Mr. John Kieling, Program Manager
Hazardous Waste Bureau-NMED

Dear Mr. Kieling,

The Albuquerque Center for Peace and Justice and Citizens for Alternatives to Radioactive Dumping fully support the comments submitted to you by Citizen Action concerning the Mixed Waste Landfill at Sandia National Laboratories and specifically the Fate and Transport model.

Our most pressing concerns are those involving the failure to consider 'triggers'. The idea of waiting for our air land and water to be polluted before acting to ameliorate the situation makes no sense to us.

Our perusal of your Fate and Transport model shows a neglect for recognizing that plants and animals, if they are found to be contaminated should be considered a trigger. Also, in relation to this, please consider all the contaminants, other wise a 'trigger' could be missed.

Please also consider contaminants in the vadose zone a trigger.

Please consider all contaminants in the MWL when calculating the risk to the populace which, after all , is our community.

Thank you for your consideration.

Sincerely,

Dorelen Bunting Janet Greenwald

*Hard copies sent.

February 7, 2006

Mr. John E. Keiling
Program Manager
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Dr. East, Bldg. 1
Santa Fe, New Mexico 87505

Dear Mr. Kieling:

Attached are comments compiled by Paul Robinson, Research Director for the Southwest Research and Information Center, on behalf of Citizen Action New Mexico regarding the Sandia National Laboratories' Corrective Measures Implementation Plan (CMIP) and Fate and Transport Model (FTM) for the Mixed Waste Landfill (MWL) required by the New Mexico Environment Department (NMED) as part of the Class 3 permit modification for the MWL.

We understand that Tech Law will be reviewing the CMIP and FTM for the NMED as well as reviewing comments submitted from members of the public concerning the CMIP and FTM during the public comment period.

Due to the number of deficiencies found in our review of the CMIP and FTM, the state's reliance on an outside contractor to review the CMIP and FTM as well as review public comments we would like to request that the NMED convene a "technical discussion group" with SNL representatives, NMED, and interested stakeholders to further evaluate both studies before the CMIP and FTM are determined to be complete by the NMED. This request has been included in our comments and recommendations.

We would also like to request copies of Tech Law's review and comments on the CMIP and FTM, including their comments on any revisions of studies.

If you have any questions please feel free to contact me at (505) 262-1862. Thank you for your consideration, and we look forward to your responses to our comments.

Sincerely yours,

Susan Dayton, Director
Citizen Action New Mexico
(505) 262-1862

Review of Sandia National Laboratories' Mixed Waste Landfill Corrective Measure Implementation Plan and Fate and Transport Model:

Comments and Recommendations

February 7, 2006

Prepared on behalf of:
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INTRODUCTION

These Comments and Recommendations address portions of the Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL) Corrective Measure Implementation Plan (CMIP) and Fate and Transport Models (FTM) posted on the New Mexico Environment Department (NMED) Website. NMED required SNL to provide these documents as part of the Permit Modification issues to SNL regarding the MWL in May, 2005.

The Corrective Measure Implementation Plan ("CMIP") is posted at http://www.nmenv.state.nm.us/hwb/SNL/MWL/SNL_Mixed_Waste_Landfill_CMI_Work_Plan_(11-2005).pdf. The Fate and Transport Model ("FTM"), titled "Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories" Document Number SAND 2005-6888 is posted at http://www.nmenv.state.nm.us/hwb/SNL/MWL/Fate_and_Transport_(Probabilistic_Performance-Assessment_Modeling_of_the_MWL;%2011-2005).pdf).

The Permit Modification issued by New Mexico Environment Department for the Mixed Waste Landfill (posted at http://www.nmenv.state.nm.us/hwb/SNL/MWL/Final_Decision/Permit_Language_for_the_Mixed_Waste_Landfill.pdf) requires that Sandia/DOE submit a CMIP that "shall, at a minimum, include:

a. A description of the selected remedy;

b. A description of the remediation system objectives;

c. An identification and description of the qualifications of key persons, consultants, and contractors that will be implementing the remedy;

d. Detailed engineering design drawings and systems specifications for all elements of the remedy;

e. A construction and construction quality assurance work plan;

f. An operation and maintenance plan;

g. The results of any remedy pilot tests, such as landfill cover test plots;

h. A schedule for submission to the Administrative Authority of periodic progress reports;

i. A schedule for implementation of the remedy;

j. A health and safety plan;

k. A comprehensive fate and transport model that studies and predicts future movement of contaminants in the landfill and whether they will eventually move further down the vadose zone and/or to groundwater;

l. Triggers for future actions that identify and detail specific monitoring results that will require additional testing or the implementation of an additional or different

remedy."

