



NEW MEXICO
ENVIRONMENT DEPARTMENT



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Direct Penetrating Radiation Monitoring at the Waste Isolation Pilot Plant Conducted by NMED/DOE OB for the CY 2010 Q-4

The New Mexico Environment Department (NMED) DOE Oversight Bureau has compiled and assessed direct penetrating radiation (DPR) data collected during CY 2010 Q-4. The accompanying table shows DPR dose levels at various locations surrounding the Waste Isolation Pilot Plant, at the Bureau Office in Carlsbad, at the Malaga Volunteer Fire Department, and at the weigh station between Carlsbad and Loving. The data were obtained using RadElect gamma radiation monitoring electrets. The electrets are housed in aluminum canisters designed to block gamma radiation from radon.

Results

The DPR results ranged from a minimum average quarterly dose of 22.3 mrad at WIPP 6 (the southeast corner of the exclusive use fence line) to a maximum average quarterly dose of 32.7 mrad at WIPP 16 (the weigh station on US 285 between Carlsbad and Loving). The WIPP 16 monitor is located along the southern transportation route. No TRU shipments have been transported over that route since September 2008. Currently, WIPP 15 serves as a control for quality assurance, and it is located at the Bureau office in Carlsbad. The average quarterly dose was 29.2 mrad at WIPP 15.

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

Graph 1 shows the average dose calculations of electrets located in the WIPP Exclusive Use Area by quarter.

Conclusion

These calculated doses from the DPR RadElect monitors are comparable with past results, and they do not show a trend of increased gamma radiation exposure above background due to WIPP operations. According to the attached reference, the average U.S. exposure to radiation from natural background sources, minus radon exposure, is about 24 mrad/qtr. Historical gamma background levels at WIPP were either determined through the use of TLDs by the Environmental Evaluation Group, or through the use of a High Pressure Ionization Chamber (HPIC) designed to monitor low levels of gamma radiation in the environment as reported in *Statistical Summary of the Radiological Baseline Program for the WIPP* (DOE/WIPP-92-037). Neither is directly comparable to data obtained by the Bureau using electrets. Comparison studies by the Bureau have shown that electrets produce higher readings than TLDs.

Response

Questions and/or comments may be addressed to Barry S. Birch by phone at (505) 845-5933, or by email at barry.birch@state.nm.us

Enclosures: 1. Table 1: Direct Penetrating Radiation as Measured by Electrets CY 2010 Q-4
 2. Graph 1: Average DPR Results in the WIPP Exclusive Use Area by Quarter
 3. Map: Location of Electrets in the WIPP Exclusive Use Area
 4. Physical Location of the Bureau Electret Gamma Monitors
 5. Summary of Radiation Reference Values

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Table 1: Direct Penetrating Radiation as Measured by Electrets CY 2010 Q-4

New Mexico Environment Department, DOE Oversight Bureau, WIPP Section

WIPP 1

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SX 3751	10/1/10 8:06 AM	12/29/10 3:03 PM	89.29	47	26.5
SFB 973	10/1/10 8:06 AM	12/29/10 3:03 PM	89.29	47	25.0
SX 3856	10/1/10 8:06 AM	12/29/10 3:03 PM	89.29	46	26.7
Average Quarterly Dose in mrad:					26.1

WIPP 2

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 065	10/1/10 7:57 AM	12/29/10 3:14 PM	89.30	46	23.6
SFC 082	10/1/10 7:57 AM	12/29/10 3:14 PM	89.30	47	24.1
SFC 057	10/1/10 7:57 AM	12/29/10 3:14 PM	89.30	48	24.8
Average Quarterly Dose in mrad:					24.2

WIPP 3

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFB 974	10/1/10 7:38 AM	1/3/11 2:36 PM	94.29	51	24.0
SFB 983	10/1/10 7:38 AM	1/3/11 2:36 PM	94.29	50	23.6
SFC 025	10/1/10 7:38 AM	1/3/11 2:36 PM	94.29	50	23.4
Average Quarterly Dose in mrad:					23.7

WIPP 4

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFB 969	10/1/10 8:36 AM	1/3/11 2:46 PM	94.26	53	25.4
SFB 999	10/1/10 8:36 AM	1/3/11 2:46 PM	94.26	49	23.6
SFC 131	10/1/10 8:36 AM	1/3/11 2:46 PM	94.26	51	25.0
Average Quarterly Dose in mrad:					24.5

