

**STATE OF NEW MEXICO
BEFORE THE SECRETARY OF ENVIRONMENT**

IN THE MATTER OF REQUEST FOR A CLASS
3 PERMIT MODIFICATION FOR CORRECTIVE
MEASURES FOR THE MIXED WASTE LANDFILL No. HWB 04-11(M)
SANDIA NATIONAL LABORATORIES
BERNALILLO COUNTY, NEW MEXICO
EPA ID NO. NM5890110518

**HEARING OFFICER'S REPORT,
PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW**

INTRODUCTION

To a certain extent, the creation, operation and closure of any landfill involves a good deal of faith. Particularly when dealing with a landfill that predates environmental regulation, one rarely can determine exactly what went into the landfill, how its contents are reacting, or how it will behave in the future. This necessarily results in uncertainty about how best to regulate it. When considering a mixed waste landfill, such as the one involved in this matter, the stakes are very high: there is no disagreement that hazardous and radioactive materials went into this landfill, which sits over a portion of Albuquerque's drinking water supply and is not far from residences. Thus, any decisions regarding the landfill must err on the side of protection of human health and the environment, to ensure the landfill does not now or in the future threaten the people of Albuquerque and their water supply. The difficulty is that the parties and members of the public disagree passionately about how best to do this, and all bring a phalanx of experts, regulations and science to support their position.

I heard this matter December 2-3 and 8-9, 2004 in Albuquerque, New Mexico, and conducted the hearing in accordance with 20.1.4 NMAC. Montgomery & Andrews, P.A. by Louis W. Rose and Jeffrey Wechsler, and Michele A. Reynolds of the US

Department of Energy and Amy J. Blumberg of Sandia Corporation represented Sandia Corporation and the Department of Energy ("Sandia"). Sandia's numerous witnesses are listed and their testimony summarized herein. Tannis Fox of the Office of General Counsel represented the Hazardous Waste Bureau of the New Mexico Environment Department ("NMED"), whose witnesses and testimony are described later in this Report. Citizen Action was not represented by counsel, but appeared through its representative Sue Dayton and witness W. Paul Robinson; Citizen's Action's witnesses and testimony are summarized herein as well. Dr. H. Eric Nuttall and Dr. Abbas Ghassemi for WERC: A Consortium for Environmental Education and Technology Development ("WERC") represented themselves and presented testimony, summarized below. All parties had submitted notices of intent to present technical testimony. Additionally, the hearing was well-attended by members of the public, many of whom spoke about the landfill and the proper remedy for it; these, too are listed below. Throughout the hearing, translation into Spanish was available simultaneously, and interpreters announced this in Spanish numerous times during the hearing.

Sandia seeks to modify the hazardous waste permit for Sandia National Laboratories ("SNL") to:

- 1) incorporate their Corrective Measures Study ("CMS");
- 2) approve a remedy for the landfill, which Sandia suggests should be a Vegetative Soil Cover; and
- 3) provide a schedule for additional steps in the development of the remedy (submit a Corrective Measures Implementation Plan, Corrective Measures

Implementation Report and Progress Reports, and a Long-Term Maintenance and Monitoring Plan).

NMED agrees that the Corrective Measures Study should be approved and incorporated into the permit, but supports a different remedy: a Vegetative Soil Cover with Bio-Intrusion Barrier. Citizen Action does not believe the Corrective Measures Study should be approved, suggesting it is incomplete and inaccurate, and asserts that the only appropriate remedy is future excavation of the landfill with treatment and appropriate disposal of its wastes. Dr. Nuttall takes issue with some of the scientific studies supporting SNL's and NMED's conclusions, and therefore opposes granting of the proposed permit modification. WERC is neutral regarding the granting of the permit modification.

The administrative record in this matter is extensive (27 volumes) and includes, *inter alia*, the application for permit modification with extensive attachments, SNL's Phase 1 and Phase 2 RCRA Facility Investigation Reports ("RFI") and Corrective Measures Study, numerous reports and studies, many postcards submitted by members of the public on the appropriate remedy for the landfill, the public notice, pre-hearing motions and orders, the transcript and exhibits, post-hearing submittals from the parties and this Report.

APPLICABLE LAW

The applicable laws governing this matter are the Hazardous Waste Act, Section 74-4-1 et seq. NMSA 1978, the Environmental Improvement Act, Section 74-4-1 et seq. NMSA 1978, the Department of the Environment Act, Section 9-7A-1 et seq. NMSA 1978 and the regulations promulgated pursuant to those laws, including the New

Mexico Hazardous Waste Management Regulations, 20.4.1 NMAC and the Environment Department Permit Procedures ("Procedures"), 20.1.4 NMAC et seq.

SUMMARY OF TESTIMONY

A brief description of the testimony follows. I took testimony from the public several times a day during each day of the hearing, at times as requested by the public, to ensure that everyone had a full and fair opportunity to speak. The parties and public cooperated well in coordinating testimony, and allowed speakers from the parties and the public to testify out of order if required by time or travel restraints. In this Report, testimony is group according to position, rather than by chronological presentation.

For the Permit Holder, SNL

John Gould, of the Department of Energy ("DOE") first testified generally about the inventory of the contents of the landfill, the more than 10 years SNL has spent studying and characterizing the contents, and the considerations Sandia used in selecting a remedy of a vegetative soil cover. TR 33-40. Richard E. Fate of SNL gave background on the landfill: it operated from 1959 to 1988, and is 1 of 268 sites (of which 5 are landfills) on which Sandia's Environmental Restoration Project is working. He explained that the landfill itself, about 2.6 acres, contains 2 basic areas: 1) the classified area in the northeast portion of the landfill, typically contains pits about 10 feet in diameter and up to 25 feet deep that were each covered by a steel cap with a trap door and once closed, covered with a concrete cap about 12 feet by 12 feet by 6 inches; 2) the unclassified area, which contains trenches about 135 feet long, 35 feet wide and 15 feet deep, that were backfilled about once a quarter as they were being filled. TR 40-48.

Timothy J. Goering of GRAM, Incorporated, a contractor who has worked with SNL's Environmental Restoration Program on this landfill for about 12 years, gave more details about the landfill and its contents. Mr. Goering first described air sampling done in 1992, that showed no radionuclides above any air standards, with the vast majority being nondetect for plutonium. TR 53-60. Mr. Goering next discussed sampling programs performed at the landfill for the Phase 1 and Phase 2 RFIs, and levels of tritium and tritium flux detected. He described boreholes drilled in 1969, 1979, 1981, and 1982 and surface soil samples taken in 1982. These results showed tritium in surface and subsurface soils. In the Phase 1 RFI, soil sampling showed tritium at depths of 110 feet, where groundwater is nearly 500 feet below the surface. Mr. Goering's testimony indicated that a number of other volatile organic compounds ("VOCs") and semi-volatile organic compounds ("SVOCs") had been detected in subsurface soils, all orders of magnitude below any EPA action levels. Target levels of metals were within background levels. TR 59-65.

SNL's Phase 2 RFI (1992-1996) included geophysical surveys that determined that no wastes had been buried outside the landfill perimeter fence. The passive and intrusive soil-gas surveys showed, again, tritium in surface soils, with the highest concentrations in the classified area near Pit 33 (the pit where the largest quantity of tritium was disposed of), with concentrations decreasing in concentric circles moving away from this area. SNL detected tritium in surface soils outside the landfill fence to the east and to the north, up to a distance of approximately 100 feet. TR-66-78. In the southern half of the classified area, SNL had an Interim Storage Site ("ISS") that operated between 1989 and 1996, where contamination above background of

Uranium-238, Plutonium-238 and Plutonium-239 was detected in soils. Follow-up sampling in 2001 confirmed low levels of plutonium in surface soils, but found only Plutonium-238 (no Plutonium-239 or Plutonium-240); no plutonium was found in subsurface soils. Mr. Goering testified that the most likely explanations for this plutonium are activities conducted at the ISS (either residual contamination on drums buried there, or a spill that was not entirely cleaned up), not the mixed waste landfill. TR 79-85, 105.

