Soil-Vapor Sampling and Analysis Plan
At Sandia National Laboratories' Mixed Waste Landfill
Citizen Action Presentation to the New Mexico Environment Department
May 1, 2007

Governor Richardson's position that we need to dismantle our nuclear weapons laboratories demands a new mission for Sandia.[1] Citizen Action would recommend that Sandia place itself in the lead for action on cleaning up legacy waste sites starting with the Sandia Mixed Waste Landfill.

In the past Citizen Action's focus has been on groundwater. Now it is on the need for monitoring of the air pathway. As was true with the defective groundwater monitoring network at the MWL, there is too little data that will be obtained from the limited soil sampling proposed by Sandia to make a decision that the wastes can safely remain in place in the middle of an urban center for the duration of their toxicity.

Sandia failed to extensively monitor these significant pathways for release. Sandia did not monitor continuously and now Sandia is proposing to still offer extremely limited sampling.

The sampling plan proposed by Sandia does not address the Notice of Disapproval specifically with respect to the problem of containers that may have ruptured and released their contents over the decades of time. The sparse sampling proposed does not address the releases that may have been extensive across the 2.6 acre MWL disposal site.

Now there is the additional need for data from the recent compaction of containers that took place within the individual trenches and pits. The comprehensive study that is necessary is both made more urgent and difficult to carry out due to the installation of the subgrade. No sampling is planned above or below the pits or trenches. No monitoring was in place when the trenches and pits were compacted possibly releasing considerable amounts of contaminants to the vadose zone as liquids and vapors. There are no plans for ongoing monitoring to identify areas where compaction activities ruptured containers and released contaminants.

The proposed sampling is not responsive to the NMED NOD. We need the total picture from releases of container rupture that is present and will be a danger realized over a period of thousands of years.

The SAP needs to include installation of a permanent monitoring capability for soil gas at a large number of locations both aerially and vertically.

Some of the wastes at the MWL are too dangerous to be left in place. Wastes that are greater than Class C cannot be legally left in place at the MWL. Dangerous emissions that cannot be controlled by leaving the wastes in place are not monitored. We need to

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[1] "This is an existential problem. It is urgent. We need to free humanity from the threat of nuclear destruction." Gov. Bill Richardson at John Hopkins University, March 28, 2007.

have careful monitoring put in place now for both air, water and surface pathways and there are no plans in place for that careful monitoring.

Despite this knowledge only a one-time sample of these dangerous contaminants was made in the early 1990s. The work in the 1990s was at sparse locations that gave knowledge that hot spots existed but did not adequately follow up to map and monitor the hot spots. The highest levels at the hot spots were not characterized. Nobody knows what portion of the Albuquerque population may have been exposed to the types of VOCs, solvents, heavy metals and radionuclides at the MWL escaping from exposed waste and contaminated surface soils. NMED Comment 60 Phase 2 RFI- "Vapor-phase transport to groundwater was not considered for tritium."

There are the growing populations of Mesa del Sol, south county and Isleta Pueblo. The necessary data from soil gas monitoring has never been in place to support the decision to leave the wastes permanently buried at the MWL or to measure the body burden that the public has already had to assume and will assume for the future.

An issue of environmental justice arises from the lack of concern for monitoring and controlling past, present and future exposure of these communities.

There was never a proper characterization of the wastes at the Mixed Waste Landfill. There has not been adequate soil gas monitoring nor has an adequate well monitoring network existed at the MWL. The characterization of the wastes by Sandia only recognized the 100,000 cu ft of radioactivity above 6,500 Ci. The CEARP performed actually recognized over 700,000 cu ft of radioactive and hazardous wastes in the dump and 100,000 cu ft was later assigned to the radioactive portion of the wastes.

The dangerous wastes were disposed of in a manner that would not be allowed today. There is the possibility for powerful synergistic chemical reactions and increased mobility of radioactive materials that was and is not considered. It is known from studies in the state of New York that landfill gases in ordinary municipal dumps can travel underground distances greater than 1500 ft. Radon gas has never been characterized in the vadose zone beneath the MWL and is not planned for characterization in the present soil sampling plan.

The large amounts and locations of various types of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and heavy metals placed in the MWL are not known. So there is an increased need for careful and continuous monitoring.

