The Value of Independent Environmental Monitoring in Nuclear Waste Disposal: A WIPP Case Study

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Prior to the start of waste disposal operations, the Carlsbad Environmental Monitoring and Research Center, CEMRC, was established to provide independent monitoring of the potential radiological and chemical environmental impacts of the Waste Isolation Pilot Plant (WIPP), a deep geological repository for transuranic, defense-related, radioactive wastes. CEMRC makes its monitoring data easily accessible to the Public. The public access to the monitoring data provides trust and transparency for the public. For a project like WIPP whose success depends on public confidence in its ability to safely dispose of nuclear waste for tens of thousands of years, it is important to maintain that public trust, confidence and support as generations pass and as local populations change. WIPP has been able to achieve such a high degree of public acceptance and support, in part, through an oversight philosophy that gives a role to the local community in evaluating the ongoing safety of the site through an independent environmental monitoring program. This article provides an up-to-date look at the various aspects of CEMRC's Independent monitoring program and whether the CEMRC's independent monitoring and communication model should be considered as part of the infrastructure needed to assure local acceptance of planned repositories anywhere in the nation or in the world.

I. INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is the only operating deep geological repository for the permanent disposal of defense related transuranic (TRU) and TRU-mixed wastes (wastes that also have hazardous chemical components) in the world. The facility recently resumed waste disposal operations after recovering from a February 2014 accident involving a radiological release from a waste container in the WIPP underground. Located near Carlsbad, New Mexico; the WIPP facility, which began receiving TRU waste in 1999, has provided the nation with a safe disposal alternative for TRU waste generated during decades of weapons production in the United States. Many factors contributed to the success of this project during nearly fifteen years of safe operations. One of the most important factors was the overwhelming support for the WIPP project exhibited by the local community and the local elected officials. One component of the broad public acceptance by the citizens of Southeast New Mexico has been the concept of independent, third party monitoring program in the vicinity of the WIPP that began before and continues after the WIPP began receiving nuclear waste.

From the standpoint of addressing operational and environmental risk, as well as public concerns, WIPP has extensive human health and environmental monitoring. In addition to the regulatory compliance monitoring, carried out by the Department of Energy's contractor, Nuclear Waste Partnership, (NWP, LLC), the facility is also monitored by an independent oversight organization, the Carlsbad Environmental Monitoring & Research Center (CEMRC), which is associated with the New Mexico State University. The CEMRC has been conducting independent health and environmental monitoring in the vicinity of WIPP since 1995. The primary goal of CEMRC is to develop and implement an independent health and environmental monitoring program in the vicinity of WIPP and make the results easily accessible to all interested parties. 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. Under the CEMRC monitoring program, air, drinking water, surface water, soil, sediments, vegetation and the local population around the WIPP facility as well as air entering and exiting the WIPP underground, are regularly analyzed. 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. 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.

II. 2014 Accident Recap

After almost fifteen years of successful waste disposal operations, on February 2014, a waste drum breach in Panel 7, Room 7, released significant quantities of americium and plutonium into the disposal room and adjacent exhaust drifts. It was the first release at the WIPP since its opening. Although no one was present in the underground at the time of the release, a total of 22 workers tested positive for very low level of radiation, presumably from some of the radioactive material that was released above ground through a small leak in the HEPA filtration system [1]. The radiation release was caused by a runaway chemical reaction inside a TRU drum, which overheated and ruptured underground, spilling radioactive materials into the repository A Continuous Air monitor (CAM) on the exhaust side of Panel 7 detected the release and activated dampers on the surface that diverted exhaust air through the standby HEPA (High Efficiency Particulate Air) filtration system. Although more than 99% of the potential release was captured in the HEPA filters, a small amount of radioactive material was released into the environment via design leakage through the two ventilation system dampers. The dampers have

