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-3

Prepared by Martin Simon, Ph.D.
(former Environmental Scientist)
WIPP Oversight Section
406 N Guadalupe Street
Carlsbad, NM 88220
(575) 885-9023

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 third quarter of calendar year 2014. The data measurements were obtained using the E-PERM® electret ionization chamber system from Rad Elec Inc.

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Introduction

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, U.S. Nuclear Regulatory Commission website http://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html, accessed August 4, 2014).

The environmental dose standard for the Waste Isolation Pilot Plant (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 at 25 mrem per year to the whole body and 75 mrem to any critical organ.

In a 1995 memorandum of understanding between the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (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.

The purpose of this communication is to transmit direct penetrating radiation (DPR) dose levels, recorded at New Mexico Environment Department (NMED) DOE Oversight Bureau (DOE-OB or the Bureau) monitoring sites, collected during the third quarter of calendar year (CY) 2014 (July through September, 2014). The Bureau maintains fourteen (14) monitoring sites located in the Exclusive Use Area at WIPP, and six (6) sites at other locations in the WIPP region (Table 1, Figure 1 and 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 14	Exclusive Use Area, Waste Handling Building, Loading Dock East	CY2006 Q-3 to present
DPR 15[1]	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

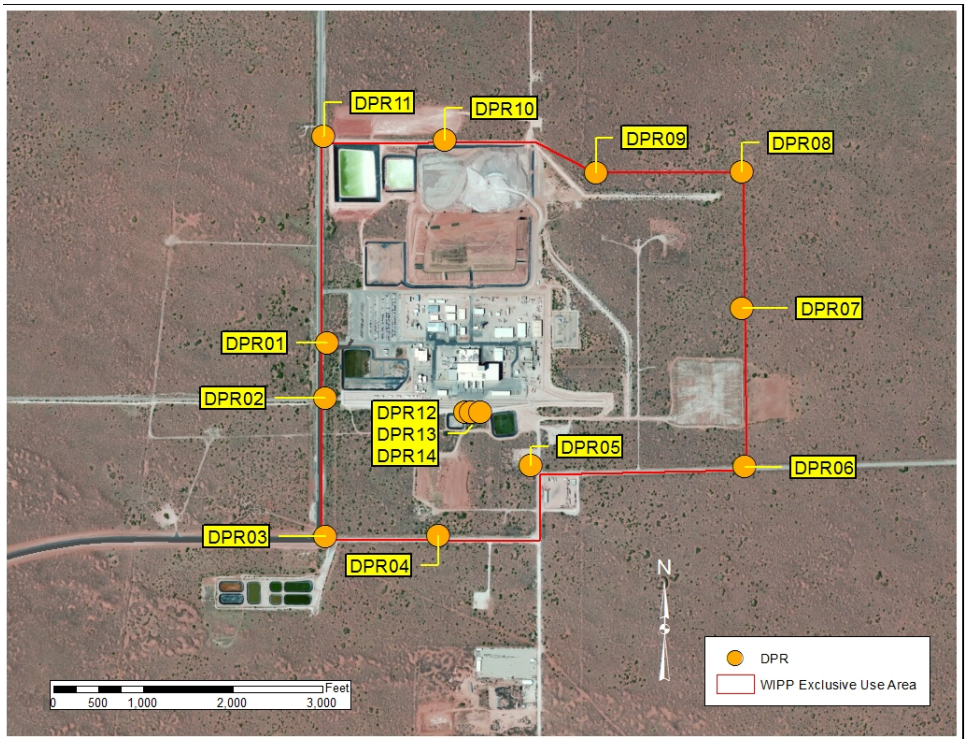

Figure 1. Location of DPR monitors maintained by the DOE Oversight Bureau at the WIPP.