The variety and amounts of wastes and the emplacement in different pits and trenches, make it extremely unlikely that the MWL is a homogeneous emitter. The current Sandia sampling analysis plan fails to consider:

- the differences in types and emission rates that may exist for the individual pits and trenches and for the different locations within the trenches themselves;
- monitoring the hot spots that were discovered for tritium (See attached figure 2-1 and compare with tritium hot spot locations in Fiure 4.25);

- the southeast corner of the MWL has an acid pit that has no planned monitoring;
- the landfill gases may travel toward the eastern boundary of the MWL and no monitoring is planned for this pathway;
- NMED Comment 60 Phase 2 RFI- Vapor-phase transport to groundwater was not considered for tritium
- NMED Comment 61 Phase 2 RFI- Active soil-gas sampling was limited to a maximum depth of 30 ft. Generally soil-gas concentrations increased with depth. NMED recognized that soil gas sampling was not done to a sufficient depth but the SAP presently still only plans a depth of 30 ft.
- NMED Comment 64 Phase 2 RFI- Tritium concentrations in sediment samples from the MW4 borehole at depths below the water table exceed the local background level for tritium. NMED should recognize that the planned testing for tritium at 30 ft also does not go deeply enough.
- Real time detection beneath the MWL is necessary below all trenches and pits and at the boundary of the MWL for the vadose zone because there is no liner.

The characterization of the wastes at the MWL has never been adequate for monitoring of the air pathway. The Phase 2 2 RCRA Facility Investigation (RFI) (p.4-1) states "The MWL is considered the most significant diffuse radiological source at SNL, NM." The Phase 2 RFI Work Plan identified the MWL "with a high potential for contaminant release through both the soil and/or surface water pathways." (p. 4-1). "Individuals or populations may be exposed to contaminants through inhalation of air contaminated with vapors or particulates. … Tritium is presently being mobilized from the MWL in the vapor phase, with a maximum flux of 6,120 pCi/m^2/hr measured east of the classified area during the summer of 1992. This vapor-phase tritium is highly mobile and may be transported through the air pathway offsite. Tritium may also be taken up by plants and then dispersed. Other radionuclides may be adsorbed to soil particles which may be blown into population areas." (P. 2-59, 2.4.2.1).

In the NMED Comments to the DOE/SML/NM MWL RFI Phase 2 Report (p.2, para 7) there is the recognition that the radioactive/mixed waste in pits SP-4, SP-35 and SP-36 had high levels of radiation and "could be removed and disposed of elsewhere, <u>in accordance with applicable regulatory requirements</u>." So, if these requirements existed, why didn't Sandia follow them and why hasn't the NMED enforced them? Were these pits opened and backfilled with concrete or dirt that was compacted?

The April 29, 2004 Consent Order between Sandia and NMED requires vadose zone monitoring that is in compliance with the RCRA Groundwater Monitoring: Draft Technical Guidance, Nov. 1992 and 40 CFR § 264.98.

RCRA Groundwater Monitoring: Draft Technical Guidance, Nov. 1992-- 5.1.2.4 Vadose Zone Monitoring -- At some sites where the potentiometric surface or water table is considerably below the ground surface, contaminants may migrate in the vadose zone for long distances or for long periods of time before they reach ground water. At other sites, the potential may exist for contaminants to migrate laterally beyond the downgradient extent of the monitoring well network along low hydraulic conductivity layers within the vadose zone. A vadose zone monitoring system may be necessary in these and other cases to detect any release(s) [aka – soil gas] from the hazardous waste management area before significant environmental contamination has occurred. Leachate released to the vadose zone, for example, may be detected and sampled using tensiometers. The use of vadose zone monitoring equipment can potentially save the owner/operator considerable expense by alerting him or her to the need for corrective action before large volumes of the subsurface have been contaminated.

The Agency recommends unsaturated zone monitoring where it would aid in detecting early migration of contaminants into ground water. The Regional Administrator also can require this monitoring on a case-by-case basis as necessary to protect human health and the environment under §§3004(u) and 3005(c). The elements, applications, and limitations of a vadose zone monitoring program are provided by Wilson (1980) and USEPA (1986b).
Moreover, the Agency is currently updating its existing guidance on vadose zone monitoring.

