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Direct Penetrating Radiation Monitoring at the Waste Isolation Pilot Plant Conducted by NMED/DOE OB for the CY 2011 Q-4

The New Mexico Environment Department (NMED) DOE Oversight Bureau has compiled and assessed direct penetrating radiation (DPR) data for CY 2011 Q-4. The accompanying table shows dose levels received from ionizing radiation along the Exclusive Use Area fence-line at the Waste Isolation Pilot Plant and at other locations in the WIPP region. 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 quarterly dose rates have been normalized to reflect an actual quarter of 91.25 days.

Changes to the Bureau DPR Program

Staff from all three Oversight Bureau sections have reviewed the Bureau's DPR program and are implementing several changes beginning this quarter in response to the updated E-PERM® System User's Manual, and to promote uniformity of data collection and reporting. The changes the WIPP Oversight Section (WOS) have implemented are outlined as follows:

Data collection changes:

- Reading each electret voltage until 2 consecutive readings are the same and recording that value, as opposed to reading each electret 3 times, recording each value and using the average value for calculations.
- Taking voltage readings at a uniform temperature. The electrets are removed from the field and allowed to come to the relatively constant room temperature at the Bureau office before voltage readings are taken.
- A new gamma monitor has been placed at the Southeast Control Site located about 12 miles upwind from the WIPP site.

Dose calculation changes:

- Applying temperature and pressure correction factors to dose rate to compensate for measurements not being made at standard temperature and pressure. Atmospheric pressure is calculated from elevation. Average quarterly temperatures are obtained from HOBO temperature data loggers.
- A very small change in the radon correction factor from .2 to .17µR/hr

- Most significantly, a correction for the inherent discharge of electrets. Rad Elec Inc has determined that electrets have a small discharge of 0.002778 volt/hr due to recombination and other properties of charges inside the electret material.

To promote Bureau uniformity of data reporting:

- Environmental gamma radiation dose will be reported in rads, maintaining that for gamma radiation, 1R=1rem=1rad.
- Sampling will be reported by location instead of equipment ID. For example, "WIPP 1" will be referred to as "WIPP Parking Lot Entrance."
- The WOS continues to work on switching from an Excel database to an Access database, with the goal of eventually participating in a common Bureau-wide cloud-based data system.

Results

It appears that all of the new changes incorporated into the DPR program will have little effect on the dose rates traditionally reported.

DPR results ranged from minimum average quarterly doses of 23.9 mrad at WIPP Southwest Corner Fence and WIPP Loading Dock WHB (West), to a maximum average quarterly dose of 32.2 mrad at the Carlsbad Bureau Office.

Table 1 shows the individual results from each electret and the normalized average quarterly dose in mrad at each location.

Table 2 compares dose rates calculated with and without the 2012 changes.

Graph 1 shows the average dose calculations from monitors located in the WIPP Exclusive Use Area by quarter, without applying the 2012 changes to the previously reported data.

Conclusion

These calculated doses from DPR are comparable with past results obtained by the Bureau and do not show a trend of increased gamma radiation exposure at the WIPP.

Response

Questions and/or comments may be addressed to Julia Marple by phone at (575) 887-6851 or by email at julia.marple@state.nm.us

Enclosures:
1. Table 1: Direct Penetrating Radiation Quarterly Dose Rates CY 2011 Q-4
2. Table 2: Comparison of DPR Doses Calculated with 2012 Changes
3. Graph 1: Average DPR Results in the WIPP Exclusive Use Area by Quarter
4. Map1: Location of DPR Monitors Maintained by the Bureau

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Julia Marple, Environmental Scientist, DOE OB/WOS

Table 1: Direct Penetrating Radiation Quarterly Dose Rates for CY 2011 Q-4

WIPP 1 WIPP Parking Lot Entrance

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 973	9/29/11 12:11 PM	1/4/12 1:23 PM	97.05	47	25.7
SFC 139	9/29/11 12:11 PM	1/4/12 1:23 PM	97.05	48	24.5
SFC 207	9/29/11 12:11 PM	1/4/12 1:23 PM	97.05	50	26.0
				Average Quarterly Dose in mRad:	**25.4**

WIPP 2 WIPP Railroad Track Entrance

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 057	9/29/11 12:19 PM	1/4/12 1:17 PM	97.04	50	26.3
SFC 065	9/29/11 12:19 PM	1/4/12 1:17 PM	97.04	47	24.6
SFC 082	9/29/11 12:19 PM	1/4/12 1:17 PM	97.04	47	24.8
				Average Quarterly Dose in mRad:	**25.2**