[1] Sampling at DPR 15 was discontinued after CY2012 Q2 when NMED moved their office from the Canal Street location to the Guadalupe Street location

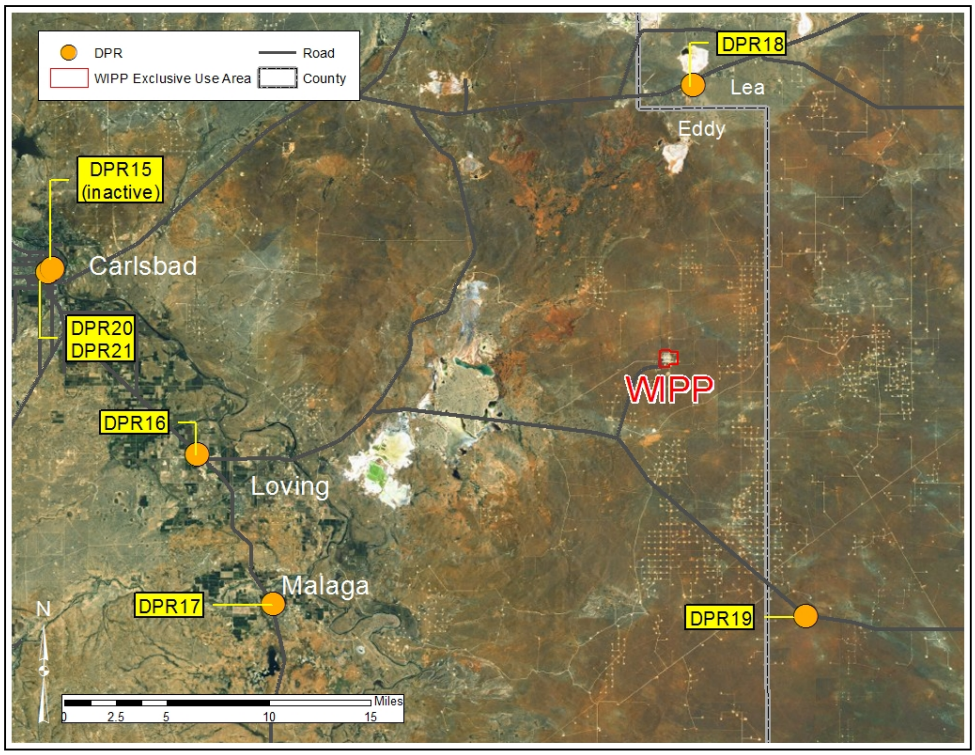

Figure 2. Location of DPR monitors maintained by the DOE Oversight Bureau in the area surrounding WIPP.

The data were obtained using the E-PERM® electret ionization chamber system from Rad Elec Inc. The electret passive ion chamber uses the principle of ion pair production resulting from gamma photons interacting with air molecules to reduce the voltage of a charged Teflon™ disk. The chambers are housed in aluminum canisters designed to block gamma radiation from radon. Using a predetermined formula, the voltage drop indicates the amount of radiation passing through the chamber. NMED DOE-OB's monitoring program reads electret passive ion chambers at the end of each quarter, converts reading into quarterly dose values presented in units of millirads (mrad).

A rad is a unit of absorbed radiation dose, regardless of its source. The rem (Roentgen equivalent man) is a commonly used unit 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. Normalized quarterly dose rates are summed for an estimated annual dose rate.

Results

DPR results at the WIPP ranged from a minimum average quarterly dose of 20.9 mrad at the Northwest Fence Corner (DPR11), to a maximum average quarterly dose of 40.4

mrad at the Southwest Fence Corner (DPR03). The data obtained for DPR01 were excluded because the DPR monitor was found disassembled at the site. The largest measurement in the region of WIPP was 41.2 mrad, measured at Loving Weigh Station, NM (DPR16).

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

Table 2: Direct Penetrating Radiation Quarterly Dose Rates for CY 2014 Q-3

DPR01 Parking Lot Entrance
Data disqualified. Canister found open.