In response to comments identified during review of the FTM and CMIP, recommendations regarding specific revisions to the FTM and CMIP are identified. The recommendations include revising the CMIP to reflect modifications proposed for the FTM.

Due to the technical nature of the FTM, the reliance of NMED on a contractor to conduct a technical review of the FTM, and the numerous areas of deficiency in the FTM noted in these comments it is also strongly recommended that NMED convene a "technical discussion group" to serve as a public meeting to provide for an exchange among interested stakeholders regarding the adequacy of the FTM and CMIP. It is recommended that such a technical discussion group include representatives of the permittee, the NMED and members of the public who have expressed an interest in the studies conducted by SNL and/or submitted comments to the NMED on the CMIP and/or FTM. It is recommended that this technical discussion group be convened prior to the determinate that the FTM and CMIP are either "comprehensive" or "complete" with respect to the technical requirements applicable to the wastes at the MWL.

I. Fate and Transport Model Comments and Recommendations

A. General Comments: The document submitted to comply with the FTM requirements in the Permit Modification is not comprehensive with respect to:

1. **The volume of each individual waste product and physical state of containers for the full range of contaminants at the Mixed Waste Landfill;**
2. **Potential for releases including vadose zone and groundwater contamination due to transport not considered in the FTM including mechanisms such as biological transport of contaminants through the ground surface, human intrusion, and movement of contaminants by wind/air;**
3. **Modeling for the complete suite of radionuclides and daughter products, metals, and volatile and semi-volatile organic compounds in the known inventory of the MWL.**

RECOMMENDATION: The FTM should be revised to provide the "comprehensive" model required by the Permit Modification and the CMIP should be modified to reflect the findings of the revised FTM following its acceptance as technically complete and comprehensive by NMED.

B. Areas not addressed in the FTM:

1. **The FTM fails to address biological transport of contaminants resulting from plant and animal uptake of contaminants and subsequent dispersion of soil, plant and animal material by wind, including vertebrate and invertebrate animals entering the landfill and plants**

transporting contaminants taken up through their root systems. Data presented at the December 2004 MWL Public Hearing by SNL demonstrate that deer mice and vegetation at the MWL show contamination with low levels of tritium and radon.

2. **The FTM fails to address transport of contaminants resulting from human intrusion associated with accidental events and the eventual failure of the land use restriction portions of the institutional controls proposed by SNL for the MWL. Accidental or unforeseen events that could be included in FTM model assumptions should be understood to include discharges of large volumes of water at the site on the order of disposal of more than 270,000 gallons of reactor cooling water at the site or the pooling of snow melt and rain water above trenches, circumstances that occurred at the MWL while it was an active disposal site.**
3. **The FTM fails to provide a comprehensive fate and transport analysis as it does not include calibrated model "realizations" for the full range of radioactive and hazardous constituents identified at the MWL including: a wide range of radionuclides, a wide range of metals and inorganic compounds including beryllium, nickel, chromium, sodium, lithium, and the range of volatile organic compounds already demonstrated to have been escaped from the MWL. A comprehensive list of radionuclides, metals and volatile organic compounds can be found in what is identified in the CMIP at p. 4-2 as "[a] detailed MWL waste inventory, by pit and trench, … provided in the Environmental Restoration Project "Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996" (SNL 1998)."**
4. **The FTM fails to identify or address fate and transport dynamics associated with the potential for formation of mobile, potential hazardous compounds by radiolysis - the process by which radionuclides can mix with non-radioactive constituents and form new compounds – to occur among waste constituents of the MWL.**
5. **The "triggers" identified in the FTM fail to include monitoring mechanisms to reflect either human intrusion, biological transport, or the waste constituents identified at the MWL, but not considered in the FTM.**
6. **The FTM fails to identify means to monitor, model and assure the effectiveness of institutional controls or the consequences of the failure of such passive site protection measures.**
7. **The FTM fails to provide a risk assessment/performance assessment analysis in its evaluation of the potential for release of contaminants from the MWL.**

RECOMMENDATION: In order for the FTM to be fully "comprehensive," NMED should require that the FTM be revised and expanded to address each of the areas of incompleteness identified above.