WIPP 5

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 061	10/1/10 8:48 AM	1/3/11 3:11 PM	94.27	52	25.1
SX 3836	10/1/10 8:48 AM	1/3/11 3:11 PM	94.27	51	26.7
SX 3746	10/1/10 8:48 AM	1/3/11 3:11 PM	94.27	50	25.8
Average Quarterly Dose in mrad:					25.9

Table 1: Direct Penetrating Radiation as Measured by Electrets CY 2010 Q-4

New Mexico Environment Department, DOE Oversight Bureau, WIPP Section

WIPP 6

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 099	10/1/10 9:22 AM	1/3/11 2:58 PM	94.23	48	23.1
SFC 126	10/1/10 9:22 AM	1/3/11 2:58 PM	94.23	44	21.1
SFC 171	10/1/10 9:22 AM	1/3/11 2:58 PM	94.23	47	22.7
Average Quarterly Dose in mrad:					22.3

WIPP 7

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SX 3872	10/1/10 9:45 AM	12/30/10 8:20 AM	89.94	50	28.5
SFB 985	10/1/10 9:45 AM	12/30/10 8:20 AM	89.94	54	27.7
SFB 987	10/1/10 9:45 AM	12/30/10 8:20 AM	89.94	56	29.2
Average Quarterly Dose in mrad:					28.5

WIPP 8

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFB 966	10/4/10 8:55 AM	12/30/10 8:51 AM	87.00	50	28.5
SFB 988	10/4/10 8:55 AM	12/30/10 8:51 AM	87.00	51	28.7
SFC 095	10/4/10 8:55 AM	12/30/10 8:51 AM	87.00	50	28.6
Average Quarterly Dose in mrad:					28.6

WIPP 9

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFB 995	10/4/10 8:23 AM	12/30/10 9:35 AM	87.05	48	27.0
SFC 018	10/4/10 8:23 AM	12/30/10 9:35 AM	87.05	50	28.1
SFB 961	10/4/10 8:23 AM	12/30/10 9:35 AM	87.05	49	27.3
Average Quarterly Dose in mrad:					27.5

WIPP 10

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 010	10/1/10 10:37 AM	12/29/10 9:35 AM	88.96	56	29.8
SFB 962	10/1/10 10:37 AM	12/29/10 9:35 AM	88.96	56	30.0
SFB 963	10/1/10 10:37 AM	12/29/10 9:35 AM	88.96	57	30.5
Average Quarterly Dose in mrad:					30.1

Table 1: Direct Penetrating Radiation as Measured by Electrets CY 2010 Q-4

New Mexico Environment Department, DOE Oversight Bureau, WIPP Section

WIPP 11

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 002	10/1/10 8:18 AM	12/29/10 2:52 PM	89.27	56	28.8
SFC 022	10/1/10 8:18 AM	12/29/10 2:52 PM	89.27	61	31.5
SFC 054	10/1/10 8:18 AM	12/29/10 2:52 PM	89.27	52	26.8
Average Quarterly Dose in mrad:					29.0

WIPP 12

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 013	10/1/10 8:57 AM	1/3/11 3:21 PM	94.27	50	24.2
SX 3896	10/1/10 8:57 AM	1/3/11 3:21 PM	94.27	48	25.1
SFC 108	10/1/10 8:57 AM	1/3/11 3:21 PM	94.27	47	22.8
Average Quarterly Dose in mrad:					24.0

WIPP 13

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 039	10/1/10 9:07 AM	1/3/11 3:30 PM	94.27	72	33.5
SFC 053	10/1/10 9:07 AM	1/3/11 3:30 PM	94.27	68	31.3
SFC 062	10/1/10 9:07 AM	1/3/11 3:30 PM	94.27	86	
Average Quarterly Dose in mrad:					32.4

* SFC 062 showed an anomalous high reading, and was not included in these calculations.