WIPP 3 WIPP Southwest Corner Fence

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFB 974	9/29/11 1:06 PM	1/4/12 1:30 PM	97.02	45	24.3
SFB 983	9/29/11 1:06 PM	1/4/12 1:30 PM	97.02	45	24.1
SFC 025	9/29/11 1:06 PM	1/4/12 1:30 PM	97.02	44	23.5
				Average Quarterly Dose in mRad:	**23.9**

WIPP 4 WIPP South Fence Center

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFK 487	9/29/11 1:18 PM	1/4/12 1:15 PM	97.00	52	26.3
SFK 527	9/29/11 1:18 PM	1/4/12 1:15 PM	97.00	55	27.7
SFK 569	9/29/11 1:18 PM	1/4/12 1:15 PM	97.00	56	28.3
				Average Quarterly Dose in mRad:	**27.4**

WIPP 5 WIPP Near SE Corner of Fence

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 061	9/29/11 1:29 PM	1/5/12 6:16 AM	97.70	49	27.5
SFC 087	9/29/11 1:29 PM	1/5/12 6:16 AM	97.70	56	29.4
SFC 159	9/29/11 1:29 PM	1/5/12 6:16 AM	97.70	54	28.5
				Average Quarterly Dose in mRad:	**28.5**

Table 1: Direct Penetrating Radiation Quarterly Dose Rates for CY 2011 Q-4

WIPP 6 WIPP Far SE Corner of Fence

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 099	9/30/11 6:12 AM	1/5/12 6:23 AM	97.01	44	24.4
SFC 126	9/30/11 6:12 AM	1/5/12 6:23 AM	97.01	42	23.1
SFC 171	9/30/11 6:12 AM	1/5/12 6:23 AM	97.01	44	24.6
				Average Quarterly Dose in mRad:	**24.0**

WIPP 7 WIPP East Fence Mid

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFB 985	9/30/11 6:15 AM	1/5/12 6:29 AM	97.01	46	24.4
SFB 987	9/30/11 6:15 AM	1/5/12 6:29 AM	97.01	47	25.7
SFC 210	9/30/11 6:15 AM	1/5/12 6:29 AM	97.01	45	23.5
				Average Quarterly Dose in mRad:	**24.5**

WIPP 8 WIPP NE Corner of Fence

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 049	9/29/11 6:08 AM	1/6/12 3:55 PM	99.41	53	26.6
SFC 084	9/29/11 6:08 AM	1/6/12 3:55 PM	99.41	58	29.2
SFC 103	No starting data was recorded for this electret				n/a
				Average Quarterly Dose in mRad:	**27.9**

WIPP 9 WIPP North Fence NE

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 074	9/29/11 6:12 AM	1/6/12 3:46 PM	99.40	51	25.7
SFC 097	9/29/11 6:12 AM	1/6/12 3:46 PM	99.40	52	26.5
SFC 204	9/29/11 6:12 AM	1/6/12 3:46 PM	99.40	57	28.9
				Average Quarterly Dose in mRad:	**27.0**

WIPP 10 WIPP North Fence Salt Pile

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 147	9/29/11 6:16 AM	1/6/12 4:04 PM	99.41	52	26.2
SFK 550	9/29/11 6:16 AM	1/6/12 4:04 PM	99.41	53	26.5
SFK 581	9/29/11 6:16 AM	1/6/12 4:04 PM	99.41	50	25.0
				Average Quarterly Dose in mRad:	**25.9**

Table 1: Direct Penetrating Radiation Quarterly Dose Rates for CY 2011 Q-4

WIPP 11 WIPP NW Corner of Fence

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 002	9/29/11 2:04 PM	1/4/12 1:06 PM	96.96	45	23.8
SFC 022	9/29/11 2:04 PM	1/4/12 1:06 PM	96.96	49	25.9
SFC 054	9/29/11 2:04 PM	1/4/12 1:06 PM	96.96	46	24.2
				Average Quarterly Dose in mRad:	**24.6**

WIPP 12 WIPP Loading Dock WHB (West)

