The Role of Independent Monitoring in Maintaining Community Support through a Radiological Incident -A WIPP Case Study – 15107

Punam Thakur*, Russell Hardy*, Roger Nelson** and Abraham Van Luik**

*Carlsbad Environmental Monitoring & Research Center, 1400 University Drive, Carlsbad, NM 88220, USA pthakur@cemrc.org
** US Department of Energy, Carlsbad Field Office, 4021 S. National Parks Highway, Carlsbad, NM 88220, USA

ABSTRACT

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) waste repository for the permanent disposal of defense transuranic (TRU) wastes. The repository is mined in the Salado Formation, a bedded salt formation of the Permian era, approximately 655 m (2150 ft.) below land surface. Located near Carlsbad, New Mexico, the WIPP facility is the world's first deep geological disposal facility licensed to accept TRU waste. Environmental monitoring is a key component in the development and operation of any nuclear facility. Well after the WIPP facility had been sited and constructed, but before repository operations began, DOE and local community leaders recognized the value of having an independent environmental monitoring program in addition to the self-monitoring program required by regulation. An independent monitoring organization, the Carlsbad Environmental Monitoring and Research Center (CEMRC) was created by New Mexico State University at its Carlsbad campus. After almost fifteen years of successful waste disposal operations, the first airborne radiation was accidently released from the WIPP and detected beyond the site boundary on February 14, 2014. The accident released moderate levels of radioactivity into the underground air. A small but measurable amount of radioactivity also escaped to the surface and was detected beyond the site's inner boundary. The results were reported to the public as they were obtained and verified. Releases were low and localized, and no radiation-related health effects among local workers or the public would be expected. CEMRC's independence and its extensive monitoring program played a crucial role in timely informing the local populations on the levels and types of radiation released from the WIPP. CEMRC also helped eliminate unnecessary concern surrounding fear of radiation by engaging local populations through news releases and presentations at "town hall" meetings sponsored by the Mayor's Office and the Department of Energy.

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) transuranic (TRU) waste repository. The repository is emplacing defense-related TRU wastes in the Salado Formation, a bedded salt formation approximately 655 m (2150 ft.) below land surface. The facility is located in the Chihuahuan desert of southeastern New Mexico near Carlsbad (shown in

Figure 1). The WIPP facility is the world's first deep geologic disposal facility licensed to accept TRU waste, with activity concentrations of alpha-emitting isotopes >3700 Bq/g (> 100 nCi/g), and half-life >20 years. Since the start of its operation in March 1999, more than 81,000 cubic meters of Cold-War legacy TRU waste have been removed from temporary locations around the nation and shipped to WIPP for permanent disposal. The WIPP is about half full in terms of its legally defined capacity.

Figure 1. The Waste Isolation Pilot Plant in southeastern New Mexico

Environmental monitoring is a key component in the development and operation of any nuclear facility. It is required by regulation. Regulatory compliance monitoring is carried out by the Department of Energy's contractor, Nuclear Waste Partnership, (NWP, LLC). Well after the WIPP facility had been sited and constructed, but before the repository become operational, DOE and local community leaders recognized the value of an independent environmental monitoring program. Community leaders saw the maintenance of local public support to be as important as obtaining that support in the first place, and saw independent monitoring as way to continue to assure the public that their health was not at risk because they allowed, even encouraged, this facility to be sited and operated nearby.

Under the leadership of former Secretary of Energy Hazel O'Leary, DOE funded New Mexico State University (NMSU) to build and operate a state-of-the-art environmental monitoring facility in Carlsbad, the Carlsbad Environmental Monitoring and research Canter (CEMRC). The purpose of CEMRC was to independently establish a baseline before operations began, and then evaluate the radiological fingerprint of the facility in its environmental setting throughout its operational lifetime. CEMRC is funded by DOE through a grant process that respects its independence in carrying out and reporting the results of environmental monitoring at and near the WIPP site.