WIPP 14

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 064	10/1/10 9:12 AM	1/3/11 3:37 PM	94.27	40	20.7
SFC 077	10/1/10 9:12 AM	1/3/11 3:37 PM	94.27	51	24.9
SFC 152	10/1/10 9:12 AM	1/3/11 3:37 PM	94.27	52	25.4
Average Quarterly Dose in mrad:					25.1

**WIPP 15
Carlsbad**

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SX 3785	10/4/10 10:16 AM	12/30/10 1:47 PM	87.15	46	27.9
SX 3823	10/4/10 10:16 AM	12/30/10 1:47 PM	87.15	48	29.5
SFC 063	10/4/10 10:16 AM	12/30/10 1:47 PM	87.15	56	30.1
Average Quarterly Dose in mrad:					29.2

Table 1: Direct Penetrating Radiation as Measured by Electrets CY 2010 Q-4

New Mexico Environment Department, DOE Oversight Bureau, WIPP Section

WIPP 16

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 060	10/4/10 11:48 AM	12/29/10 12:53 PM	86.05	57	34.0
SFC 132	10/4/10 11:48 AM	12/29/10 12:53 PM	86.05	54	31.8
SFC 173	10/4/10 11:48 AM	12/29/10 12:53 PM	86.05	55	32.2
Average Quarterly Dose in mrad:					32.7

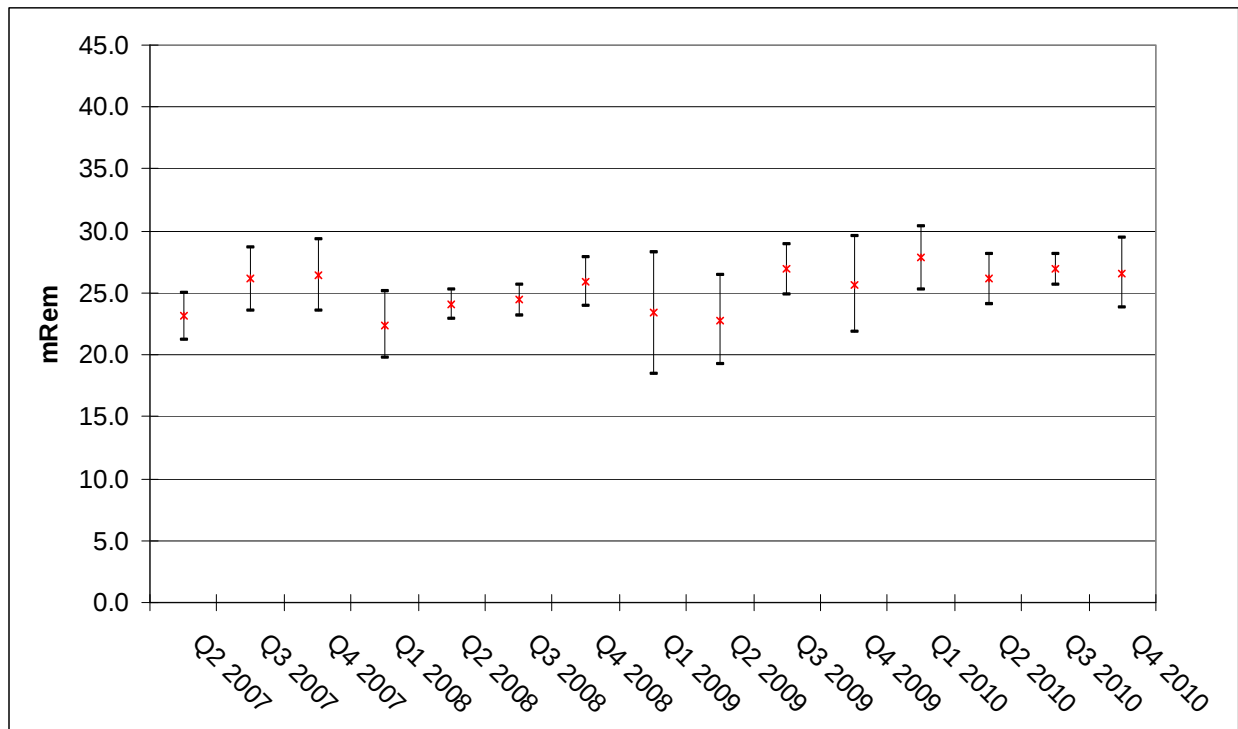
WIPP 17

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 012	10/4/10 11:38 AM	12/29/10 1:18 PM	86.07	49	27.8
SFC 021	10/4/10 11:38 AM	12/29/10 1:18 PM	86.07	49	27.5
SFC 044	10/4/10 11:38 AM	12/29/10 1:18 PM	86.07	51	28.8
Average Quarterly Dose in mrad:					28.0