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 013	9/30/11 6:18 AM	1/5/12 1:03 PM	97.28	43	24.1
SFC 108	9/30/11 6:18 AM	1/5/12 1:03 PM	97.28	43	23.8
SFC 185	Electret was touched and discharged before final reading				n/a
				Average Quarterly Dose in mRad:	**23.9**

WIPP 13 WIPP Loading Dock WHB (Center)

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 039	9/30/11 6:21 AM	1/5/12 12:42 PM	97.26	50	26.4
SFC 053	9/30/11 6:21 AM	1/5/12 12:42 PM	97.26	49	25.6
SFC 062	9/30/11 6:21 AM	1/5/12 12:42 PM	97.26	50	26.3
				Average Quarterly Dose in mRad:	**26.1**

WIPP 14 WIPP Loading Dock WHB (East)

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 077	9/30/11 6:25 AM	1/5/12 12:47 PM	97.27	46	26.1
SFC 094	9/30/11 6:25 AM	1/5/12 12:47 PM	97.27	50	25.8
SFC 152	9/30/11 6:25 AM	1/5/12 12:47 PM	97.27	46	25.8
				Average Quarterly Dose in mRad:	**25.9**

WIPP 15 Carlsbad Bureau Office (Canal St)

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 063	9/29/11 2:09 PM	1/5/12 1:09 PM	97.96	60	32.6
SFC 114	9/29/11 2:09 PM	1/5/12 1:09 PM	97.96	60	32.1
SFC 145	9/29/11 2:09 PM	1/5/12 1:09 PM	97.96	60	32.0
				Average Quarterly Dose in mRad:	**32.2**

Table 1: Direct Penetrating Radiation Quarterly Dose Rates for CY 2011 Q-4

WIPP 16 Loving Weigh Station

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 075	9/30/11 6:28 AM	1/5/12 12:39 PM	97.26	58	29.9
SFC 195	9/30/11 6:28 AM	1/5/12 12:39 PM	97.26	58	29.2
SFC 212	9/30/11 6:28 AM	1/5/12 12:39 PM	97.26	62	31.4
				Average Quarterly Dose in mRad:	**30.1**

WIPP 17 Malaga VFD

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 012	9/30/11 6:32 AM	1/5/12 12:34 PM	97.25	53	28.7
SFC 021	9/30/11 6:32 AM	1/5/12 12:34 PM	97.25	52	27.7
SFC 044	9/30/11 6:32 AM	1/5/12 12:34 PM	97.25	53	28.4
				Average Quarterly Dose in mRad:	**28.3**

WIPP 18 Hobbs Hwy/ North Access Rd

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFC 092	9/30/11 9:50 AM	1/5/12 6:33 AM	96.86	53	28.1
SFC 182	9/30/11 9:50 AM	1/5/12 6:33 AM	96.86	51	26.8
SFC 183	9/30/11 9:50 AM	1/5/12 6:33 AM	96.86	54	28.8
				Average Quarterly Dose in mRad:	**27.9**

WIPP 19 Southeast Control

Electret ID	Start Date and Time	Finish Date and Time	# of Days	Voltage Drop	Quarterly Dose Normalized
SFK 410	9/29/11 6:20 AM	1/5/12 6:38 AM	98.01	58	29.8
SFK 443	9/29/11 6:20 AM	1/5/12 6:38 AM	98.01	58	29.8
SFK 562	9/29/11 6:20 AM	1/5/12 6:38 AM	98.01	53	27.0
				Average Quarterly Dose in mRad:	**28.9**