Again, the Phase 2 RFI surveys also detected low levels of VOCs and SVOCs, orders of magnitude below EPA action levels. The results indicated tritium in subsurface soils to depths of 120 feet, with highest levels below the classified area. The only metal above regulatory action levels was beryllium, which occurs naturally and does not originate from the landfill, according to Mr. Goering.

Mr. Goering next described the hydrogeology at the landfill site, noting that depth to groundwater varies between 468 to 495 feet below surface, flowing toward the west, with low hydraulic conductivity (0.17 feet per year) in shallower wells due to tight materials in the formations, and higher in deeper wells (18.5 feet per year). SNL has sampled groundwater since 1989, at first quarterly, then reduced to semiannually as they detected no evidence of contamination. Currently, SNL samples annually. TR 98-101.

Referring to a study by Baskaran on uranium ratios in groundwater, Mr. Goering noted that SNL's January 2001 studies of groundwater samples showed exactly the uranium ratios predicted, indicating that uranium occurs naturally in the groundwater at the mixed waste landfill, as it does throughout the Albuquerque Basin (not as a result of

disposal of wastes at the landfill). Mr. Goering indicated that SNL believes that earlier different ratios are attributable to less accurate data and analyses methods. TR 96-97.

SNL has occasionally detected radionuclides in groundwater sampling that he believes are false positives. Tritium has been detected in 11 of 240 analyses, Strontium-90 at the rate of 8 of 121 samples, and plutonium-239 in 1 of 134 samples; these were mostly detected in early sampling. Since 1995, tritium has only been detected once. SNL asserts that detection and analytical technique have improved since the early detection of radionuclides, which SNL believes represent false positives rather than valid true measurements, as the detections were not repeated consistently. TR 98-99. Nickel and chromium were only detected in wells with stainless steel screens as a result of rust, and toluene was only detected in a well with a defective packer containing toluene. TR 99-100. Mr. Goering and Sandia assert that there is no evidence of groundwater contamination from the mixed waste landfill. TR 100.

Mr. Goering also outlined and described Sandia's environmental surveys of vegetation, which showed very low levels of tritium in vegetation above background levels, particularly in the northeast corner of the landfill. A special ecological study in 1997 indicated that tritium is also elevated in the tissue of mice collected from the mixed waste landfill. TR 102-04.

Next, Dick Fate continued testifying about how wastes were disposed of in the landfill. A group of health physicists received wastes, checked a form that summarized the contaminants and packaged the wastes (often in two layers of plastic bags or in drums). Liquids were evaporated from wastes or solidified, and employees at the time have indicated no liquid wastes went into the landfill. A few records from the landfill

stated that liquids were put in the landfill, written in the mid to late 1970s and the 1990s, but Sandia now asserts that these records are not correct and that liquid wastes were not put into the landfill. TR 108-12. Mr. Fate also asserted that Sandia has a good inventory of the contents of the landfill, based on a large body of historical records, photographic records, interviews with former employees and the characterization results, all of which support each other. TR 112-14. For approximately 3 hours, Richard Kilbury of NMED studied Sandia's inventory records for the landfill, and traced randomly-selected disposal records from the late 1950s to 1989 to the current unclassified waste disposal sheets. Mr. Kilbury was able to successfully trace all 36 records he targeted, gaining confidence in the published inventory and that all classified waste was in fact contained in the unclassified inventory (without specific names of the project names and places or weapon numbers). NMED Exhibit 15. On cross and re-direct, Mssrs. Fate and Peace testified that several earlier memos Sandia had produced were incorrect, and that later data, interviews and NMED analysis all concluded that no high-level waste was placed in the landfill. TR 424-53.

Mark Miller, a health physicist employed at SNL, discussed the half lives of several of the components of the landfill. TR 120-22. He noted that tritium is a major contaminant at the landfill and is the most mobile, resulting in its rapid decay. Sandia calculated doses from landfill sources for on-site workers and to residents of Zia Park housing, that were far lower than the background radiological dose in Albuquerque of 360 millirems per year. TR 122-24.

Mike Nagy, a SNL contractor for risk management, testified about the risk assessment in Sandia's Corrective Measures Study, which was based on NMED and

EPA guidance and calculated for both human and ecological receptors. The risk assessment was similar to those performed for other sites at Sandia National Labs. The primary purpose of the CMS risk assessment was to calculate the relative risk of the various remedial alternatives, to use as a criteria for selecting a remedy. Both industrial and residential risks were evaluated, and pathways evaluated included ingestion (including home-grown produce) and inhalation. SNL used a DOE-approved computer code, RESRAD for the evaluation, with input parameters negotiated with NMED. Ecological receptors selected were a generic plant, a deer mouse and the burrowing owl. TR 126-29.

Jerry L. Peace, a SNL geologist, geophysicist and civil engineer, testified about the Corrective Measures Study Final Report dated May 2003 ("CMS"). The CMS identified and screened 16 remedial technologies, of which 4 were selected for detailed evaluation. Peace showed a schematic of a general vegetative soil cover and described its layers. SNL developed corrective action objectives for the CMS: to minimize exposure to site workers, the public and wildlife; to limit migration of contaminants to groundwater; to minimize biological intrusion into buried waste; and to prevent or limit human intrusion. The CMS used 5 general corrective measures families: no further action ("NFA"); institutional controls (signs, fences, monuments, security patrols and maintenance of the site); containment and engineering controls (such as a RCRA Subtitle C cap or alternative covers); stabilization in-situ treatment (like in-situ vitrification); and present or future excavation, storage, treatment and disposal.

Screening criteria for preferred technologies were: responsiveness to at least one corrective action objective; implementability; and performance. 8 technologies were screened: the vegetative soil cover; a RCRA Subtitle C cap; a bio-intrusion barrier as a stand-alone unit and incorporated into a vegetative soil cover and a RCRA Subtitle C cap; complete excavation with aboveground retrievable storage; complete excavation with off-site storage; partial excavation with off-site disposal; and future excavation. 4 of these failed screening. Structural barriers failed due to poor performance and susceptibility to weathering and cracking. Containment cells failed due to unknown performance and inability to confirm barrier continuity. In-situ vitrification failed as not implementable due to the heterogeneity of the waste at the landfill and other factors. In-situ grouting or chemical fixation failed due to unknown performance and difficulty of confirmation. TR 131-137.

4 technologies were found suitable for the site: NFA with institutional controls, a vegetative soil cover, a vegetative soil cover with bio-intrusion barrier and future excavation. At the request of the public and WERC, complete excavation with off-site disposal was also evaluated, although it had failed the previous evaluation criteria. After further evaluation and cost estimates, Sandia recommended a vegetative soil cover as the preferred alternative for the following reasons: covers are the EPA presumptive remedy for CERCLA and RCRA facilities; a soil cover will minimize water infiltration and drainage with minimum maintenance required; a soil cover emulates the natural site characteristics and will support native vegetation indefinitely; the remedy is cost effective, minimizes risk to site workers and the public. Mr. Peace also described

vadose zone boreholes in place and used to monitor moisture content of soil. TR 138-41.

Mr. Fate testified about NMED's selection of a bio-intrusion barrier, noting several disadvantages. One disadvantage is that there is no long-term performance data, so its effectiveness in reducing bio-intrusion is not really known. It also is more expensive to construct as it is bigger than a cover without such a barrier, and its maintenance costs are higher.