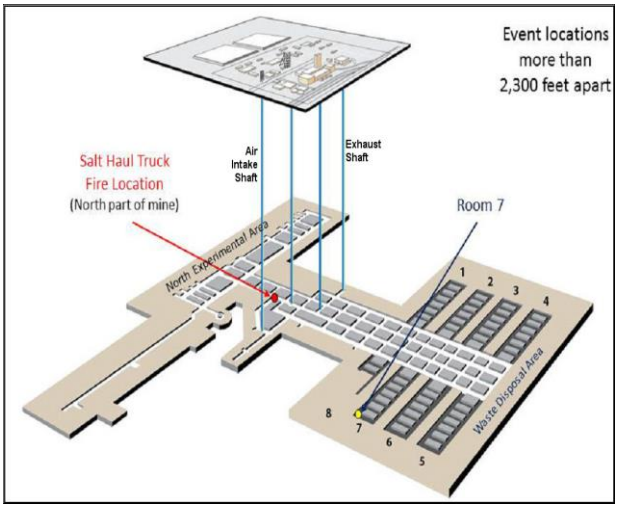

Fig. 1. WIPP Layout and location of Feb. 14, radiation release event

since been sealed off with high-density expanding foam insulation. Figure 1 shows a schematic of the WIPP underground layout and the location where the radiation release event occurred.

III. Radiation Level Measurements

Following the announcement of the underground radiation detection event by DOE, the CEMRC accelerated analysis of the underground air both before (Station A, pre-HEPA) and after the HEPA filtrations (Station B, Post HEPA) as well as ambient air filters to determine the underground source term and the amount and type of radionuclides that were ultimately released into the environment.

Independent analytical results of air filters from sampling stations on and near the WIPP facility confirmed brief detection of trace amounts of ^{241}Am and $^{239+240}$ Pu at two sampling locations: (1) Onsite station, which is about 0.1 km northwest of the WIPP exhaust shaft, and (2) Near Field, about 1 km northwest of the facility. The highest concentrations detected were 10.2 µBq/m^3 for $^{239+240}$Pu and 115.2 µBq/m^3 for ^{241}Am at the Onsite sampling Station, and 81.4 µBq/m^3 for ^{241}Am and 5.8 µBq/m^3 for $^{239+240}$Pu at the Near Field Station [2]. While levels were elevated and detectable above background, these levels would not be considered dangerous and were well below levels that would be considered a risk to people or the environment. It should be noted that the sampling rate for high-volume samplers 1.13 m^3 (40 cfm) is significantly greater that the respiration rate for humans 0.03-0.14 m^3 (1-5 cfm), so any attempt to estimate internal dose from exposure to the reported levels would need to account for the volume differences. A week after the event, the radiation at these stations had decreased by a hundred times, and two weeks later the radiation levels at these stations were back to the pre-release levels and sometimes not even detectable, demonstrating no continuing or long-term environmental contamination.

The intensified analyses of the WIPP underground air, both just before and just after the HEPA filters, called Station A and Station B, respectively were also performed to show just how much radiation escaped the underground and how well the HEPA filters worked to prevent the underground radiation from reaching outside. As expected, the filter removed the morning after the event at Station A (before filtration) showed high levels of radioactivity, about 4337 Bq/m^3 of air for ^{241}Am and 671 Bq/m^3 of air for $^{239+240}$Pu (Figure 2, left). The filter collected the very next day showed about 342 Bq/m^3 of air for ^{241}Am and 38.8 Bq/m^3 of air for $^{239+240}$Pu. By the morning of February 21,

these levels had dropped to 0.2 Bq/m^3 of air for combined Pu and Am.

The amount of radiation measured on Station B (Post -HEPA filtration) were much lower, about 2.3 Bq/m^3 for ^{241}Am and 0.22 Bq/m^3 for $^{239+240}$Pu. By February 21, a Station B sample had only about 0.43 Bq/m^3 of combined Pu and Am. Based on the CEMRC analyses of the Station A and Station B measured over the first week of the event, and accounting for the total air flow, the source term of Station A is estimated to be about 4 GBq (100 mCi). The amount of airborne radioactivity based on Station B samples defines the source term of contamination that ultimately escaped from the repository and was calculated to be around 50 MBq (1.3 mCi).