40 CFR § 264.98 Detection monitoring program.

An owner or operator required to establish a detection monitoring program under this subpart must, at a minimum, discharge the following responsibilities:

(a) The owner or operator must monitor for indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogen), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous constituents in ground water. The Regional Administrator will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors:

(1) The types, quantities, and concentrations of constituents in wastes managed at the regulated unit;

(2) The mobility, stability, and persistance of waste constituents or their reaction products in the unsaturated zone beneath the waste management area; …"

The vadose zone monitoring required under RCRA does not exist. This SAP does not address this non-compliance.

The proposed long-term monitoring for the MWL also does not meet RCRA long-term monitoring requirements nor DOE Order 450.1 and 435.1 requirements.

Soil-gas monitoring from beneath the dump through the vadose zone down to the uppermost aquifer needs to be accomplished for the MWL.

The vadose zone has not been monitored as it should have been prior to the decision to permanently dispose of long lived radioactive and hazardous wastes above the aquifer with potential to also enter the air pathway.

The absence of a liner beneath the MWL requires comprehensive vadose zone monitoring ***now***, and not after the dirt cover has been installed.

Newer technologies are available and were developed at Sandia Laboratories to characterize and monitor the releases from hazardous environments such as the MWL. Why hasn't Sandia applied these technologies at the MWL?

An article by Irwin and Brouillard[2] describes the technological design of a new landfill at SANDIA to protect groundwater. The article describes the liner and detection systems installed beneath the trench for real-time monitoring of remediated wastes disposed of in a large trench. One realizes just how deficient the characterization and monitoring at the MWL is by comparison:

> "Sandia National Laboratories in Albuquerque, New Mexico, operates a Corrective Action Management Unit (CAMU) for the DOE. The CAMU containment cell has a capacity to permanently store up to one million cubic feet of treated soil. The containment cell is situated approximately 500 feet above groundwater in a region with low rainfall and infiltration. These site conditions required a unique approach to monitoring cell integrity and protecting groundwater. **To satisfy RCRA groundwater monitoring requirements**, a Vadose Zone Monitoring System (VZMS) for detecting leaks was incorporated into the containment cell design. One component of the VZMS, the Primary Subliner (PSL) monitoring subsystem, utilizes the containment cell subliner to focus potential leakage into five longitudinal trenches, which are filled with a wicking material surrounding vitrified clay piping. The vitrified clay piping provides access for neutron probes to measure soil moisture content directly under the containment cell. The other component of the VZMS, the Vertical Sensor Array (VSA), consists of 22 time-domain reflectometers that provide a backup to the PSL. These two vadose zone monitoring subsystems allow for real-time leak detection, as well as long-term assessment and assurance of containment cell performance." (Emphasis supplied).
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> ... "Vadose zone monitoring of the CAMU containment cell was accepted by EPA Region VI regulators because of its high probability for early detection of leakage if it were to occur, as well as enabling timely implementation of a corrective action to mitigate the possibility of any impacts to groundwater."

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[2] *Real-Time Monitoring Capability for Performance Assessment*
Corrective Action Management Unit Containment Cell
*Sandia National Laboratories, New Mexico,*Michael J. Irwin1, Lee A. Brouillard

Given the longevity of the MWL wastes containing greater-than-Class C transuranics, the dump will remain a toxic time bomb of waste for at least the next 100,000 years.

With the recent compaction performed at the dump for subgrade construction that may have caused unmonitored releases and future releases, a permanent soil gas monitoring network needs to be done for the long-term. In addition, a long term well monitoring network needs to be installed. (See, 40 CFR 265.121 and 63 FR 56710).

Horizontal drilling methods developed by Sandia National Laboratories could be used beneath the MWL. This method would be especially indicated since the compaction and rupture of containers at the MWL. The technique was used at Rocky Flats and touted as being a cost effective method for characterization.
http://rockyflats.apps.em.doe.gov/references/145-Side_Drill_Detect_Under_Bldgs.pdf
"Horizontal Directional Drilling and Environmental Measurement While Drilling (HDD/EMWD) allows remote characterization of the soil. The system provides testing for suspected underground contamination from a distance. It also provides the immediate production of data on what contamination there may be and where it may be found. Conventional vertical drilling methods used previously required workers to stand directly above the borehole. Potentially contaminated soil was brought to the surface where it could become a hazard to workers and the environment."