C. Areas addressed inadequately in the FTM:

1. **The FTM relies on data regarding releases of radionuclides, heavy metals and VOCs ("volatile organic compound") from the Phase 1 and Phase 2 RCRA Feasibility Investigation (RFI) gathered 1993 – 1995. FTM at 14. No new data gathering was conducted. No new data gathering is proposed to calibrate or verify the modeling conducted**.

RECOMMENDATION: The NMED should require that SNL conduct a monitoring program to verify the accuracy of the model parameters and model results identified in the FTM. This program should include sampling of the vadose zone at and beneath the MWL to determine if the FTM's predictions and assumptions accurately reflect conditions at the MWL.

2. **The FTM appears to have failed to identify or consider either the mechanisms for deterioration of waste containers or the consequences of the deterioration of waste containers in any manner during development of the input parameters and assumptions for its VOC, heavy metal and radionuclide models, with the single exception of the radon model runs in which radium-226 containers were determined to deteriorate in 1,000 years**.

The failure to address container deterioration systematically in the FTM results in the model using inappropriate, non-conservative assumptions about the "source terms" of waste constituents. The MWL waste containers, or the MWL waste containers SNL is aware of, include 55-gallon drums, plastic bags and other short-lived containers with an identifiable lifespan that is very short, a few decades in the case of 55-gallon drums, compared to the extremely long-lived hazards associated with the MWL contents other than tritium and cobalt-60.

The failure to address the limits on the durability containers due to deterioration mechanisms and resulting contaminant releases ignores a primary critique of SNL's data presented at the December 2004 MWL Public Hearing, as identified by the Hearing Officer, that SNL studies and models to date have failed to address the inevitable deterioration of waste containers.

RECOMMENDATION: To reflect the intent of the Hearing Officer as stated in her Final Report and Proposed Final Order, the FTM should be revised to identify and address fate and transport dynamics that would occur as a result of the deterioration of all VOC, heavy metal and radionuclide containers at the MWL.

Also, the FTM's analysis of potential radon movement should be revised to both identify mechanisms that would result in deterioration of the radium-226 containers and conduct model realizations for container deterioration faster than the 1000-year period reported such as deterioration within 100-years of disposal.

3. **The FTM concludes that PCE, the one organic compound modeled in the FTM, would reach groundwater for all 100 model runs ("realizations") with the majority of the model runs showing PCE reaching groundwater within 50 years**.

The FTM states:

"Figure 22 [on p. 55] shows the simulated PCE concentrations in the groundwater as a function of time for all 100 realizations. **The majority of the realizations show the aquifer concentrations peaking before 50 years**. **Depending on the time of disposal, this corresponds to peak concentrations occurring by 2010 – 2040.** [emphasis added]. To date, no detectable amounts of PCE have been found in the groundwater at the MWL. This is still consistent with the simulations which show a large amount of variability in the simulated concentrations resulting from uncertainty included in the input parameters." FTM at pp. 54-55. Figure 22 is attached these comments as APPENDIX A.

Thus, the FTM confirms that a volatile organic compound already shown to have escaped from the MWL, tetrachloroethylene (PCE), is likely to reach the groundwater aquifer within 50 years in most model runs. This finding should serve as a basis for NMED to focus a substantially higher degree of attention on the need for a corrective measure at the MWL that can be demonstrated to effectively control releases of VOCs.

Figure 23 in the FTM shows the concentration of PCE anticipated in the groundwater by the model realizations. This figure shows that the vast majority of the realizations – about 80% - show PCE levels in the groundwater in the range of 1 – 5 micrograms per liter, equivalent to parts per billion. Prediction of those concentrations of PCE reaching the groundwater represent a prediction of significant contamination as PCE is not naturally occurring and therefore **zero** PCE would be predicted to have reached groundwater if no PCE were already shown to have escaped from the MWL. Figure 23 is attached to these comments in APPENDIX A.