THE ROLE OF INDEPENDENT MONITORING

The scope of CEMRC monitoring activities is broad, and includes people (whole body counting for the public as well as workers), water (drinking and surface waters), soil, sediment, and air (ambient as well as WIPP exhaust air) sampling. Routine reporting is done annually. Non-routine results, if they occur, are reported as they are found after review and interpretation. Its mission is to detect and report radioactive contaminant levels, even those below the regulatory requirements. The CEMRC program has capabilities to detect radionuclides rapidly in case of accidental releases from the repository or other portions of the facility during operations.

The WIPP repository was sited successfully and operated safely and efficiently for nearly 15 years. Just weeks before its 15th anniversary, an airborne radiation release was detected beyond the site boundary on February 14, 2014. It was the first unambiguous release at the WIPP. The accident released moderate levels of radioactivity into the underground air. The dominant radionuclides were americium and plutonium. A small, but measurable amount of radioactivity also escaped to the surface and was detected beyond the site's inner boundary.

The radiation release was likely caused by a chemical reaction inside a TRU waste drum containing a nitrate salt bearing waste stream from Los Alamos National Laboratory.The chemical reaction is suspected to have caused a waste drum to rupture underground, releasing radioactive material into the ventilation air flowing through the repository and up the exhaust shaft [1]

CEMRC's independence and its extensive monitoring program played a crucial role in informing the local populations on the levels and types of radiation released from the WIPP. This paper describes the CEMRC's independent monitoring program and its role in maintaining the community support following the radiation release event. The results were reported to the public as they were obtained and verified. The program also helped eliminate unnecessary concern surrounding fear of radiation by engaging local populations through local newspaper articles, and presentations at "town hall" meetings. This timely dissemination of information is important for assuring the local public that the potential health impacts of radiation from the WIPP are being independently evaluated, and provides the public a basis for judging the continued acceptability of this facility.

INDEPENDENT MONITORING AND THE RADIATION RELEASE EVENT AT WIPP

The success of any nuclear facility is strongly tied to the degree of public participation, acceptance and understanding that is established. WIPP is an example where public engagement has been consistent, and at a high level. It was held up as a model relationship between an implementer and a host community in the final report by the Blue Ribbon Commission on America's Nuclear Future [2, 3]. In part, this degree of public acceptance was assured by, and is maintained by, independent oversight. The CEMRC has been conducting independent health and environmental monitoring in the vicinity of WIPP since 1995 and has made the results easily accessible to all interested parties. Public access to the monitoring data and their ability to

directly participate in CEMRC's whole body counting program provides a key element of trust and transparency for the public.

On Friday, February 14 at 11:30 pm, an underground continuous air monitor alarmed. The monitor was located in the exhaust ventilation air immediately downstream of panel 7, the most recent active waste emplacement area. Waste emplacement operations had been suspended nine days earlier due to an unrelated event. Working as designed, the WIPP ventilation system automatically switched to filtration mode upon the air monitor alarm. In filtration mode, the ventilation system reduces the underground airflow, and directs the exhaust air stream from the underground through HEPA filter banks when it reaches the surface. This is intended to prevent any discharge into the atmosphere in the event of an accident involving waste underground. The ventilation system functioned as designed, so there was no reason to suspect any substantial release to the environment. However, the continuous air monitor indicated significant airborne concentrations were released into the air in and downstream of panel 7, which precipitated heightened awareness by on-site radiation control staff, and the collection of addition air samples in and around the site.

Following the announcement of the underground radiation detection event by DOE, the CEMRC used its ultra-sensitive fixed ambient air radiation sampling to ascertain whether or not there were releases to the environment. CEMRC also intensified analyses of the WIPP underground air and three ambient air sampling locations it operates as part of its routine sampling program. The WIPP ventilation system incorporates isokinetic sampling locations in the exhaust air stream both before and after the HEPA filters, called Station A and Station B, respectively. Increased scrutiny of these samples was a high priotity as soon as site access was allowed. Rapid analyses were performed on other environmental samples collected from within a 100-mile radius of WIPP to assess the regional impact of the radiation release event to the local environment, if any.