DPR02 Railroad Track Entrance

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 428	6/30/14 5:18 PM	10/1/14 11:55 AM	36	21.3
SFK 437	6/30/14 5:18 PM	10/1/14 11:55 AM	42	25.1
SFK 438	6/30/14 5:18 PM	10/1/14 11:55 AM	38	22.1
			Average Quarterly Dose in mrad:	**22.8**

DPR03 Southwest Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 673	6/30/14 5:20 PM	10/1/14 11:50 AM	65	36.2
SHC 676	6/30/14 5:20 PM	10/1/14 11:50 AM	48	26.7
SHC 736	6/30/14 5:20 PM	10/1/14 11:50 AM	103	58.4
			Average Quarterly Dose in mrad:	**40.4**

DPR04 South Fence Center

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 550	6/30/14 5:22 PM	10/1/14 12:00 PM	41	24.7
SHC 685	6/30/14 5:22 PM	10/1/14 12:00 PM	43	23.9
SHC 704	6/30/14 5:22 PM	10/1/14 12:00 PM	44	24.3
			Average Quarterly Dose in mrad:	**24.3**

DPR05 Near Southeast Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGI 991	6/30/14 5:26 PM	10/1/14 11:34 AM	39	22.0
SHC 816	6/30/14 5:26 PM	10/1/14 11:34 AM	49	27.2
SHC 657	6/30/14 5:26 PM	10/1/14 11:34 AM	62	34.4
			Average Quarterly Dose in mrad:	**27.9**

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	20.2
SFK 478	3/25/14 5:11 PM	7/2/14 2:13 PM	38	24.2
SFK 512	3/25/14 5:11 PM	7/2/14 2:13 PM	40	29.0
			Average Quarterly Dose in mrad:	**24.5**

DPR07 East Fence Mid

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 674	6/30/14 5:33 PM	10/1/14 10:04 AM	14	7.4
SGJ 037	6/30/14 5:33 PM	10/1/14 10:04 AM	69	38.6
SHC 755	6/30/14 5:33 PM	10/1/14 10:04 AM	56	31.2
			Average Quarterly Dose in mrad:	**25.8**

DPR08 Northeast Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 431	6/30/14 5:33 PM	10/1/14 10:07 AM	43	25.6
SFK 510	6/30/14 5:33 PM	10/1/14 10:07 AM	44	25.9
SFK 533	6/30/14 5:33 PM	10/1/14 10:07 AM	35	20.2
			Average Quarterly Dose in mrad:	**23.9**

DPR09 North-Northeast Fence

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFC 074	6/30/14 5:39 PM	10/1/14 10:11 AM	38	22.9
SFC 097	6/30/14 5:39 PM	10/1/14 10:41 AM	41	25.3
SFC 204	6/30/14 5:39 PM	10/1/14 10:41 AM	39	23.9
			Average Quarterly Dose in mrad:	**24.0**

DPR10 North Fence Salt Pile

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SHC 658	6/30/14 5:40 PM	10/1/14 10:45 AM	55	31.2
SHC 765	6/30/14 5:40 PM	10/1/14 10:45 AM	49	27.7
SHC 793	6/30/14 5:40 PM	10/1/14 10:45 AM	56	32.1
			Average Quarterly Dose in mrad:	**30.3**

DPR11 Northwest Fence Corner

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGJ 042	6/30/14 5:43 PM	10/1/14 12:10 PM	34	19.3
SGJ 083	6/30/14 5:43 PM	10/1/14 12:10 PM	38	21.4
SGJ 986	6/30/14 5:43 PM	10/1/14 12:10 PM	39	22.1
			Average Quarterly Dose in mrad:	**20.9**

DPR12 Waste Handling Building Loading Dock (West)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 344	6/30/14 5:45 PM	10/1/14 11:45 AM	35	20.8
SFK 441	6/30/14 5:45 PM	10/1/14 11:45 AM	36	21.8
SHC705	6/30/14 5:45 PM	10/1/14 11:45 AM	46	25.3
			Average Quarterly Dose in mrad:	**22.6**

DPR13 Waste Handling Building Loading Dock (Center)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SGI 997	6/30/14 5:47 PM	10/1/14 10:20 AM	35	19.8
SGJ 041	6/30/14 5:47 PM	10/1/14 10:20 AM	41	23.5
SHC 653	6/30/14 5:47 PM	10/1/14 10:20 AM	51	28.1
			Average Quarterly Dose in mrad:	**23.8**