The FTM shows that PCE reaches groundwater based on data from previously detected releases of VOCs at the MWL as, the FTM notes:

"Although no quantitative estimates of the volumes of these contaminants disposed of in the MWL exist, soil samples provide an estimate of the extent and concentration of the region contaminated with VOCs at the MWL." FTM at p. 52.

The lack of information about this highly mobile contaminant in the MWL inventory, or the form and condition of containers used for disposal of PCE and other VOCs and SVOCs, prevents SNL from conducting analyses based on accurate estimates of the amount of VOCs and SVOCs in the MWL. The lack of recent or current VOC and SVOC monitoring data since the 1993 Phase 2 RFI prevents SNL from accurately reflecting the current extent of VOC and SVOC releases from the MWL in the FTM.

As SNL has no information available about the VOC waste volume and disposal practices the FTM used the:

"[M]aximum measured gas concentration (5,900 ppb) … as a minimum value in a uniform distribution increasing to ten times this value to develop a range of equilibrium aqueous concentrations." FTM at p. 52. In other words, since the MWL permittee acknowledges that it has no information on the amount or form of the PCE (and other VOCs and SVOCs) in the landfill or how the containers they were disposed in have aged, the model used the amount of VOCs and SVOCs more than a decade ago that had already leaked from the landfill for the "source term."

This method of identifying the "source term" for the PCE FTM does not account for the likelihood that the amount of PCE, and other VOCs, leaking from waste containers may have increased significantly since 1993 when the VOC releases used to develop the FTM were detected.

The FTM only modeled one organic compound, PCE, though a dozen VOCs and SVOCs were demonstrated to have been released from the landfill by 1995. In spite of the demonstration that PCE would reach groundwater within 50 years in all model realizations, the FTM failed expand its modeling study to address the fate and transport of other organics detected in the Phase 2 RFI monitoring data.

Similarly the FTM fails to identify or present model realizations for the decay products of PCE and the other VOCs and SVOCs demonstrated to have escaped the MWL in 1993. This is particularly problematic as at least one decay product of PCE, vinyl chloride, has a maximum contaminant level (MCL) established by EPA of 2 ppb, less than the proposed trigger level of 2.5 ppb proposed for PCE in the FTM at p. 62. See EPA "National Primary Drinking Water Regulations" at http://www.epa.gov/safewater/contaminants/dw_contamfs/vinylchl.html.

As no information is presented in the FTM regarding fate and transport model realization data for any PCE decay product, no information is presented regarding concentrations of any decay products in groundwater that may have been predicted by the FTM model realizations.

The FTM should be revised to correct inconsistencies in data presented regarding PCE releases from the MWL. The FTM states that the maximum PCE detected in 1993 was 5,900 ppb at p. 52, but lists the maximum concentration of PCE in 1993 as 5,200 ppb on Figure 21 at p. 53.

RECOMMENDATION: Because PCE was shown to reach groundwater in all model realizations within approximately 50 years, the FTM should be revised to include model realizations reflecting future movement of all VOCs and SVOCs found to have been released from the landfill in 1993. These additional models and model realizations should be revised to include consideration of the decay products of PCE and the other VOC s and SVOCs that were shown to have escaped the MWL by 1993. Decay products modeled should include any decay products, such as vinyl chloride, that may have MCLs as low or lower than that established for PCE.

The FTM should be revised to reflect the potential for container deterioration to have resulted in significant additional VOC and SVOC releases from the MWL at rates well beyond the "ten times" indicated in the FTM at p. 52. As substantial additional deterioration of VOC and SVOC containers is likely to have occurred since 1993, it is reasonable for the FTM to be revised to include consideration of VOC and SVOC source terms 100x and 1000x the maximum values detected in the vadose zone in 1993 for all VOCs and SVOCs detected at the landfill. Model realizations considering source terms 100 – 1000 times concentrations detected in 1993 will allow the FTM to address the potential for additional releases since 1993 or releases not detected in 1993.

The FTM should be revised to include evaluation of the vapor phase transport mechanism attributed to the VOCs that reached the groundwater at the Chemical Waste Landfill at SNL. This revision should be included to ensure that the assumptions regarding PCE movement used in the FTM reflect real world conditions at as demonstrated at other landfills at SNL.

The FTM should be revised to include a VOC and SVOC detection and monitoring system to provide real world data to verify results of model realizations.