Five days later, on Wednesday, February 19, CEMRC reported that it had found trace levels of americium and plutonium at a monitoring station located approximately one kilometer (0.6 miles) northwest of the WIPP facility. The filter had been installed at the station prior to the event, on Tuesday, February 11, and was removed on Sunday, February 16. The levels detected at this sampling station indicated a small release of radioactive particulate from the WIPP site. A second ambient air sampling station located approximately 12 miles southeast of the WIPP facility on Highway 128 showed no detection of radioactive particles. These findings were immediately reported to the public and the local news outlet via press release.

The levels found by CEMRC were very low (81.4 µBq/m^3 of ^{241}Am and 5.8 µBq/m^3 of $^{239+240}$Pu), well below any level of public or environmental concern. There is no risk to anyone from contamination levels this low. t is important to realize that they were only detectable because of the ultra sensitivity of modern radiation monitoring equipment and radiochemical analyses.

The monitoring results of a third ambient air sampling station located a hundred yards away from the underground air exhaust point (On-Site station) and within the WIPP property protection area was released by CEMRC a few days later because CEMRC personnel were not able to access the area for collection of the filter until Tuesday, February, 18, 2014. This On-Site filter showed 115.2 µBq/m^3 of ^{241}Am and 10.2 µBq/m^3 of $^{239+240}$Pu, again not posing any health risk concern. A week after the event, the airborne radioactive particulate levels at these stations had decreased

by a hundred times, and two weeks later the levels at these stations were back to the pre-release levels and sometimes not even detectable, demonstrating no long-term environmental contamination.

As an example of a CEMRC data product, Figure 2 shows the ambient air monitoring data for $^{239+240}$Pu and ^{241}Am at three sampling locations in the vicinity of the WIPP site. Results are roughly similar for the three locations and show seasonal fluctuation patterns. The source of pre-event airborne contamination is largely wind suspension of weapons-testing contamination present on soils. That is ambient contamination from atmospheric weapons testing conducted in the 1950s and 1960s, not attributable to the presence of WIPP.

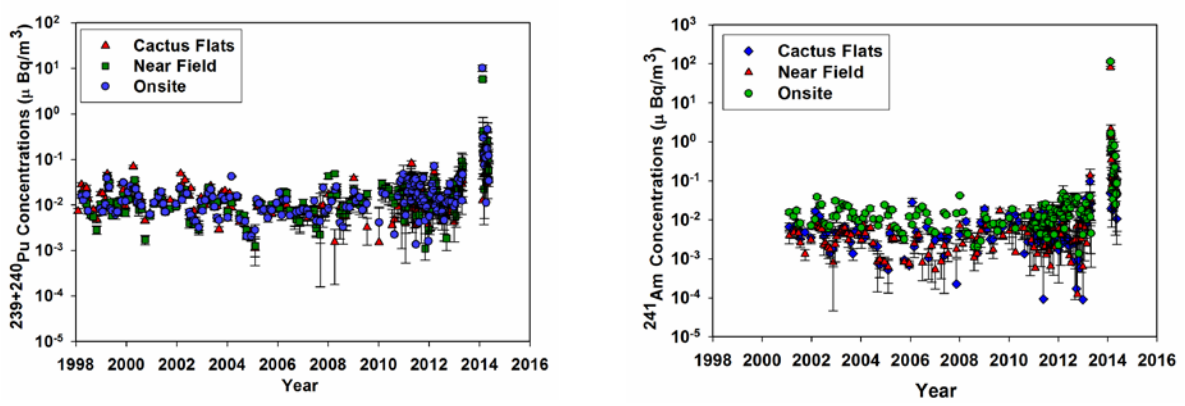

Figure 2. The Pre- and post-release event $^{239+240}$Pu (left) and ^{241}Am (right) concentrations in ambient air at three stations in the vicinity of the WIPP site.