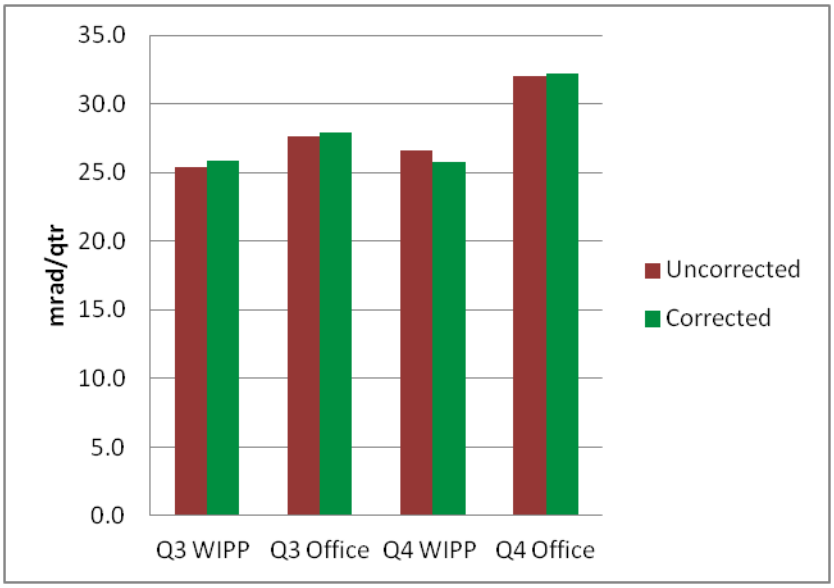
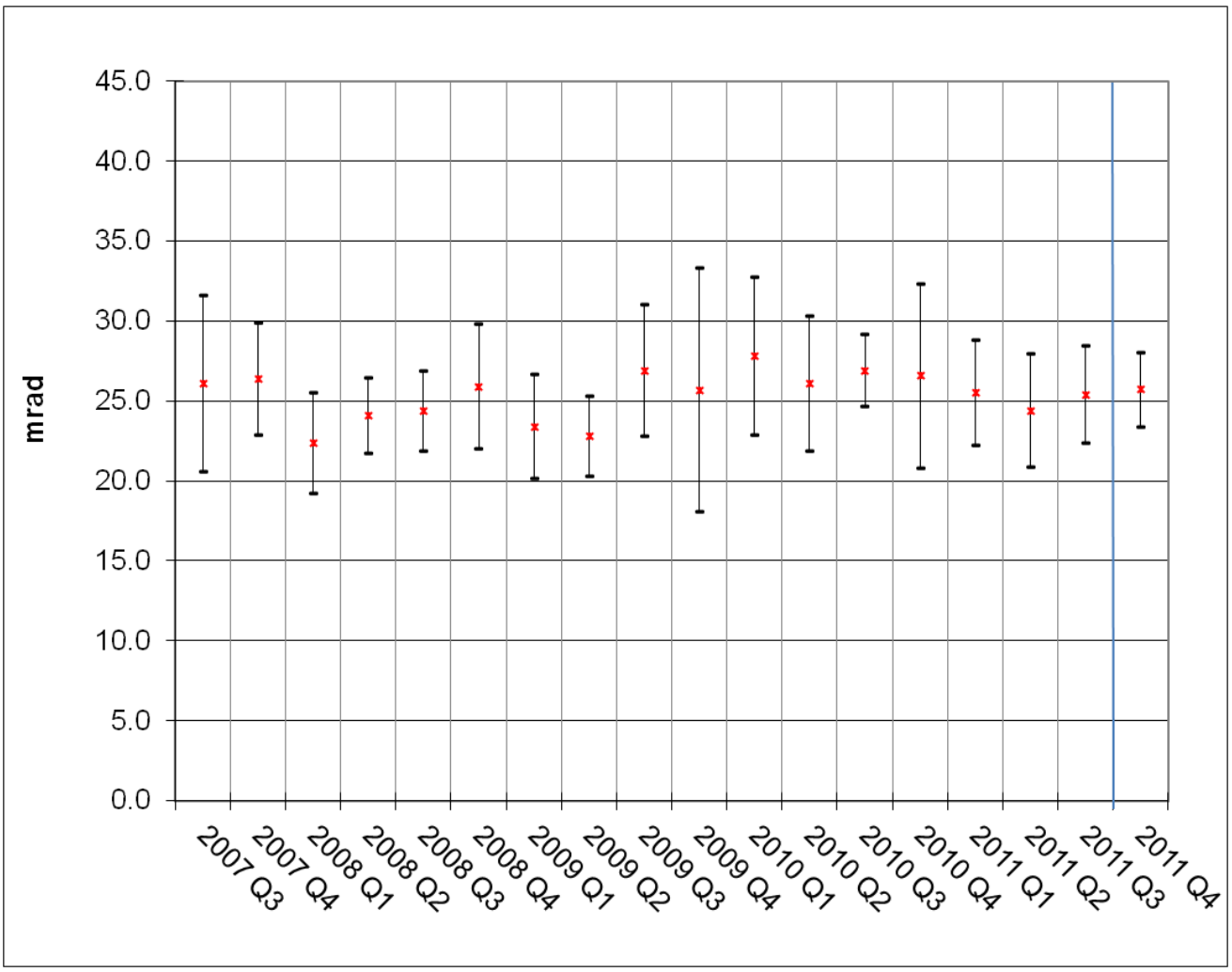