Mr. Miller also testified that the nearest residence to the landfill is the Zia Park Housing development, that is approximately 4 miles from the landfill, on Kirtland Air Force Base. TR 391.

Independent Witnesses: Dr. Eric Nuttall and Dr. Abbas Ghassemi for WERC

Although Dr. Nuttall filed for party status and testified as an independent individual, he possesses substantial scientific expertise: he's been a faculty member for 30 years at UNM's Department of Chemical and Nuclear Engineering, has 3 degrees (including a Ph.D) in chemical engineering and a minor in nuclear engineering. He has more than 200 publications and has extensive experience with uranium and nuclear waste sites and remediation technology. He served on the first peer review panel of WERC: A Consortium for Environmental Education and Technology Development, that reviewed the mixed waste landfill. Dr. Nuttall highlighted recommendation 4 of the second WERC peer review panel, from its report dated January 31, 2003, that an integral numerical "fate and transport" model be developed for the landfill. The panel found it "regrettable" that such a model had not yet been developed. As Dr. Nuttall described it, this is critical to understanding the behavior of the entire system of the

landfill, and that without such a model, it is not possible to predict how the landfill will behave in the future or what risks it presents. TR 146-49.

Dr. Nuttall also noted that the material in the landfill will be there for "a very long time," although some of its constituents will degrade over time. However, SNL has not been able to provide any data on the status of how much of different materials in the landfill (tritium, cobalt) have been released to soil or is releaseable to soil, or how they will be transported through soil over time. He noted that several of Sandia's landfills have leaked to groundwater, so the risk is real. The type of model recommended by the panel has been developed at other repositories, including WIPP and Yucca Mountain, and he thinks the mixed waste landfill is a significant enough site to merit similar study. He noted that the results of the model would be most useful in the process of selecting and designing the remedy, but that it could be run and used at any time. He felt it would be important to continue to use a comprehensive model to study the landfill as future monitoring results come in, to understand what is happening as material buried in the landfill is released and as it gets wet. On cross-examination, Dr. Nuttall agreed that groundwater monitoring data for the landfill does not show evidence of contamination beneath the landfill. TR 149-58 However, he pointed out that what has not been quantified is the status of the various containers and cannisters in the landfill (plastic bags, 55-gallon drums), how they will decay and break down in the future, releasing radioactive and hazardous materials, and how those materials will behave and move in the subsurface. He emphasized that since the landfill site is not completely dry, anything placed in it could become mobile in the future once the container it is in is

breached, as all containers will eventually. TR 158-71. A sophisticated and complex model can and should be used to help understand these issues. TR 171-77.

Dr. Ghassemi, executive director of WERC since 1999, testified for WERC as a neutral independent party witness. He has a Ph.D., MS and BS in Chemical Engineering, and has written more than 75 articles and papers on waste management and related topics. WERC is a consortium of New Mexico universities, asked by the US Congress to perform an independent peer review of the performance of the SNL mixed waste landfill. The purpose of the review was to have an independent group of technical experts assess the documents and the validity of the assumptions used by the Department of Energy ("DOE") in evaluating the landfill's performance and safety. WERC's first report (2001), prepared by experts from New Mexico universities, suggested a comprehensive study evaluating options for the landfill. The later follow-up report (2003), by experts from universities around the country, reviewed the draft CMS (as the final was not yet completed). Dr. Nuttall served on the first panel, but not the second. The second panel was impressed with the quality of the work that Sandia staff and technical staff had used in preparing the CMS, and noted clearly that current removal of the buried waste at the landfill presents a high degree of risk to the environment and to on- and off-site human population. TR 183-88. Dr. Ghassemi noted on cross that he had heard in SNL's testimony that SNL had collected additional data that the panels had recommended, including additional inventory information and studies of long-term impacts on health and the environment with continuous monitoring.

Members of the Public

Carl White, individually and for the Albuquerque-Bernalillo County Groundwater Protection Advisory Board, recommended excavating the landfill in the future when radiation levels were acceptable for remediation activities. He presented a letter from the Board dated April 12, 2001 sent to the Environment Department with that recommendation. TR 86-89.

Dorie Bunting testified that Sandia should excavate and remove the waste, to safeguard the health and safety of Albuquerque. TR 179-80. Mallery Downs, a registered nurse and president-elect of the NM Public Health Association, also advocated removal of wastes from the landfill to protect public health. TR 181-82. Floy Barrett, a resident of Albuquerque for 35 years, testified that the only way to ensure that the mixed waste landfill never releases toxic substances into the environment is to excavate it, noting that this was done at the chemical site at Sandia without any incident or reported injury to workers. TR 263-64. Sue Chavez referred to other DOE sites that have contaminated groundwater and the environment, and asserted that the landfill should be excavated with proper disposal of wastes to ensure this does not happen at the mixed waste landfill. TR 280-85.

Ellen Robinson testified on behalf of the Gray Panthers of Greater Albuquerque, asking for a "real cleanup" of the landfill. TR 286-87. David Robinson, for the Albuquerque Unitarian and Universalist Fellowship, also expressed his concern that radioactive and toxic constituents from the landfill will eventually percolate to groundwater. TR 287-89. Martin Zehr, who has worked with the Middle Rio Grande Water Assembly and the Urban Users and Economic Development Constituency Group,

urged that we not take chances that the landfill could contaminate precious groundwater. TR 290-94. Steven Dapra, on the other hand, stated that there is no need to excavate the landfill, but it needed additional fill dirt to prevent ponding, native grasses and continued monitoring. TR 294-95.

Matthew Lasek alleged that DOE has changed its estimates of the costs of cleaning up the landfill, and that DOE cannot be relied on to do the right thing in preventing contamination from the landfill. TR 354-57. Marla Painter, a political organizer with 30 years of advocacy work on environmental impacts of DOE's activity, also asserted that DOE cannot be trusted, and warned against covering the landfill, with no bond to ensure later remediation of the wastes if needed. TR 357-64.

Peter Neils, of Citizen Action, submitted postcards for the record with comments from citizens supporting excavation as the remedy for the landfill. Throughout the course of the hearing, a total of approximately 350 postcards were submitted and are exhibits to the transcript. Mr. Neils also testified that he strongly believes the landfill should be excavated and the site restored to its natural condition. TR 492-505. Mark Ruud of the Mountainview Neighborhood pointed out that the cost of excavating the landfill should be considered part of the development of nuclear weapons, and he wants the landfill excavated. TR 505-10. Robin Seydel urged the Secretary to think about cleaning up the landfill in the long-term, rather than capping it. TR 510-15. Mary White, a retired DOE employee, pointed out that a lot of data for other DOE sites is located in repositories around the country, and could help provide precedents for cleaning up this landfill. TR 516-21. Hildegard Adams, a retired teacher, also urged the Secretary to require cleanup, not covering, of the landfill. TR 523-25. Julia Stephens, Director of the

Rio Grande Community Development Corporation and community coordinator for the South Valley Partners for Environmental Justice, submitted a statement for the record, encouraging a closure plan for the landfill. TR 527-531.

Frank Titus, a hydrogeologist since 1956 who for 6 years was manager of hydrology for the Uranium Mill Tailings Remedial Action Program, stated that he believes the landfill has been well-studied and assessed, and poses little hazard staying where it is, although he acknowledged that he generally testifies as an environmentalist and is not a big fan of DOE. TR 531-40. Conversely, Charlie O'Dowd made clear that he does not trust DOE or Sandia, and wants the landfill excavated. TR 540-46.