DPR14 Waste Handling Building Loading Dock (East)

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 473	6/30/14 5:49 PM	10/1/14 11:40 AM	36	22.0
SFK 574	6/30/14 5:49 PM	10/1/14 11:40 AM	33	20.1
SFK 578	6/30/14 5:49 PM	10/1/14 11:40 AM	35	21.4
			Average Quarterly Dose in mrad:	**21.2**

DPR16 Loving Weigh Station

Data disqualified. Water found in canister.

DPR17 Malaga Volunteer Fire Department

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 380	6/30/14 5:54 PM	10/1/14 10:30 AM	43	24.4
SFK 524	6/30/14 5:54 PM	10/1/14 10:30 AM	48	27.3
SFK 543	6/30/14 5:54 PM	10/1/14 10:30 AM	51	29.4
			Average Quarterly Dose in mrad:	**27.0**

DPR18 Hobbs Hwy / North Access Rd

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 581	6/30/14 5:56 PM	10/1/14 10:35 AM	44	26.6
SGJ 001	6/30/14 5:56 PM	10/1/14 10:35 AM	58	33.2
SHC 767	6/30/14 5:56 PM	10/1/14 10:35 AM	61	34.5
			Average Quarterly Dose in mrad:	**31.4**

DPR19 Southeast Control

Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Quarterly Dose Normalized
SFK 410	6/30/14 5:58 PM	10/1/14 11:25 AM	44	26.5
SFK 443	6/30/14 5:58 PM	10/1/14 11:25 AM	40	24.0
SFK 562	6/30/14 5:58 PM	10/1/14 11:25 AM	36	21.0
			Average Quarterly Dose in mrad:	**23.8**

DPR20	NMED Guadalupe St. Office Interior			Quarterly Dose
Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Normalized
SHC 656	7/2/14 1:36 PM	10/1/14 11:29 AM	48	27.1
SHC 691	7/2/14 1:42 PM	10/1/14 11:29 AM	55	30.5
SHC 812	7/2/14 1:36 PM	10/1/14 11:29 AM	49	27.4
		Average Quarterly Dose in mrad:		**28.3**

DPR21	NMED Guadalupe St. Office Exterior			Quarterly Dose
Electret ID	Start Date and Time	Finish Date and Time	Voltage Drop	Normalized
SHC 774	7/2/14 1:54 PM	10/1/14 10:45 AM	64	36.0
SHC 785	7/2/14 1:54 PM	10/1/14 10:45 AM	66	37.2
SHC 709	7/2/14 1:54 PM	10/1/14 10:45 AM	48	26.8
		Average Quarterly Dose in mrad:		**33.3**