The NMED should request a revision of the FTM that corrects any inconsistencies in data used and presented in the FTM. The indication that the FTM authors may have understated the maximum PCE gas concentrations in 1993 by more than 10% (the difference between 5,900 and 5,200) in one of its models (as reflected in Figure 21) should serve as a basis for the NMED to require verification that the appropriate, higher value was used in the FTM. In addition, the NMED should require that SNL verify that model realizations were indeed conducted with using values "ten times" the 1993 maximum gas concentration of PCE as neither Figure 21 or any other portion of the FTM discussion of VOC model realizations appear to reflect the use of values "ten times" 1993 maximum gas concentrations asserted by the FTM at p. 52.

The NMED should consider requiring improvements in the Corrective Measure proposed for the MWL to prevent future releases of VOCs and SVOCs from the MWL as the FTM (and a 1995 Argonne National Laboratory study cited in the FTM, as discussed below) demonstrates the high probability of VOCs reaching groundwater beneath the MWL at values at or near applicable maximum contaminant level standards.

4. **The FTM identifies a 1995 Argonne National Laboratory [cited as Johnson 1995 in the FTM] report at p. 16 that showed that VOCs released from the MWL could reach the water approximately 250 years from the time of disposal. This study was not provided to NMED as part of either the Corrective Measures Study (CMS), Corrective Measure Implementation Plan (CMIP) or the references for either of those reports**.

The FTM at p. 16 states:

"**The [Argonne National Laboratory study report as Johnson, 1995] study also included screening calculations for aqueous-phase transport of PCE and TCE, and predicted that these VOCs could reach the water table approximately 250 years**

from time of disposal. No calculations were conducted for vapor-phase transport, which has proven to be the most significant transport mechanism for organic compounds in the vadose zone at nearby ER sites, including the Chemical Waste Landfill."

This 1995 study is cited as:

"Johnson, R., D. Blunt, D. Tomasko, H. Hartmann, and A. Chan, 1995, A Human Health Risk Assessment for the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico, Argonne National Laboratory, Argonne, IL."

Though the FTM asserts that the Argonne Study used a "worst case scenario" approach, the failure of the 1995 Study to consider vapor-phase transport mechanisms, which has been shown to have resulted in VOCs escaping the Chemical Waste Landfill at SNL reaching the groundwater aquifer, appears to contradict that assertion.

The combination of the 1995 Argonne study with the FTM demonstrates that the high mobility of VOCs is not controlled by the proposed Corrective Measure at the MWL and the likelihood that VOCs will reach the groundwater aquifer beneath the MWL even if the currently approved Corrective Measure is installed at the MWL.

RECOMMENDATION: The NMED should require SNL to provide the agency with copies of the 1995 Argonne Study, review the Study, and consider its relevance regarding the adequacy of the Corrective Measure identified in the Permit Modification since SNL failed to present the Study to NMED or the public or consider it during the development of the Corrective Measure Study.

The NMED should review the Corrective Measure approved in the Permit Modification as the conclusions of the 1995 Argonne Report are contrary to the conclusions presented in the CMS and MWL hearing by SNL that contaminants such as VOCs *could not* reach groundwater at the MWL site. See statement "Contaminants are unlikely to reach groundwater …" CMS at 29.

5. **The "trigger levels" identified in the FTM fail to provide for early detection and early response to releases prior to the exceedence of health–based standards. The proposed trigger levels fail to provide either early detection or early response as they are set at values at or near regulatory standards rather than at levels that would demonstrate the "edge of the plume," which is the purpose of trigger levels as identified by the MWL Hearing Officer's Final Report at pp. 35 – 40.**

The trigger levels identified in the FTM are values that are well above background concentrations for the constituents identified and fail to identify levels that would demonstrate that the "edge of a plume" has reached a location of concern or that statistically significant increases in the concentration of contaminants have been detected by monitoring activities.

Exceedences of the proposed trigger levels identified in the FTM would demonstrate that significant and extensive contamination has already occurred, not conditions at the "edge

of the plume," and would result in subsurface contamination that would be much more expensive to remedy than contamination detected at trigger levels set at concentrations exceeding background by a statistically significant value, such as 25% or 50%, above locally appropriate background values.