Cecilia Chavez, who spoke in Spanish through simultaneous translation, encouraged Sandia to set a positive precedent by cleaning up the landfill, rather than covering it. TR 630-32. Janet Greenwald, a coordinator for Citizens for Alternatives to Radioactive Dumping, challenged Sandia managers to prove their commitment to the future of Albuquerque and its citizens by cleaning up the landfill, to ensure it never contaminates groundwater. TR 632-35, 942-43. Seth Rainwater testified that in order to teach future generations about responsibility, we should require Sandia to clean up the landfill. TR 635-38. Sally-Alice Thompson, an 81-year old Albuquerque resident, encouraged the "pay as we go" approach, making Sandia cleanup the landfill, rather than leaving the future expense to future generations. Joan Brown, a Franciscan sister working in ecology ministry through the Office of Social Justice of the Catholic Archdiocese of Santa Fe, urged that we consider moral and ethical considerations in deciding the proper remedy for the landfill. TR 684-86.

Louella Wilburn recounted her history of multiple cancer diagnosis and treatment, as a result of growing up in Ely, Nevada, 175 miles north of the Nevada test site, and strongly recommended cleaning up the waste in the landfill to prevent future health threats. TR 722-25. Mark Doppke, conservation chair for the Sierra Club Rio Grande Chapter Central Group (of over 3,000 members), also urged erring on the side of precaution to clean up the landfill. TR 725-30. David Brugge, an anthropologist, reminded us that proposed monitoring for 100 years is not really very long, when considering the length of time humans now live. TC 837-39. Maureen Wright encouraged us to think about future generations in selecting a remedy for the landfill. TR 935-36. Silvana d'Ouille wants the "landfill mess" cleaned up. TR 936-38. Bob Press also encouraged the Secretary to consider future generations in ruling on the remedy for the landfill. TR 939-41.

Lilly Otto testified that she remains concerned that putting a cap on the landfill may not prevent contamination of the aquifer in the future, so she wants excavation. TR 1050-51. Lance Voss, who worked for NMED's Oversight Bureau, questioned the honesty, integrity and decision-making in the public process. TR 1051-59. Janet Harman testified that it's important to dig up and deal with the waste in the landfill. TR 1223-24. Jean Witherspoon of the Albuquerque-Bernalillo County Groundwater Protection Advisory Board read 6 recommendations from the Board that included allowing the landfill to be covered, with re-evaluation of the need for remediation every 5 years, and with Sandia providing financial assurance for any future activities, including maintaining institutional controls and remediation. She explained that this morning, the Board reaffirmed their original 2001 recommendations. TR 1322-25. Jeanne Pahls,

who taught near the Fernald plant and watched several young students die of cancer, stated that as long as the waste is in the ground, it has not been addressed properly. TR 1326-28.

Citizen Action

Citizen Action is a public interest group that advocates removal of waste from the landfill and closure of the landfill. Although the group was not represented by counsel, it appeared through its director, Susan Dayton, and W. Paul Robinson of Southwest Research and Information Center.

On behalf of Citizen Action, Erik Ringelberg, principal of Upstream Technologies, Inc., testified that Sandia should have used randomized samples and better quality assurance/quality control laboratories for its sampling program. TR 557-63. His assessment was that Sandia's RFI and CMS assume homogeneity in waste, but in fact one should expect randomized releases as it is unlikely the containers and bags in the landfill will all deteriorate at the same time. He did not agree with Goering's conclusions regarding false positives, and asserted Sandia should have done statistical analyses to determine which readings, if any, were false positives. On cross-examination, Ringelberg admitted he was not aware of follow-up sampling of toluene at the well with the damaged packer, of well-purging done before and after sampling. TR 687-90. He alleged that Sandia's cost projections for leaving the waste in place were artificially low, and artificially high for excavating. Even if too high, Sandia's estimates for excavating (\$545 million) are a "bargain" when compared to the \$208 million it cost to excavate 7,777 cubic yards in Pit 4 at INEEL. TR 584-95. On cross-examination, Mr. Ringelberg admitted he had not performed detailed cost-calculations that would be necessary to

truly compare INEEL and Sandia costs. TR 666-68. He also acknowledged that the sporadic levels of measurement of contaminants in groundwater monitoring wells at the landfill are more an "area of concern" than "a definitive indicator of something." TR 694-95.

Dr. Marvin Resnikoff is a senior associate at Radioactive Waste Management Associates, a national firm that provides consulting services in radioactive waste and radiation exposure. For almost 40 years, he has worked on many radioactive waste issues, including dry cask design, high-level nuclear waste transportation accident risks, radiation exposure reconstruction, and nuclear power plant decommissioning, dose reconstruction work for plaintiffs at Homestake Mill in New Mexico, reviewing fate and transport models for Brookhaven National Laboratory, and reviewing risk assessment studies of Los Alamos. His firm produced a book released in March 2005 on groundwater contamination at DOE facilities (not including SNL). TR 607-08.

The main points to which Dr. Resnikoff testified are: that Sandia should have provided a closure plan, not a Corrective Measures Study, that Sandia's risk assessment is inadequate, that NMED must demand a more thorough waste inventory, that a vegetation layer is not an appropriate closure action and that it (a vegetation layer) violates federal regulations, and that excavation at the landfill is needed to reduce risks to human health. TR 608-09. Not being an attorney or a RCRA expert, Dr. Resnikoff admitted to being confused as to which regulations applied to the landfill. TR 609-11. He argued that it is far more cost-efficient to prevent soil and groundwater contamination than to clean them up, and disagreed that Sandia's streamlined approach

is appropriate (because he asserted the landfill is not a low-risk facility, because gamma radiation rates are high).

In reviewing Sandia's risk assessment, Dr. Resnikoff was critical that it is based on present-day conditions, such as soil measurements from the Phase 2 report. Since Sandia only found tritium in soils, that was used in the risk assessment. However, as drums and containers degrade, other radiological contaminants will be released that were not considered. TR 613-14. Both Dr. Resnikoff and Mr. Ringelberg stated that they had not used, and were not familiar with, EPA guidance documents to evaluate Sandia's risk assessment TR 671-75. On re-direct, Dr. Resnikoff identified the EPA guidance document he had referred to, and acknowledged that they involved Superfund sites. TR 711-13.

Dr. Resnikoff agreed with Dr. Nuttall that a fate and transport model is needed, that would look at the containers in the landfill to see whether they will degrade over time and what will be released from them. He is particularly concerned about ion exchange resins, that are generally about 50% water, that could mobilize contamination in the future. He argued that the Phase 2 report and CMS report should have tried to estimate future leakage from containers in the landfill, to assess the risks from these to the environment and the public, and should have considered risks from organic, inorganic and radiological constituents documented in the landfill inventory. TR 613-15. However, on re-cross-examination, he acknowledged that the Department of Energy, rather than NMED, would regulate radioactive waste at the landfill. TR 719.

In later testimony, Dr. Resnikoff was critical of Sandia's use of the RESRAD program, as he stated that in his experience using the RESRAD program hundreds of

times, it requires a homogenized landfill (rather than the use of discrete data points). TR 615. He agreed with Ringelberg that when Sandia got measurements they thought were too high or in error, they did new measurements which were lower. Testing high samples until they are lower is not random, and underestimates the presence of contamination. TR 616-17.

Dr. Resnikoff testified about several sites (including Lake Ontario Ordnance Worksite in upstate New York, uranium mining sites in Elliott Lake, Canada, and Karnes, Texas) where institutional controls were lost within 30 years, allowing waste facilities to be breached and people to be exposed to radionuclides. He charged that institutional controls can not ensure that the public, such as inquisitive children, are not exposed to the landfill's contents. He has also noted what he believes is a trend of the government selling off former weapons facilities. So, Dr. Resnikoff alleged that the risk assessment should have considered risks to resident individuals after institutional controls are no longer in force. Last, he alleged that the risk assessment has failed to consider the synergistic effect of chemicals within the landfill mixing. TR 617-19.