IV. Public Perception and Nuclear Facilities

The general public often reacts to the nuclear accident involving release of radioactive materials with fear, anxiety and confusion. Public abhorrence of radiation, radioactivity or radioactive waste, are influenced by remnants of the cold war education and a general lack of effective public education and outreach by the nuclear industry and government authorities involved in nuclear power or use of radioactive materials. The lack of education and understanding of radiological risk, and in some cases the safety record of these entities, has led to a lack of trust of the authorities and operators of nuclear installations. The general public often regards reports and public statements, including radiological measurements reported by federal agencies and their contractors, with distrust and suspicion. Studies have also shown that the public's trust in the source of information about radiation is often critical to the acceptance of the results. The risk of radiation is best communicated by someone who can be viewed as independent and not involved or otherwise associated with the owner or operator by the public. When there is an event involving a nuclear facility, early dissemination of information plays an essential part in the establishment of public trust. Telling them what they should know or what they want to know are some of the necessary tools to obtain public trust. Open and transparent communication between the public and representatives of the waste management organization is also vital for the success of any nuclear facility. The fear, anger, and distrust following the accident at Fukushima Nuclear Power Plant shows that communication is still a major problem. There is a need to develop and practice good communication model in order to improve the future response to a contamination event with the public. It is also important to note that these problems will never be fully prevented but they can be ameliorated somewhat by raising public understanding of radiation and its effects as part of a long term educational strategy.

V. Independent Environmental Monitoring and Nuclear Waste Disposal

The success of any nuclear facility is strongly tied to the degree of public acceptance and understanding that is established. WIPP is an example where public engagement has been consistent and at a high level. WIPP has achieved this high degree of public acceptance and support, in part, through an oversight philosophy that gives a role to the local community in evaluating the ongoing safety of the site through an independent environmental monitoring program operated by CEMRC. Before the repository became operational, the DOE and local community leaders recognized the potential value of an independent monitoring as way to maintain community support for the WIPP project. CEMRC was born out of the local community's demand to be a participant in an independent monitoring program, which is funded on an annual basis by the DOE through a financial assistance grant process. Although the program is funded by DOE, the process respects independence in carrying out and reporting the results of environmental monitoring at and near the WIPP site. Public surveys of residents within 160 km of the WIPP site showed concern over radiation in the air, in their own bodies, in drinking water, and last but not least, in soil and surface water. CEMRC therefore monitors all of these media.

Following what was a minor radiological release event, there were understandably fearful reactions from a number of citizens residing in Carlsbad and the nearby communities. CEMRC's independent environmental monitoring program and their early public engagement proved invaluable in providing timely and accurate environmental data to local community leaders and members of the general public. The data, and open communication from CEMRC, helped reassure citizens in Carlsbad and the surrounding area that the release was extremely low and the extent was very limited. CEMRC further communicated that the probability of any environmental or health impacts from the release was extremely low. It is unlikely the local community would have placed the same level of trust in similar assurances of safety coming from DOE or other State and Federal regulators.

While there is no consensus in the literature, the WIPP incident has shown that public support for nuclear facilities is and will continue to be a major determining factor in the successful siting and construction of similar facilities. Public perception is dynamic and can be shaped by legitimate 'actors' and that transparency and participation of the community in the monitoring process can defuse tension and allay public concern regarding the credibility of the reported data.

VI. CONCLUSIONS

It is difficult to overstate the potential benefits of independent, third party monitoring of the WIPP site that ensures a role for the local community in ongoing evaluation of the safety and performance of the site. Entrusting local stakeholders with monitoring responsibilities helps build a positive relationship with the participating communities, and strengthen the oversight role of the local community which balances the relationship between the local community and the Federal government, helping ensure that the interests of the local community are considered in agency decision-making. Furthermore, the University affiliation helps maintain costs at manageable levels that are favorable to the funding organization, especially considering that these projects can last many decades. In addition to the financial and technical value of the program, there is a societal benefit, not only to the local community but also to the all interested parties with whom the data are shared. A community that is contemplating hosting an interim storage facility for spent nuclear fuel or a permanent disposal site for radioactive waste should consider including an independent environmental monitoring and community outreach program as part of the infrastructure needed to encourage local acceptance of nuclear facilities in their community.

ACKNOWLEDGMENTS

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