Though neither the Permit Modification or the Secretary's Final Order provide a specific definition for "trigger levels," several sources can be identified that demonstrate that the appropriate understanding of "trigger level" as identified in the MWL Hearing Officer's Final Report is a concentration of a constituent designated to "detect contamination" or the "edge of a plume," rather than an exceedence of a regulatory standard.

In her Final Report, the Hearing Officer identified an example of trigger levels as: "one trigger could be that if contaminants moved a specific distance deeper under the landfill, then this might result in NMED ordering future excavation" at p. 40.

At the MWL Public Hearing in December 2004, NMED's technical witness Willam Moats stated, "…triggers themselves would be designed around detection of contamination in the vadose zone and the groundwater." MWL Hearing Transcript at p. 1141.

RECOMMENDATION: To insure that trigger levels identify the "edge of a plume" and "detect contamination," rather than the exceedence of regulatory standards, the trigger levels applied to the monitoring systems at the MWL should be set at concentrations that reflect a significant increase above background values rather than at a concentrations that approach regulatory standards and are many times higher than background conditions. The location of the monitoring systems at which the trigger levels would apply should be beneath the landfill, but well above the groundwater level for the trigger levels to serve as an "early warning system" rather than confirmation of groundwater contamination by applying proposed trigger levels at an elevation at which groundwater is found as proposed in the FTM.

To provide "detection of contamination," trigger levels should be established at a level 25 – 50% above initial concentrations for contaminants of concern. Verification of contaminant concentrations when detected will provide assurance that values that exceed background concentrations by a significant amount are not anomalous or indicative of analytic error.

6. **The trigger levels proposed in the FTM fail to identify trigger levels for waste constituents that apply at the edge of the MWL or in the vadose zone below the site but above the water table**.

The FTM lists recommended "trigger levels" in Section 4.2.1 at pp. 61 – 62. The list fails to include vadose zone trigger levels for contaminants identified in the MWL and only lists vadose zone trigger level for "infiltration" as measured by moisture content increase.

RECOMMENDATION: The FTM should be revised to provide for a vadose zone monitoring program that includes analysis of all of the constituents identified on pp. 61 – 62 and other constituents that may be identified based on these comments or other recommendation provided to the NMED to insure that all transport mechanisms, both anticipated and unanticipated, are addressed by the trigger levels implemented at the MWL.

7. **The FTM discussion of "Trigger Levels"' does not address the degree to which monitoring for moisture content changes would reflect vapor phase movement of VOCs**.

Vapor phase movement of VOCs is noted as the mechanism for VOC transport to groundwater at the Chemical Waste Landfill at SNL. See quote from Johnson 1995, FTM at p. 16.

RECOMMENDATION: The FTM should identify effective technologies for detection of vapor phase movement of VOCs into the vadose zone beneath the MWL. These technologies should be included in an expanded monitoring system to provide for detection of VOC and SVOC releases from the MWL.

8. **A broad range of sources of uncertainty in the FTM were identified by the FTM lead author Dr. Clifford Ho in a powerpoint presentation at a DOE-sponsored public meeting on the FTM in January 2006. The "uncertainty variables" identified by Dr. Ho included: waste inventory and size; thickness of cover and vadose zone; and transport parameters including: infiltration, adsorption coefficient, saturated conductivity, moisture content; tortuosity coefficients, and boundary-layer thickness.**

The FTM Report posted at on the NMED site does not identify the "uncertainty variables" in as clear and succinct a manner as the presentation by Dr. Ho and does not identify the range of values use for each of the "uncertainty variables" parameters used in model realizations to account for those sources of uncertainty for each of the contaminants modeled.

RECOMMENDATION: The FTM should be revised to identify the full range of uncertainty variables associated with each of the constituents addressed in the FTM.

The FTM should be revised to identify the range of values used in model realizations to account for the uncertainty associated with each variable.

II. Corrective Measures Implementation Plan Comments and Recommendations

A. **The CMIP fails to effectively incorporate the content and findings of the FTM in either the evaluation or design of the Corrective Measure proposed for the MWL**.

While the CMIP includes the full text of the FTM as Appendix E in the CMIP as posted by NMED, the body of the CMIP does not appear to refer to or incorporate any of the information identified in the FTM in the substance of the CMIP.