Dr. Resinkoff strongly criticized Sandia for failing to assess disposal of liquids at the landfill. He noted Sandia documents that revealed that almost 19 million galls of liquids were put in at Technical Areas 3 and 5, that created a water mound that may have interacted with waste at the landfill. TR 619-20. On cross-examination, he agreed that the groundwater mound was not under the landfill, and he was not certain how close it is to the landfill or its waste. TR 664-65, 93-94.

At the Beatty, Nevada landfill site, Dr. Resnikoff pointed out that tritium has contaminated groundwater (357 feet below ground surface) and moved off-site within 35

years. More water was buried with radioactive waste at Beatty, about 700,000 gallons. But, he testified, the greatest amount of liquid is precipitation, about 37 million gallons, even though the site received only 6 inches of annual precipitation (less than in Albuquerque). Resnikoff asserted that Beatty provides an example of how the Sandia mixed waste landfill could contaminate groundwater, and suggested that the Beatty site had similar geologic and climatic characteristics to the Sandia landfill, as well as similarities in the types of waste disposed of and methods of disposal. TR 697-98. He also noted that the chemical waste landfill in Technical Area 3 has contaminated groundwater, as has the Lurance Canyon Burn site. TR 620-21.

Further, Dr. Resnikoff challenged Sandia's inventory and waste characterization. He charged that calling materials classified is a "smokescreen" to keep people from learning what really went into the landfill. He challenged NMED's review of classified records, which he believes conflicts with high gamma readings measured at the site that have never been adequately explained. TR 621-23.

Dr. Resnikoff alleged that the vegetative cover is not an appropriate corrective action for the landfill, since it could allow migration of waste constituents and exposure to the public. The vegetation layer will not prevent water that is already in the landfill from continuing to leach into the soil. He was skeptical that without watering or fertilizing the vegetative cover will not take root. TR 624-25.

Dr. Resnikoff urged the Secretary to select excavation as the remedy, at least for the long-lived and hazardous materials. He alleged this is the only way to reduce the risks. He acknowledged that a cover could be placed on the landfill and excavation could take place in the future. He, however, had no concerns that the landfill could be

excavated safely. TR 626-27. He recommended that a vadose monitoring system be put in place immediately, and should be used until excavation. He agreed with Ringelberg that Sandia had overestimated excavation costs. TR 627-28.

Last, he alleged that Sandia's preferred alternatives do not appear to be consistent with federal regulations. He charged that the proposal does not meet the requirements in 40 CFR 265.111, as it will not be completed within a reasonable period of time, will not minimize migration, and will require additional closure operations. TR 628. On cross-examination, Dr. Resnikoff acknowledged documents between NMED and Sandia (AR 98-021) agreeing that the landfill did not have to meet federal closure requirements, as long as Sandia demonstrated "equivalent" requirements. TR 660-63.

W. Paul Robinson also testified for Citizen Action. His resume is attached to Citizen Action's Notice of Intent. He testified that the proposed draft permit would not require any further efforts to investigate the extent of contamination at the landfill, the landfill's inventory, the decomposition of containers in the landfill, or options for retrieval in the future if additional releases occur. TR 733. He alleged that the draft permit does not require compliance with Sandia's permit, and fails to address long-term risks to groundwater. TR 733-34. The CMS and draft permit do not consider groundwater contamination at other SNL sites TR 734-35. Further, he alleged that the draft permit modification does not comply with applicable regulations, as it does not control the source of releases, and it does not accurately or comprehensively identify all potential sources of release. Instead, it relies on a CMS Report that focuses on releases already detected. TR 735-36. Additionally, the draft permit modification fails to propose a corrective measure that meets applicable waste management standards (including 40

CFR 264.111, incorporated into NM Hazardous Management Regulations), but simply covers the landfill, requires perpetual active maintenance, and leaves hazardous waste constituents in place. TR 736-37. On cross-examination, Mr. Robinson admitted he was not a legal expert in RCRA, and appeared somewhat confused about exactly which RCRA requirements applied to the site and remedy selection process. TR 867-71.

Robinson urged NMED to withdraw approval of the CMS Report, and that it require a financial guarantee from Sandia, based on a model such as the trust fund for the mixed waste landfill at Oak Ridge, TN, which DOE agreed to voluntarily. TR 738-40. Mr. Robinson completed a report titled, "Is Trust Us, We're the Government' Really a Guarantee?, a Review of Financial Assurance Options" dated June 18, 2002 that reviewed several other government sites where financial assurance mechanisms were used. He was concerned that if NMED were to order Sandia to excavate the site in the future, this might not be accomplished if no financial assurance mechanism has been required. Although RCRA does contain an exemption for the federal government for financial assurance requirements (40 CFR 264.140(c)), he noted several examples that have nonetheless been used, including: trust funds at closed uranium mill tailings disposal sites (UMTRCA); trust funds for RCRA closure and post-closure plans (and state oversight costs) for a mixed waste landfill at Oak Ridge, TN; financial assurance from non-governmental operators such as at the Waste Isolation Pilot Plant (WIPP) in New Mexico; and private operator corporate insurance, used by the Oregon Department of Environmental Quality for the Umatilla Chemical Weapons Depot. TR 816-24, 855-58, Citizen Action Exhibit 10, p. 1-2. On cross-examination, Mr. Robinson acknowledged that NMED may already be receiving funds to oversee compliance at

DOE facilities, TR 857-58, and that the Oak Ridge agreement occurred at a CERCLA site, not a RCRA one, TR 876-77.

Mr. Robinson criticized the proposed remedy as less protective of human health and the environment than those required for Sandia's chemical waste landfill and classified waste landfill. At the chemical waste landfill, that contained a similar mix of constituents, 53,000 cubic yards of soil and debris were excavated, taken to a corrective action management unit ("CAMU") for treatment or placed in a containment cell for long-term monitoring or disposal off-site. The classified waste landfill (which also contained similar constituents of concern) was excavated, separated and treated, and Sandia proposes to return the majority of the 50,000 cubic yards excavated to the site for backfill. TR 740-42.

Mr. Robinson was highly critical of the costs estimated in the CMS Report. He alleged that the estimates failed to include indirect costs, and are not supported by accurate data or based on actual corrective measures and closure experience at NML (such as the chemical waste landfill). TR 742-43. In Mr. Robinson's report dated March 30, 2004, he reviewed cost estimates in the CMS Report (which he alleged failed to provide reference material, citations or authors). The CMS Report references fail to identify any information from either the chemical waste landfill or the radioactive and hazardous waste facility. Further, he alleged that the highest costs for each of the excavation alternatives do not have specific or cited supporting cost data. TR 748-53, AR 04-037, Citizen Action Exhibit 10. Robinson cited Sandia reports that contradict cost information in the CMS, and which he alleged provide costs that are one-seventh to one-seventieth of costs estimated in the CMS. TR 754-56. He also criticized Sandia's

failure to include opportunity costs associated with what he termed “the failure of SNL to commit to excavation and clean closure” of the landfill. TR 758-61. In discussing cost estimates in the CMS, Robinson compared land values to those in North Albuquerque Acres, arguing that Sandia had substantially undervalued the landfill, and that lost opportunity costs were sacrificed to an inexpensive remedy. TR 827-31. Were Sandia to excavate the landfill, the lost opportunity costs of the buffer zone would not be necessary, as the buffer area could be developed. TR 848-50.

Mr. Robinson also compared voluntary corrective measures that Sandia took at the chemical waste landfill to those at the mixed waste landfill, which he alleged were far less extensive. TR 744-47. He noted that while tritium is a consistent finding and topic of discussion for the mixed waste landfill, other hazardous and radioactive materials are not discussed much. TR 748. Robinson also discussed groundwater sampling results, which he feels may indicate possible release of contaminants such as cadmium TR 757-59.