Within weeks of the event, CEMRC released the results for Station A and Station B filter contamination levels to the public. The analysis of these filters is designed to show how well the HEPA filters worked to trap the underground radiation. The filter removed the morning after the event at Station A (before exhaust air enters the HEPA filter) showed high levels of radioactivity, as expected, about 4337 Bq/m^3 of ^{241}Am and 671 Bq/m^3 of $^{239+240}$Pu. The sample collected the very next day showed about 342 Bq/m^3 of ^{241}Am and 38.8 Bq/m^3 of $^{239+240}$Pu. By the morning of February 21, these levels had dropped to 0.2 Bq/m^3 of combined Pu and Am.

Station B (air after HEPA filtration) showed much lower levels, about 2.3 Bq/m^3 of ^{241}Am and 0.22 Bq/m^3 of $^{239+240}$Pu when it was collected on February 18. Three days later it was about 0.43 Bq/m^3 of combined Pu and Am.

The amount of airborne radioactivity based on Station B samples defines the source term of contamination that ultimately escaped from the repository. Summing all isotopes (Pu and Am) measured over the first week of after the event, and accounting for the total air flow, the source term was calculated as 2.8E+7 Bq (~0.8 mCi). This source term is dominated by ^{241}Am (>90%).

In terms of radiological risk at or in the vicinity of the WIPP site, the increased risk from the WIPP releases is exceedingly small, approaching zero.

Another capability developed by CEMRC as part of its service to the southeastern New Mexico region is a program called “Lie down and be counted”. This program uses a state of the art whole body counting system that can measure the body burdern of radioactive elements at extremely low levels. It has operated over the past 15 years and over 500 local residents have particpated to form a baseline. Following the radiation release event, CEMRC also offered this free lung and whole body counting service to adult citizens living within a 100-mile radius of the WIPP facility seven days a week. Concerned citizens were encouraged to be measured to see what radiation might exist in their lungs and whole body. Even though there was not a substantial upsurge in the number of citizens who took advantage of this, just the mere availability of such a service, provided a sense of security to concerned citizens after the event.

The release of any radioactivity has the potential to alarm portions of the general population who do not understand the difference between actual risk and perceived risk. There are mutiple factors that influence risk perception including whether the exposure to the risk is voluntary, out of their control, unfamiliar, or may have long term health effects. It is not suprising that some media treatment of the WIPP radiation release event amplified the public’s perception of their risk. Following the event, there were rumors propagated in some media, and conflicting reports, which did not help assure the public. The WIPP release incident was newsworthy, but it was not dangerous to any member of the public.

CONCLUSION

The public’s trust in the source of information about radiation is a key element of its acceptance. The public tends to trust scientists with expertise who can be viewed as independent. CEMRC expertise and independence help it achieve the requisite credibility. To provide the public with timely and useful information, the monitoring data was posted directly from the laboratory to the CEMRC website. From this website, the public could view WIPP monitoring and sampling results as soon as they became available.

Graphs of the monitoring data were displayed along with information on how to interpret the graphs in order to show the quickly decreasing trend in radiation in the ambient air with time. Information on the contaminant levels that might have been a cause for public concern, had they been found, were also posted.

User-friendly tables of analytical results were posted on the website. These tables could be searched easily by sampling locations, data, or media type.

Throughout the duration of the response to the February 14 release event, data continued to be posted directly onto the website after quality-assurance review. On June, 2014, CEMRC archived the WIPP release event data, meaning CEMRC is no longer updating the data but ensuring its availability for historical and informational purposes. CEMRC has returned to its pre-event monitoring program in terms of frequency and locations, but is always ready to increase sampling frequency and to expedite analyses if there is a reason to do so. CEMRC sampling stations away

from the WIPP site are being expanded in numbers and locations in response to the February release event.

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