Neither the "Regulatory Basis" (Section 3), "MWL Characteristics" (Section 4), "Technical Basis" (Section 5), "Vadose Zone Moisture Monitoring" (Section 7), "Conclusions" (Section 8) nor "References" (Section 9.0) sections of the CMIP identify or refer to the FTM or the data it contains.

RECOMMENDATION: The CMIP should be revised to incorporate the analyses and findings in the FTM - when it is determined to be comprehensive and meet the requirements of the Permit Modification and associated guidelines and regulations by NMED - in the design, operation and monitoring and maintenance plans proposed by the permittee for the MWL.

B. **The CMIP fails to provide a comprehensive or detailed long-term operation and maintenance plan for public comment or review**.

While the MWL Permit Modification requires the permittee to provide an operation and maintenance plan, the CMIP only provides information about vadose zone instrumentation and defers the presentation of information on the duration and frequency of the operation and maintenance plan until the conclusion of an unspecified consultation process with NMED. That approach is identified as the process for development of a MWL long-term monitoring and maintenance plan. No aspects of a MWL monitoring program other than vadose zone monitoring are identified or addressed in the CMIP. See CMIP p. 7-1.

RECOMMENDATION: The CMIP should be revised to include a comprehensive long-term monitoring and maintenance program for public review and comment. The proposed long-term monitoring and maintenance program should include: all parameters to be monitored, all media – including air, soil, vadose zone, groundwater and biota (plants and animals); recommended limits of detection for analytic equipment to be use; frequency of sampling and analysis; quality control and quality assurance measures; monitoring and maintenance cost estimates; MWL cover inspections and maintenance activities; and measures to verify that all institutional control aspects of the proposed corrective measure are in place and enforced for the full closure and post-closure period at the MWL.

C. The CMIP proposes only three vadose zone monitoring sites – boreholes - and does not provide a demonstration that such an arbitrary and limited number of instruments will provide comprehensive vadose zone monitoring.

The CMIP at p. 7-1 describes a vadose zone monitoring program that includes three access holes based on the "simplicity, low cost and long-term viability" of the approach. Unfortunately, the permittee did not consider it appropriate to provide a vadose zone

monitoring program that is comprehensive enough to comply with the MWL Permit Modification or capable of monitoring the vadose zone beneath all of the MWL. This shortcoming in the CMIP is particularly significant in light of the FTM demonstrations that groundwater contamination due to VOC releases is inevitable as it occurs in all model realizations.

In its analysis, the CMIP fails to identify locations where contaminants from the MWL have been shown to have migrated from their point of disposal into the vadose zone in the Phase 2 RFI investigation nor does it correlate those locations with the three vadose zone monitoring sites in the CMIP. These locations are identified in the record of the MWL public hearing and include data from the "RFI Phase 2" conducted in the early 1990s.

No information is available on the extent of the migration of contaminants since the RFI Phase 2 investigations as such an investigation has not been required by NMED or attained and reported by SNL.

RECOMMENDATION: The CMIP should be revised to incorporate data from an investigation of the current extent of migration of contaminants into the vadose zone. The NMED should require SNL to conduct investigations using technologies such as ground penetrating radar and other geophysical methods to detect moisture distribution in addition to soil borings and other methods to insure that the vadose zone monitoring program can be demonstrated to be comprehensive and addresses the full extent of vadose zone contamination beneath and adjacent to the MWL.

The CMIP should be revised to include additional vadose zone monitoring that is capable of providing a comprehensive capacity to detect contaminants released from the MWL.

In the alternative, the CMIP should be revised to demonstrate that the proposed vadose zone monitoring system is configured in a manner that can detect all potential routes of migration of contaminants, including volatile and semi-volatile organic compounds, identified beneath or adjacent to the MWL in the RFI Phase 2 investigation.

D. **The CMIP fails to address the technical literature related to bio-intrusion barriers or identify monitoring systems appropriate for detect of release associated with bio-intrusion into the MWL**.