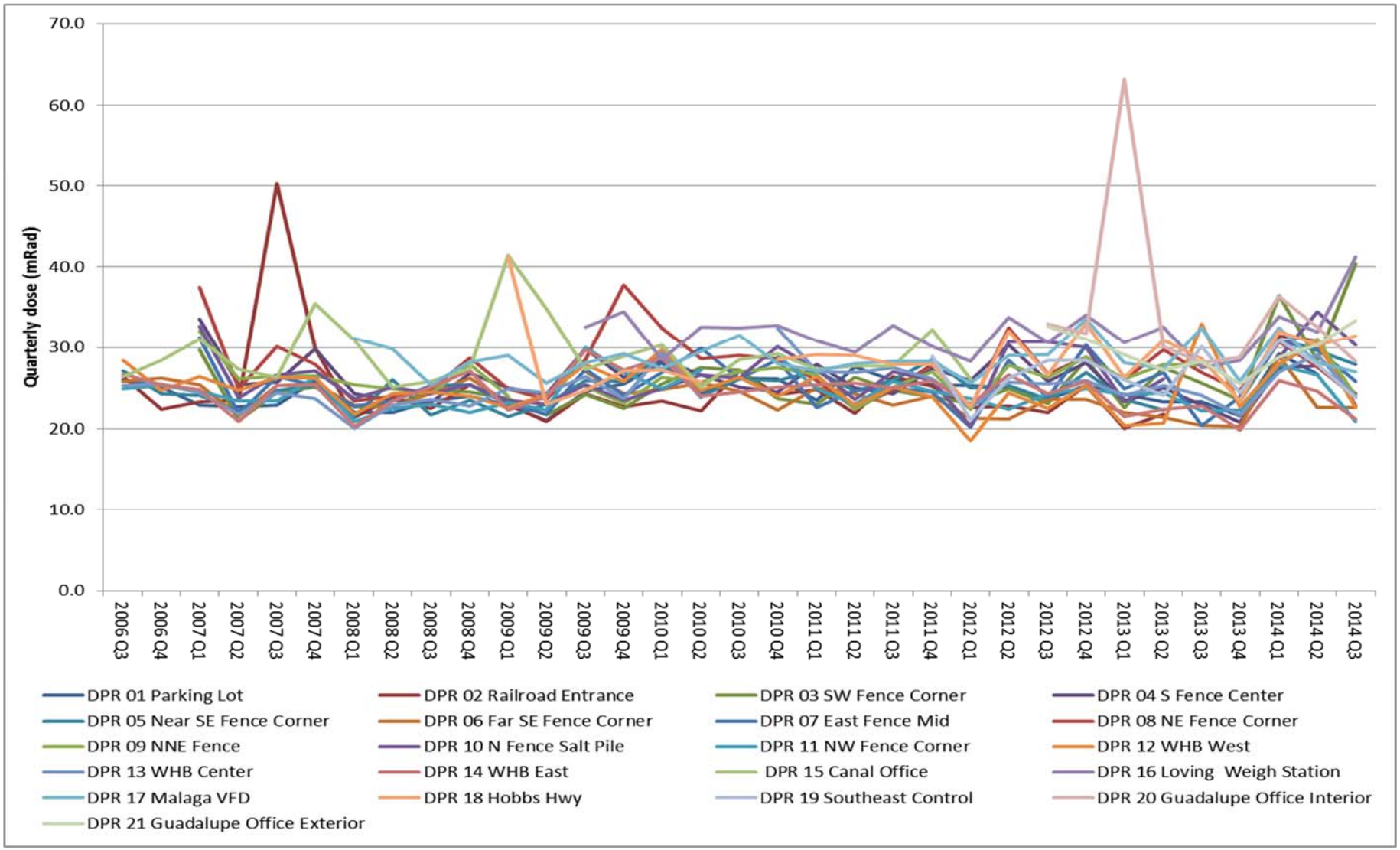

Figure 3. Quarterly dose calculations for each DPR monitoring location from CY2006 Q-3 to CY2014 Q-3.

