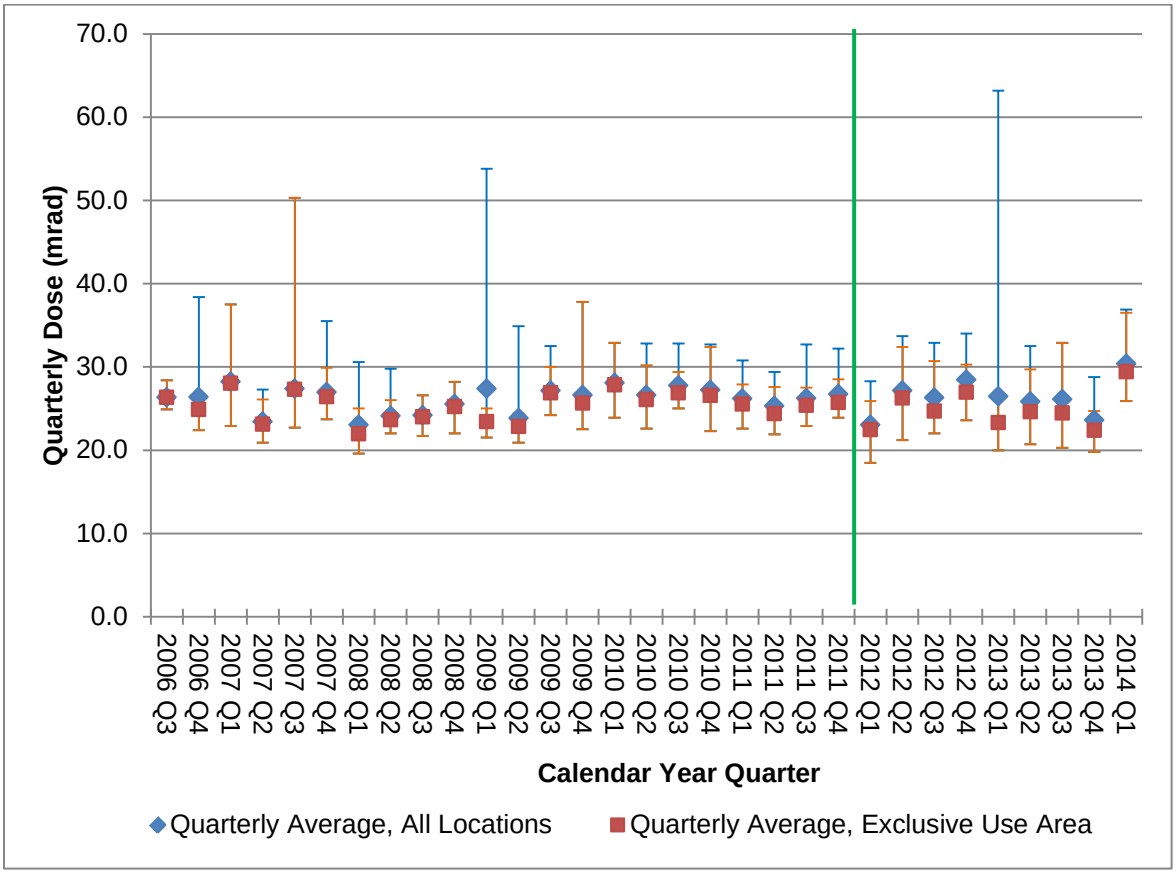

Figure 4. Average DPR Results for all monitoring locations by quarter. The error bars represent maximum and minimum results for the quarter. The green line denotes the implementation of 2012 program changes, most significantly, the application of temperature and pressure correction factors and correcting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

Conclusions

These calculated doses from DPR are comparable with past results obtained by the Bureau. There is an increase in calculated dose for CY2014 Q-1, a time frame that includes the underground haul truck fire and radiological release at WIPP.

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 103.6 to 146.0 mrem. These observed dose rates are less than the average U.S. natural background annual dose of 310 mrem.