Mr. Robinson noted that institutional controls are critical to the remedy proposed in the permit modification, but alleged that they cannot be relied on for more than 100 years. For this reason, he charged that the proposed remedy is only a temporary remedy. He testified that 100 years is an “insignificant” period of time when dealing with the hazards present in the landfill. TR 762-66. Robinson questioned the CMS risk assessment concerning dangers to works from excavation, particularly as SNL’s chemical waste landfill was excavated without injury or incident. TR 766- 68.

In characterizing the containment at the landfill, Mr. Robinson noted that much of the waste was deposited in plastic garbage bags into unlined trenches left open for

years at a time, practices that would be prohibited today. He felt that characterizing this system as a landfill is "a generous interpretation," given the poor management practices used in burying the waste. TR 769-72. In applying his hydrology courses and experience, Mr. Robinson noted that unsaturated and vadose zones have both vertical and horizontal components of flow, and very complex mechanisms. TR 773-74. He cited a Sandia document dated September 13, 1989 that stated that reactor cooling water was disposed of in two drain fields near the landfill from 1963 to 1971, which is substantially more than is discussed in the CMS Report. Citizen Action Exhibit 9, TR 794-98. However, on cross-examination, he admitted that the volumes of water referred to in this document were actually disposed in the surface impoundments for the liquid waste disposal system (not the mixed waste landfill), and that he had no specific knowledge of the liquid waste disposal system and its location. He further acknowledged that he was not aware of any monitoring data that shows that releases of contaminants from the liquid waste disposal system have migrated to the landfill. TR 871-74. Additionally, he pointed out another document that identified volumes and radioactive and non-radioactive materials that went into the landfill, not included in the CMS Report. Citizen Action Exhibit 9, TR 798-810.

Mr. Robinson charged that the CMS Report has not demonstrated that the landfill and proposed remedy will prevent the migration of any hazardous constituents in ground or surface water at any future time. To the contrary, he charged, Sandia testified that the groundwater release pathway was not considered in detail in the CMS. Additionally, migration downward of contaminants has been demonstrated. TR 824-26.

Another document Robinson used was a memo from John Gould to Dick Fate that discussed future excavation of the landfill, and measures to take to allow this as a future option. TR 813-16, Citizen Action 11. The same exhibit memo also referred to 3 pits as "open" on November 20, 1998, when according to other Sandia statements, all pits had been filled years earlier. TR 815.

On behalf of Citizen Action, Robinson recommended that the Secretary select an alternate remedy, and require Sandia to excavate the landfill, redispense clean waste at the site, redispense transuranic wastes at sites permitted for them, and redispense other wastes at permitted facilities or at the site. On cross-examination, Robinson clarified his opinion that the public notice of the hearing was sufficiently broad to allow the Secretary to adopt this alternate remedy. Another option for the Secretary is to reject the proposal being considered and send the process back for further evaluation. TR 840-43.

New Mexico Environment Department

Carolyn Cooper, technical staff member of the Permits Management Program of NMED's Hazardous Waste Bureau, first outlined the history, geology and climate at the landfill, consistent with the testimony from Sandia's witnesses. TR 903-09. In discussing the inventory prepared by Sandia, Ms. Cooper noted that it is in all likelihood incomplete, and that most older landfills operating when this landfill did have no disposal records or incomplete ones at best. Ms. Cooper also testified that in order to determine whether Sandia's published inventory accurately represented classified waste disposal, NMED had staff with appropriate DOE security clearance review the classified inventory. The only difference between the classified and unclassified inventories is that the classified one contains information about project names, places

and weapons numbers. NMED randomly selected 36 disposal records from various years, and determined that it could trace the specific classified waste item to an item listed in the published waste inventory, which convinced NMED that Sandia's inventory is a reasonably accurate representation of the classified records and of the types of wastes routinely disposed of in the landfill. TR 910-12 (Kilbury-Kennett memo, 7/21/00, NMED Exhibit 15.) Ms. Cooper also detailed the research NMED had performed that confirmed that high-level radioactive waste had not been buried at the landfill, and refuted concerns from Dr. Maurice Weisberg and Dr. Nuttall that fuels and wastes from particular experiments had been disposed of in the landfill. TR 912-18.

Ms. Cooper also described the groundwater monitoring system at the landfill and the extensive groundwater monitoring data for the 6 monitoring wells and 1 background well. NMED's analysis is that the groundwater monitoring data, as a whole, shows no contamination of groundwater beneath and surrounding the landfill. Ms. Cooper explained NMED's conclusion, consistent with Sandia's and WERC's, that sporadic detections of radionuclides and hazardous constituents are not the result of releases from the landfill, based on the "abundance" of data showing no contamination in groundwater and the lack of any related contamination in the vadose zone. TR 918-27.

Ms. Cooper listed public information meetings NMED has held on the landfill, proposed remedies and the Class 3 modification requested by Sandia. TR 927-34. She also described the public notice issued by NMED for the hearing, NMED Exhibit 1. TR 930-32.

William McDonald of NMED's Hazardous Waste Bureau, testified about Sandia's Phase 1 and Phase 2 RCRA RFIs of the landfill. After detailing the numerous air,

surface soil and soil boring samples taken, Mr. McDonald noted that the Phase 1 results indicated that tritium was the primary contaminant of concern and that tritium had migrated from the landfill disposal cells into surrounding soil, with water and water vapor movement. Tritium activity was greatest in the top 30 feet of soil. However, the Phase 1 could not determine whether contamination had reached groundwater, and outlined additional work needed. TR 947-52. The Phase 2 RFI included air and soil samples, vadose zone tests and groundwater monitoring. After a radiation survey in Phase 2, the three pits with elevated surface-contact radiation were backfilled with soil, reducing their radiation levels to background. Total tritium flux activity at the landfill declined from 0.294 curies in 1993 to 0.09 curies in 2003; Sandia also measured significant decreases at Pit 33, the area of highest tritium activity. Soil borings detected tritium down to 120 feet, but samples from the monitoring well network showed no evidence of groundwater contamination. TR 952-58.

William Moats, the Albuquerque group manager for NMED's Hazardous Waste Bureau's Permits Management Program, oversees staff responsible for 10 federal and private facilities with hazardous waste permits from NMED, and oversees implementation of the Federal Facility Compliance Order at SNL. He has reviewed RCRA Facility Investigation and Groundwater Investigation Reports for dozens of solid waste managements units ("SWMUs"), including for the mixed waste landfill. TR 960-65.

Mr. Moats outlined the regulatory framework for NMED's regulation of the mixed waste landfill. NMED regulates the landfill as a SWMU pursuant to 40 CFR 264.101 (incorporated by 20.1.4.500 NMAC), for which corrective action was required under the

permit and the Consent Order entered into by NMED and DOE/Sandia, signed April 29, 2004 ("Consent Order"). 40 CFR Part 264 does not apply because the landfill is not a Part B permitted facility, and 40 CFR 265 does not apply because Sandia did not include the landfill in its Part A interim status permit. However, the requirements NMED has imposed on the landfill are similar to, and equally protective of, human health and the environment, were it regulated under Parts 264 or 265. Although Moats testified that NMED's "regulatory time line" is 30 years, based on RCRA's postclosure care requirements in 40 CFR 264.117(a)(1), he noted that 40 CFR 264.117(a)(2)(ii) allows NMED to extend this time period if necessary to protect human health and the environment. Should future monitoring results indicate a threat to groundwater or continued/increased levels of tritium or other contaminants, NMED can extend the post-closure care period. TR 967-76.