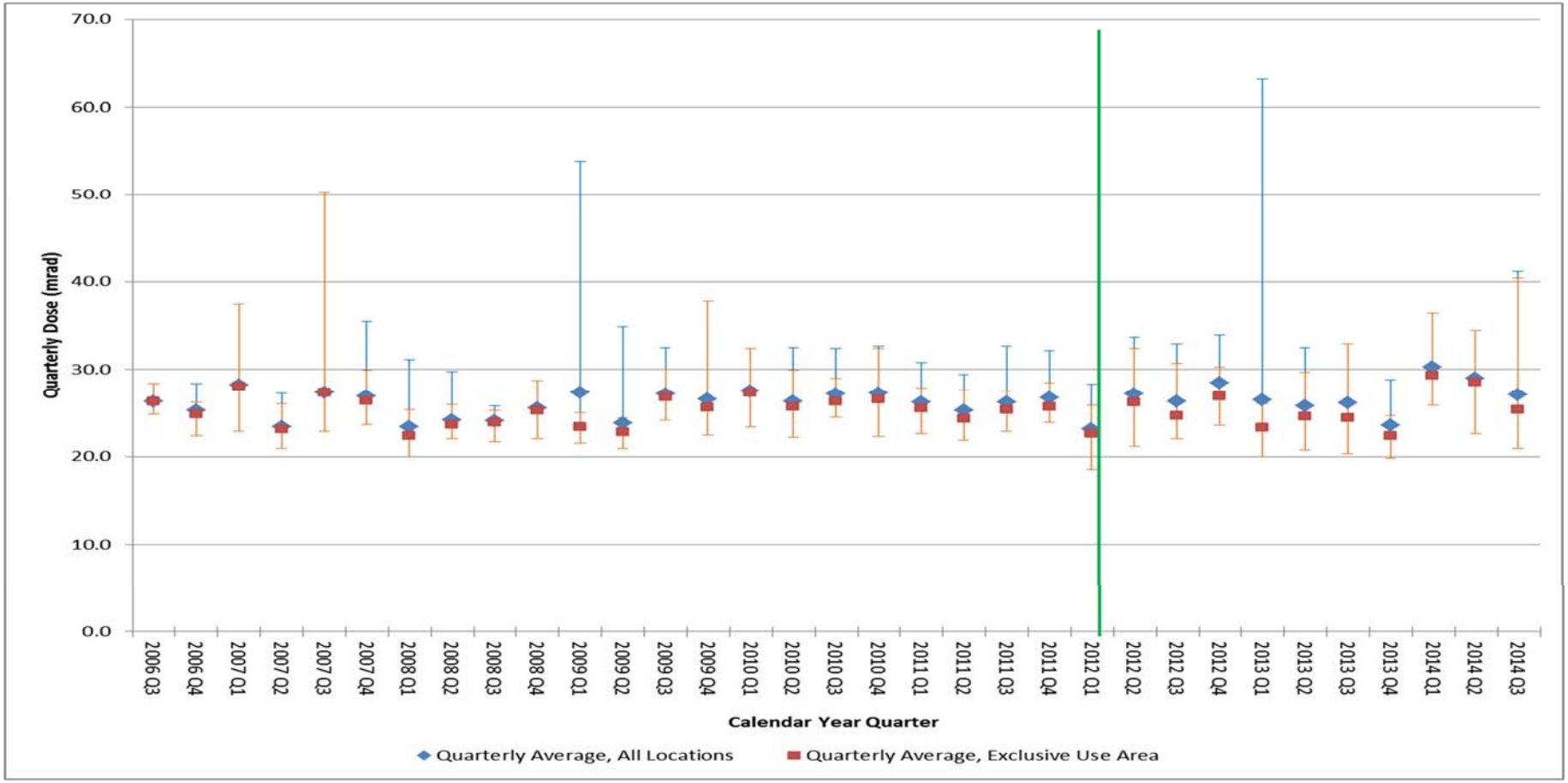

Figure 4. Average DPR results for all monitoring locations by quarter. The vertical blue lines represent maximum and minimum results of all sites for the quarter, and the orange vertical lines represent maximum and minimum results of the exclusive area sites for the quarter. The green line denotes the 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 DOE Oversight Bureau. There is a decrease in calculated dose from CY2014 Q-1 to CY2014 Q-3. If you extrapolate these quarterly dose rates for an entire year, the annual direct penetrating radiation dosages measured by the NMED at the WIPP range from 83.6 to 161.6 mrad. In the case of gamma radiation, the quality factor is one, and thus one rad is equal to one rem. These observed dose rates are less than the average U.S. natural background annual dose of 310 mrem.

Reference

Department of Energy and Environmental Protection Agency. “Memorandum of Understanding Between the U.S. EPA and the U.S. DOE Concerning the Clean Air Act Emission Standards for Radionuclides 40 CFR § 61, Including Subparts H, I, Q & T.” Signed by Mary D. Nichols, EPA Assistant Administrator for Air and Radiation: September 29, 1994. Signed by Tara O'Toole, DOE Assistant Secretary for Environment, Safety, and Health, April 5, 1995.