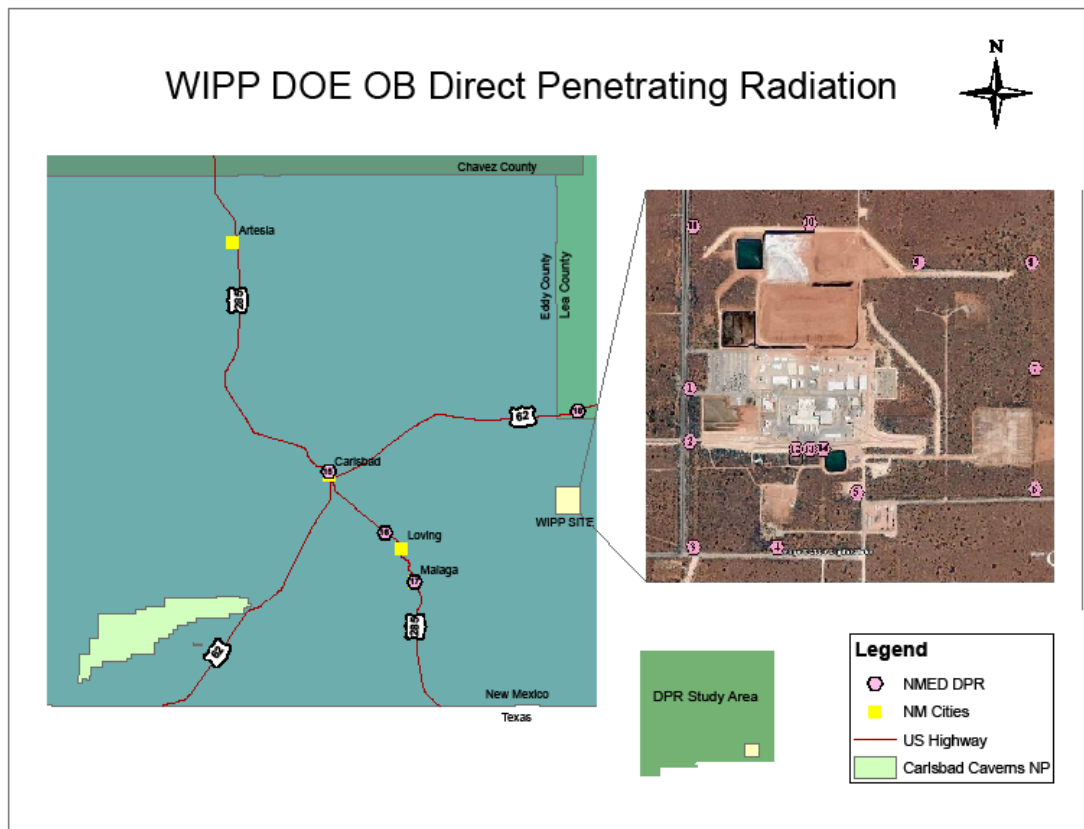
WIPP 18

Electret Number	Start Date and Time	Finish Date and Time	# of Days:	Voltage Drop	Quarterly Dose
SFC 092	10/8/10 8:26 AM	12/29/10 2:14 PM	82.24	50	30.2
SFC 182	10/8/10 8:26 AM	12/29/10 2:14 PM	82.24	45	26.8
SFC 183	10/8/10 8:26 AM	12/29/10 2:14 PM	82.24	78	
Average Quarterly Dose in mrad:					28.5

* SFC 183 showed an anomalous high reading, and was not included in these calculations.



Graph 1: Average DPR results in the WIPP exclusive use area by quarter



Physical Location of the Oversight Bureau's Electret Gamma Monitors

WIPP 1 – On the Exclusive Use Area fence, east side of the North Access Rd., just north of the cattle guard at the south drive way into the main parking lot at the WIPP

WIPP 2 – South of the main parking lot at the WIPP, east side of the North Access Rd. on the back side of the gate in the Exclusive Use Area, north of the rail road track

WIPP 3 – South of the WIPP, east of the intersection of the North Access Rd. and WIPP Rd. on the Exclusive Use Area fence, north of the cattle guard

WIPP 4 – On the Exclusive Use Area fence, east of WIPP 3

WIPP 5 – Following the WIPP Rd beyond its intersection with the North Access Rd. until it stops at a “Tee”- intersection, towards the north. The Exclusive Use Area fence goes to the west, away from the road. This gamma monitor is on a corner of the fence here

WIPP 6 – On the southeast corner of the Exclusive Use Area fence

WIPP 7 – On the east side of the Exclusive Use Area fence, between WIPP 6 and WIPP 8