A patented inside-out well design from the United States Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL) accommodates simultaneous gas sampling and groundwater sampling as well as remediation in the same bore hole - a trick that until now required multiple wells or complex well-within-a-well solutions. The technology is used to monitor volatile organic compounds (VOCs) at INEEL, Sandia National Laboratory, Los Alamos National Laboratory, NASA White Sands, and Tucson Airport. This technology should be given consideration for use at the Sandia MWL. Sandia National Laboratory is currently using the INEEL technology in six vapor-extraction wells ranging from 140 to 486 ft. deep at the 2-ac. chemical-waste landfill. http://www.erosioncontrol.com/msw_0103_inside.html
The MWL is not properly designed to meet RCRA regulations in effect for vadose zone monitoring for early leak detection at the MWL.

Soil-gas monitoring from beneath the dump through the vadose zone down to the uppermost aquifer needs to be accomplished for the MWL.

The need for monitoring radon emissions is now recognized after the Phase 2 RFI has been completed. The NOD specifically cites radon emissions from sources that have not been contemplated by the Fate and Transport model. A large number of wastes that produce radon emissions in the dump were ignored. Sandia now plans only to do that monitoring after the soil cover has been installed. The radon monitoring should be performed before soil cover installation for characterization of the vadose zone beneath the dump and possible remediation if necessary to protect the public and environment.

A public meeting should be held for the deficiencies of the Fate and Transport Model. Citizen Action considers the published Fate and Transport Model as lacking any predictive value for release of contaminants from the MWL and cannot be salvaged. The Fate and Transport Model failed to predict the chromium and nickel groundwater contamination.

In an article by Shlomo P. Neuman[3] regarding mathematical models for DOE legacy waste sites, he states:

> "The tendency has been to rely on models at the expense of detailed site investigations, site monitoring, and field experimentation. In fact, models have often been used to "demonstrate" that additional site or experimental data would be of little value for a project. The reasons for this state of affairs are easily identified as regulatory and budgetary pressures.
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> "It is often tempting to 'demonstrate' by means of a model that a given waste disposal or remedial option is safe, or that additional site data would be of little value, by basing the model on assumptions, parameters and inputs that favor a predetermined outcome."

The characterization of contamination along the storm run-off pathway has not been performed in a meaningful way. Samples are only collected at the four corner locations of the MWL. There has been no study of the topography away from the MWL site to map the storm runoff pathways. Instead there has been blind sampling at the four corners of the MWL.

There is no data on the current levels of biological uptake and dispersion that is currently existing in the vicinity of or at a distance from the MWL.[4]

CONCLUSION

- The soil-gas sampling plan must perform comprehensive soil-gas characterization to identify where long term monitoring is required.
- Measurements need to be made over and under the areas where there has been compaction.
- Soil Gas Plan needs to address monitoring presently and for the long-term in the unsaturated zone. A phased approach over several years should be performed in which the soil-gas sampling plan is the start for installing the permanent network for long-term monitoring of soil gas and groundwater.
- Since Sandia plans to dispose of the wastes in unlined pits and trenches without the protections provided for by an engineered landfill with a liner and leachate

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3 *National Academies Press* - **"Long-Term Institutional Management of U.S. Department of Energy Legacy Waste Sites (2000), Appendix G – "Mathematical Models Used for Site Closure Decisions"** ***by Shlomo P. Neuman and Benjamin Ross***

4 T. E. Hakonson, 2/15/02, *Review of Sandia National Laboratories/New Mexico Evapotranspiration Cap Closure Plans for the Mixed Waste Landfill.*

collection, long-term monitoring of the wastes must be provided prior to soil cover installation.

- A comprehensive soil sampling plan will also identify important locations for placement of long term monitoring wells.
- Extraction and treatment of soil gases should be anticipated and may be necessary.
- Radon gas monitoring in the vadose zone and in the air above the MWL should be performed now.
- The minimum number of monitoring points will be greater than 100 sampling ports in 3 dimensions.
- The Fate and Transport Model should have a public hearing for its deficiencies.
- Characterization of contamination along the storm run-off pathway should be performed.
- A Risk Assessment Study needs to be performed after proper characterization of the soil-gas pathway, the groundwater pathway and the surface run-off pathway have been completed.

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