Mr. Moats reviewed the findings of the Phase 1 and 2 RFI reports, noting that at the landfill, radioactive wastes, rather than chemical wastes, pose the most acute threat to human health and the environment. He outlined and reviewed levels of radioactive and other contaminants found at the landfill in soil, air and soil gas, and re-asserted NMED's conclusions that: 1) the levels do not represent unacceptable risk to human health or the environment under an industrial land use scenario, and 2) the levels do not represent a risk to groundwater. Like Ms. Cooper, Mr. Moats testified there is no evidence of groundwater contamination at the landfill. TR 978-987.

Refuting allegations by witnesses for Citizen Action that the landfill is likely to contaminate groundwater like other DOE sites, Mr. Moats asserted that the other sites mentioned (Sandia liquid waste disposal system, chemical waste landfill, Tijeras Arroyo

and Lurance Canyon Burn sites and non-Sandia site in Beatty, Nevada) are not comparable so are not predictive of anything likely to happen at the mixed waste landfill in the future. Mr. Moats then explained why these sites were different, and why those at Sandia would not affect the mixed waste landfill. His testimony on this point was precise, technically detailed, and credible. TR 987-93. Moats also contradicted testimony from Robinson and Resnikoff, who alleged that as canisters and other storage containers of waste in the landfill breach and break down over time that additional contaminants will be released. While Moats agreed the containers would break down over time, he explained that the contaminants they contain will not migrate unless mobilized by water, which will be essentially eliminated by the evapotranspiration cover. TR 994-96. Concerns voiced by Resnikoff, Robinson and Ringelberg for Citizen Action were rebutted by Moats as based on outdated information (excess surface gamma radiation) or not accurate (MARSSIM guidance for sampling techniques, analysis of laboratory error and quality control problems). TR 997-1005.

Mr. Moats testified about the initial screening of potential technologies in the CMS, and criteria used to eliminate less favorable technologies. The 4 candidate alternative studied in most detail included: no further action with institutional controls; vegetative soil cover; vegetative soil cover with bio-intrusion barrier; and future excavation. All included use of institutional controls. Each was evaluated using 5 criteria: long-term reliability and effectiveness; reduction of toxicity, mobility or volume of wastes; short-term effectiveness; implementability and cost (including operation and maintenance costs for 30 years). Mr. Moats explained how each alternative ranked and was evaluated. Additionally, NMED directed Sandia to evaluate complete excavation

with off-site disposal, even though it did not pass initial screening, as a result of public input and concern. TR 1008-19.

Mr. Moats then reviewed NMED's authority for Sandia's draft permit under RCRA and delegations from EPA, and the regulatory history of the CMS. He outlined the provisions of the draft permit and how they will guide the design and implementation of the remedy, as well as long-term maintenance and monitoring. TR 1064-73. In response to Citizen Actions' urging that NMED require Sandia to post financial assurance for the remedy, Moats noted that DOE and Sandia Corporation are exempted from these requirements by federal law. TR 1074. He also refuted Dr. Resnikoff's allegations that DOE's long-term stewardship program cannot be counted on to maintain the cover for the landfill or institutional controls, but pointing out NMED's enforcement options in Sandia's RCRA permit. TR 1975.

Mr. Moats effectively responded to Dr. Baskaran's report and conclusions by quoting updated information and other sampling not used by Dr. Baskaran, that demonstrated that contaminants from the landfill have not contaminated groundwater. TR 1076-85. Moats also reviewed Mr. Robinson's 2001 report and NMED's contrary conclusions that sporadic detections of acetone and phenolics are not groundwater contamination. TR 1085-87. In response to Dr. Hakonson's report, Moats noted that several of his conclusions agreed with NMED's (cover would be adequate to prevent migration of water, and biointrusion can interfere with covers). TR 1088-90.

In discussing WERC's first peer review report, Moats outlined the many areas where WERC and NMED agree, particularly regarding the high quality of Sandia's data and the conclusion that there have not been releases that currently pose an

unacceptable threat to human health or the environment. He noted several areas where WERC suggested additional analysis that have been required or will be required with design and implementation of the remedy selected. TR 1091-97. Moats' analysis of the second WERC report contained similar corrections and additions, making many of WERC's criticisms moot; he again noted many areas of agreement. TR 1097-1103. Mr. Moats also reviewed Dr. Resnikoff's paper on his review of the risk assessment in the Phase 2 RFI, which disagreed with Sandia's conclusion that groundwater has not been impacted by the landfill. Moats effectively refuted Resnikoff's criticisms, noting that the inventory for the landfill while not complete was as thorough as needed for selection of a remedy. He cited updated samples and readings that contradicted Resnikoff's concerns, and pointed to provisions in the draft permit addressing other issues raised by Resnikoff. TR 1104-13. Moats's analysis of Schneider and Resnikoff's March 2004 report evaluating the CMS was similarly detailed, responsive and effective. TR 1113-19.

Paige Walton of TechLaw, Inc., contracted with NMED to provide risk assessment support and testimony. She has considerable experience with risk assessment at sites with hazardous and radiological constituents, and used a variety of dose assessment models. TR 1023-27. She noted that Sandia's risk assessment was based on an industrial land use scenario using detectable releases, consistent with EPA policy, refuting Citizen Action's allegation that it should instead have been based on the entire waste inventory. TR 1028-31. She discussed acceptable radiation doses and hazard quotients for animals at the site, again consistent with EPA policies and calculation methods. TR 1033-35. She also explained how the future assessment

presented only acceptable levels for human and ecological receptors. TR 1035-40. However, the risk assessment was clear that risks to excavation workers would be high for the current excavation scenario, a conclusion with which WERC agreed. TR 1045. She concluded by stating that the risk assessments performed by Sandia showed no unacceptable risks to a nonintrusive industrial worker, selecting vegetative cover with bio-intrusion barrier. (TR 1049).

RECOMMENDATION

I recommend that the Secretary order Sandia to select remedy Alternative III.c: Vegetative Soil Cover with Bio-Intrusion Barrier, with a number of conditions discussed below, including the identification (in a public process) of specific triggers for further or additional remediation, review (in a public forum) of monitoring data at the landfill every 5 years with re-evaluation of the need for excavation, the development of a comprehensive fate and transport model to assist in the design and implementation of the remedy, future monitoring and the identification of appropriate triggers for further remediation. Given Sandia's findings of tritium in the tissues of burrowing mice that can move up food chain, the barrier is necessary to keep rodents and other animals out of the waste. See Goering, TR 103-06, 250-52.

ANALYSIS

Scope of the hearing

The goal of this hearing was to select a remedy for the mixed waste landfill. Much of the testimony and public comment concerned other matters, including closure standards, post-closure care, appropriate post-closure monitoring and other matters not directly relevant to selection of a remedy. Some of these other matters will be

discussed in the course of design and implementation of the remedy, once it is selected. However, it is premature to decide and detail many of those matters at this time.

Remedy Selection

NMED presented a convincing argument for the remedy it included in the draft permit modification: a vegetative cover with bio-intrusion barrier. The presence of animals, birds and other biota with tritium in their tissues above background levels convinced me that the bio-intrusion barrier should be required. If the remedy performs as predicted and if the contents of the landfill behave as predicted, this remedy should protect human health and the environment.

Citizen Action presented a convincing argument that Sandia had over-estimated the costs of excavation (both currently and in the future), although I cannot go as far as Erik Ringelberg and term excavation at the landfill a "bargain," even as compared to another site. However, the costs of excavation are only one part of remedy selection, and the evidence did not convince me that the selected and proposed remedy was not protective of human health and the environment. More accurate cost estimates might come into play when re-evaluating the need for excavation in the future.

Triggers for Action and Re-Evaluation of Excavation in the Future

Much of the public testimony and that of Citizen Action focused on concern about future degradation of conditions at the landfill. Sandia's, WERC's and NMED's witnesses consistently testified that current excavation of the landfill would pose unacceptable risks to the people performing this activity, and to the public and the environment in general if the excavated waste is transported off-site. However, these witnesses also agreed that radioactive (and some hazardous) constituents of the landfill

would likely decline over time, making excavation potentially a safer option in the future; yet, as levels decline over time, the need for excavation may also decline.