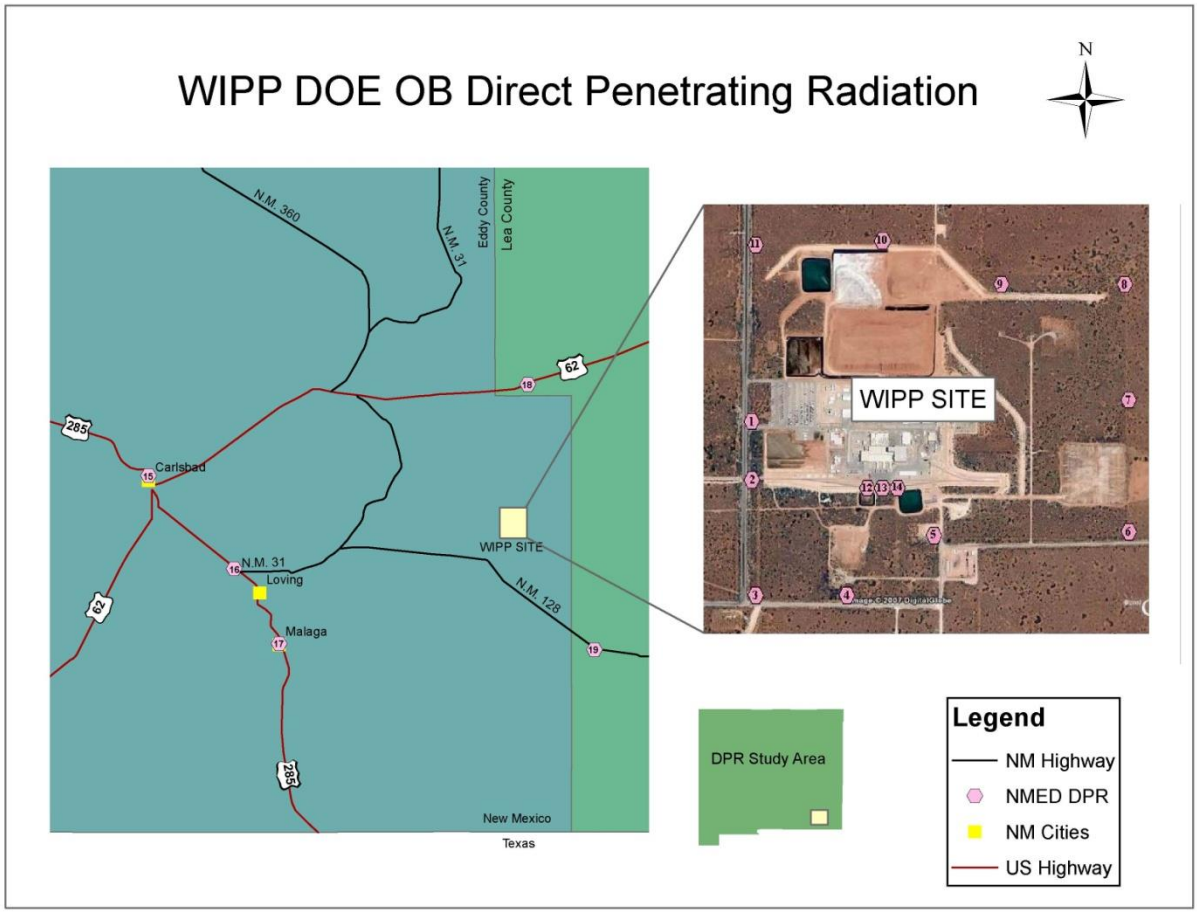
Table 2: Comparison of DPR Doses Calculated with 2012 Changes

This graph shows the similarity of dose rates with and without the calculation corrections implemented this quarter. It appears that the combined 2012 changes will have little effect on the reported DPR dose rates.

The result of implementing the new temperature correction factor is apparent in the very small difference noticed when comparing the WIPP uncorrected and corrected data. The average temperature at the WIPP site measured 30° C during Q3 and 13° C during Q4. The temperature correction factor corrects for measurements not being made at 20° C.



Graph 1: Average DPR Results in the WIPP Exclusive Use Area by Quarter (±2 sd)
The blue line denotes the implementation of the 2012 changes.



Map 1: Location of DPR Monitors Maintained by the Bureau