WIPP 8 – At the northeast corner of the Exclusive Use Area fence

WIPP 9 – On the north Exclusive Use Area fence, between WIPP 8 and WIPP 10

WIPP 10 – East of WIPP 11, on the fence of the Exclusive Use Area, north side of the salt pile

WIPP 11 – East side of the North Access Rd, north of the WIPP, at the northwest corner of the Exclusive Use Area fence, across the road from the Far Field Ambient Air Monitoring station

WIPP 12 – Just south of the loading dock, behind the WHB, on the Property Protection Area fence, south of the railroad track

WIPP 13 - Just south of the loading dock, behind the WHB, on the Property Protection Area fence, south of the railroad track

WIPP 14 - Just south of the loading dock, behind the WHB, on the Property Protection Area fence, south of the railroad track

WIPP 15 - Outside the Oversight Bureau Office in Carlsbad

WIPP 16 - At the weigh station on US 285 between Loving and Carlsbad, on the fence behind the picnic tables

WIPP 17 - Near the intersection of US 285 and Black River Village Rd, at the Malaga Volunteer Fire Department

WIPP 18 – Near the intersection of the Hobbs Highway and the North Access Road, just west of the cattle guard on the North Access Rd

Natural Background Sources	Avg Dose	Units
Cosmic - Sun and Outer Space	28	mrem/yr
Terrestrial - Earth's Crust	28	mrem/yr
Internal - Our own bodies	40	mrem/yr
Radon - Uranium in the Earth	200	mrem/yr
	296	mrem/yr

Man-Made Radiation Sources	Avg Dose	Units
Medical	54	mrem/yr
Consumer Products	10	mrem/yr
Industrial Uses	3	mrem/yr
Atmospheric Testing	1	mrem/yr
	68	mrem/yr

U.S. Average Exposure **364 mrem/yr**
Greatest exposure over a lifetime is due to Radon Gas

Radiation Dose - Medical

Procedures	Avg Dose	Units
Radiation Therapy, Tumor	600,000	mrem/yr Tumor
CAT Scan, Head	5,800	mrem/yr Head
CAT Scan, Lower Spine	1,500	mrem/yr Lower Spine
Fluoroscope	5,000	mrem/yr
Mammogram, Breast	400	mrem/yr Breast
Mammogram, low-dose screen	0.2	mrem/yr Breast
Dental X-Ray	55	mrem/yr Mouth
Dental X-Ray	65	mrem/yr Mouth
Chest X-Ray	20	mrem/yr Chest
Chest X-Ray	50	mrem/yr Chest

Radiation Dose - Consumer Products	Avg Dose	Units
Cigarettes, 1.5 pack per day	8,000	mrem/yr Lungs
Dental Porcelain (Full Dentures)	60,000	mrem/yr Gums
Tinted Glasses	4,000	mrem/yr Eyes
Building Materials	7	mrem/yr Whole Body
Radium Watch Dial	6	mrem/yr Whole Body
Smoke Detector	1	mrem/yr Whole Body

DOE Dose Limits	Avg Dose	Units
Annual Limit	2 to 5	Rem/yr
Members of the Public	100	mrem/yr
<i>(As a consequence of all routine DOE activities.)</i>		

Acute Exposure Effects	Avg Dose	Units
Slight Blood Changes	25 to 50	Rem
Radiation Sickness	100 to 200	Rem
Blood System Damage	200 to 500	Rem
LD 50-60 (lethal dose to 50% in 60 days)	450 to 600	Rem
Gastrointestinal Damage	> 500	Rem
Death within 2 to 3 days	> 5,000	Rem

REM (Roentgen Equivalent Man), unit for measuring dose equivalent
RAD (Radiation Absorbed Dose), unit for measuring dose in any material
Conversion of Rem to millirem: 1 rem = 1,000 millirem (mrem)

Dose vs. Dose Rate:
Dose rate is the rate at which you receive the dose
Dose rate = dose divided by time (rem/hr or mrem/hr)
Dose is the amount of radiation you receive
Dose = Dose Rate X Time

Radioactivity Units, Disintegrations per minute (dpm)
Larger Unit, Curie (Ci) 1 Ci = 2.22E+12 dpm

Contamination Units = Radioactivity (dpm)/Area or Volume

Source: Sandia National Laboratories Radiological Worker I Training