WERC's 1st Report agreed with Sandia's conclusion that tritium is the most mobile contaminant of concern, that it has decreased significantly over time, that that future concentrations of tritium will continue to decline. (AR 04-029, 8/31/01, page 32). On the other hand, it is unclear whether events within the landfill could change these predictions, if, for example, buried containers and plastic bags storing waste breach in the future and release additional radioactive and hazardous materials. Citizen Action's witnesses repeatedly insisted that we cannot predict what will happen in this landfill because we do not know exactly what went in, or in what quantities, or how they will react synergistically once containers begin to breach.

Two things can assist in understanding what is happening in the landfill in the future: a comprehensive model (discussed below), and continued monitoring and evaluation. I recommend that the Secretary require Sandia to prepare a report every 5 years re-evaluating the feasibility of excavation and analyzing the continued effectiveness of the selected remedy, as suggested by the Albuquerque-Bernalillo County Groundwater Advisory Board. The report should be presented in a public forum, and the public should have an opportunity to evaluate and comment on data presented. The report need not be of the magnitude of a full-scale RFI or CMS; NMED staff should determine what should be included, with input from Sandia and the public.

Additionally, I recommend that NMED identify monitoring "triggers" for future action (pre-determined target levels of contaminants that trigger the need for a response, including the responses of increased monitoring and future excavation) (See

WERC, 1/31/03, #3.d) Again, NMED should set these triggers with input from Sandia and the public, perhaps as part of review of the CMS Implementation Plan. As NMED pointed out in testimony, these can be set as part of Sandia's contingency plan for the landfill's remedy development.

Need for a comprehensive model

Dr. Nuttall's education, credentials and experience with a broad variety of nuclear and radioactive wastes at many sites give his testimony substantial weight, and the fact that he testified as an independent witness not aligned with any particular group or party increases his credibility. The WERC panel's recommendations come from "very recognizable national experts in this field, that have just impeccable credentials," as Dr. Nuttall testified, and you cannot just "ignore" their recommendations. TR 174. I agree with this assessment: it would be risky and unwise to ignore the strong recommendation of this independent panel of experts. As so many witnesses and members of the public testified and stated: the long-term possibility of any leakage from the mixed waste landfill must be eliminated. The evidence was clear that one important way to study and achieve this goal is a comprehensive fate and transport model of the site, calibrated and modified as additional monitoring data is collected over time; Sandia should be required to do this at the mixed waste landfill, but remedy selection need not wait for it.

Importance of Continued Public Participation

In the process of presiding over this hearing, I was impressed with the level of participation of the public and Citizen Action, with their technical knowledge and understanding, and their detailed study of the history of this landfill. Their presence and participation resulted in a more thorough and comprehensive review of the landfill and

proposed permit modification. The public and Citizen Action demonstrated over and over that these issues are of passionate importance to them, and they should be allowed to continue to participate in the process of review as the remedy for the landfill is implemented. It is particularly important for the public to be able to participate in identifying the triggers for future action, and 5-year evaluations of feasibility of excavation and continued effectiveness of the selected remedy. This will ensure that if the selected remedy is not effective, not properly implemented or maintained, or if new or not-predicted conditions or issues arise, they will be brought to NMED's attention and addressed.

In order for the public to be able to participate in a meaningful way in future evaluations, Sandia and NMED must make critical documents readily available for review. I suggest that the Secretary require NMED and Sandia to provide a convenient method for allowing the public to review Sandia's Corrective Measures Implementation Plan, Corrective Measures Implementation Report, progress reports, long-term monitoring and maintenance plan, and any other documents developed by NMED or Sandia for the landfill, including posting these on a publicly-accessible website.

Allegations of Groundwater Contamination from the Landfill

The record contained evidence that there remains controversy about what quantity of liquids were placed in the mixed waste landfill, and whether they have affected groundwater. (See AR 00-044 Baskaran Report; Table J.1.2-1 of CMS Final Report, AR 93-004; Resnikoff and Robinson reports and testimony). Some of this controversy is due to the fact that Sandia's reports on liquids have changed over time, partly due to additional research and interviews Sandia conducted. However, the first

WERC Report, and correspondence and calculations exchanged in 2001 by Goering and Nuttall convinced me that the coolant reactor liquids discharged into Trench D likely did not reach groundwater or contaminate groundwater. (See AR 01-107), and both NMED, WERC and Sandia consistently analyzed available data to conclude that the mixed waste landfill has not contaminated groundwater. Many of the issues initially raised by Resnikoff and Robinson were answered or explained by later NMED witnesses, additional Sandia testimony and research, and uncontroverted evidence that the groundwater has not been contaminated under the mixed waste landfill. It will be particularly important to identify appropriate triggers specifically aimed at the protection of groundwater. For example, one trigger could be that if contaminants moved a specific distance deeper under the landfill, then this might result in NMED ordering future excavation.

Thoroughness and completeness of the inventory

At the mixed waste landfill, the horse is already out of the barn: the waste has already been disposed of there. Short of inventing a time machine, no one can go back and know definitively exactly what was placed in the landfill and how it was deposited. Although Sandia testified to substantial efforts to re-create what went in to the landfill, through (among other methods) examination of historical records and interviews with former employees, some confusion and disagreement remains. Issues include whether waste from particular tests and projects went in, what sorts of containers were placed where, and how much liquid was placed in or on the landfill. (see Nuttall, Resnikoff and Robinson testimony, AR 03-034, AR 97-001). As with the controversy regarding discharges potentially affecting groundwater, Sandia has changed its reporting and

listing of the contents of the landfill over time, and even rejected a study by its consultants, claiming the improved information is the result of additional research and interviews with former employees.

I found NMED's testimony credible, and for the most part I was impressed with the detailed efforts and studies from both Sandia and NMED showing that high-level radioactive waste was not buried at the landfill. Given the length of time this landfill has been documented and studied, it makes sense that not all documentation is accurate. However, I was troubled by the Kilbury-Kennett study in July 2000, which acknowledged that only 3 hours were spent comparing and tracing 36 items in landfill records that otherwise would take months to study. From this small sampling of records, NMED concluded that the classified records were sound and Sandia knew how much of what went into the landfill over time. I was not convinced that enough was done in this area to verify these records and inventory, particularly given the significant amount of controversy surrounding the inventory raised by Citizen Action's witnesses, the WERC panel and the public. However, in spite of this, based on NMED's and Sandia's testimony, I had to agree that there is a reasonably accurate and complete inventory for the landfill, and that more is known about this landfill than about many other historic landfills.

Adequacy of CMS Report and Risk Assessment

NMED and the WERC panels consistently found Sandia's risk assessment adequate, and the quality of work in the CMS Report to be of high quality. (See WERC, 8/31/01, General Conclusion #7). The risk assessment, testimony and reports support

the conclusion that dangers to human health and the environment outweigh any benefits of removing waste from the landfill at the present time.

Similarly, the CMS Report has been approved by NMED and the 2nd WERC Report found the draft CMS to be of generally high quality, comprehensive and highly detailed. (See WERC, 1/31/03, page vii). Approval by this independent panel of experts is reassuring and weighed heavily in my analysis.

RECOMMENDED FINDINGS AND CONCLUSIONS

Recommended findings of fact and conclusions of law are attached and incorporated herein by reference.

RECOMMENDED FINAL ORDER

A draft Final Order consistent with the recommendations in this Report is attached and incorporated herein by reference.

Respectfully submitted,

Original signed by Jennifer J. Pruett
Jennifer J. Pruett, Hearing Officer

April 20, 2005

Dated