An extensive body of technical literature has been developed on bio-intrusion barriers as well as releases of contaminants through vertebrates, invertebrates and plants that have been shown to have penetrated bio-intrusion barriers. This data was summarized in a report by a leading international expert on bio-intrusion barrier design and function prepared for Citizen Action New Mexico and presented to the NMED as part of its comments on SNL's proposed corrective measure at the MWL. This report, "Review of Sandia National Laboratories/New Mexico Evapotranspiration Cap Closure Plans for the Mixed Waste Landfill," by Tom Hakonson, Ph.D., Environmental Evaluation Services, LLC, is available at http://www.radfreenm.org/pages/hakonson_full.htm.

In his report, Dr. Hakonson's asserted that assumption that "tritium is now present in vegetation and animals that now occupy the MWL" was correct. He also cited investigations in which Sr- 90, Cs-137 and Pu - all contaminants found at the MWL - have been discovered in animals occupying similar landfills containing mixed wastes and further states that biological transport of radioactive contaminants is likely to occur over time and increase over the long-term.

Information presented at the Mixed Waste Landfill Public Hearing in December 2004 by SNL confirms Dr. Hakonson's assertion regarding deer mice and vegetation at the MWL which show contamination with low levels of tritium and radon. See MWL Hearing Record Transcript at pp. 102 - 104 as noted in Hearing Officer Final Report at pp. 7 and 35.

Regarding biological transport of contaminants, Dr. Hakonson's report states:

"Both plants and animals have the potential to transport buried waste to the ground surface. Plants do so via roots that can penetrate several meters into the landfill. Furthermore, most plant species have the capability to penetrate the relatively thin cover soil layer proposed for the MWL. This means that the term, "shallow rooted" as used by the SNL/NM ET cap designers is inappropriate given that the grass species that they propose to use to revegetate the ET cover all have the capability to send roots several meters into the soil. If soil moisture penetrates beyond the existing rhizosphere, plant root distribution will extend downward to capture moisture at the deeper depths.

"Roots in contact with waste can incorporate soluble constituents and transport them to the ground surface. This uptake process is analogous to a one-way valve in that contaminants are pumped upward to above ground vegetation that eventually senesces and deposits associated contaminants on the ground surface. Burrowing by animals and insects also has the potential to access buried waste several meters below the ground surface. This can lead not only to chemical and radiation exposures to the organisms but also to physical transport of the waste upward in the soil profile and to the ground surface.

"This leads to what I believe is one of the more important deficiencies in the proposed MWL closure, namely the assumption that vertical and horizontal transport of site contaminants resulting from biological processes is not an important contributor to exposure pathways. My review suggests that relevant data from the MWL on contaminants in vegetation, animals, and soil cast to the surface by burrowing animals apparently do not exist. The reason biointrusion may be important is that it represents the major mechanism leading to vertical transport of contaminants to the ground surface and through the drying effect of plant transpiration on cover soils, plays a major role in the evolution of volatile contaminants from the ground surface. While vertical transport by biota may be small on a short time scale, over many decades these processes may become dominant in mobilizing buried waste.

"<u>It is my opinion that the soil sampling done by SNL/NM in 1990 as a part of the Phase 2 RFI provides little information that can be used to answer questions about the effects of biointrusion in transporting MWL contaminants to the soil surface. The RFI soil sampling grid resulted in evenly spaced samples (i. e., that were non-randomly distributed), that provided coarse spatial resolution of contaminant concentrations, and that involved sampling locations that were recently disturbed such as Trench F where</u>

backfill was added just months before the soil samples were taken. Furthermore, those samples that were taken in 1990 represent a single snap shot in time and depending on the degree of past mechanical disturbances that occurred within the MWL boundaries, they may represent a snap shot with little elapsed time between soil surface disturbance and when the soil samples were taken.[emphasis added]."

RECOMMENDATION: The CMIP should be revised to include a thorough investigation and re-sampling of the soil at the MWL to identify bio-intrusion mechanisms and biological transport of contaminants, and consider the relationship of these findings of such investigations to the Corrective Measure for the MWL. The NMED should consider revisions to the Corrective Measure permitted for the MWL based on information concerning biological transport in Dr. Hakonson's report and sampling data collected from the flora and fauna at the MWL by SNL since biological transport of contaminants has occurred - and continues to occur - at the dump.

The implementation of a comprehensive sampling program designed to detect levels of radioactive contamination in plants and animals living at the MLW is strongly recommended as a part of the CMIP with appropriate trigger levels to be used to determine future corrective actions at the MWL.

APPENDIX A

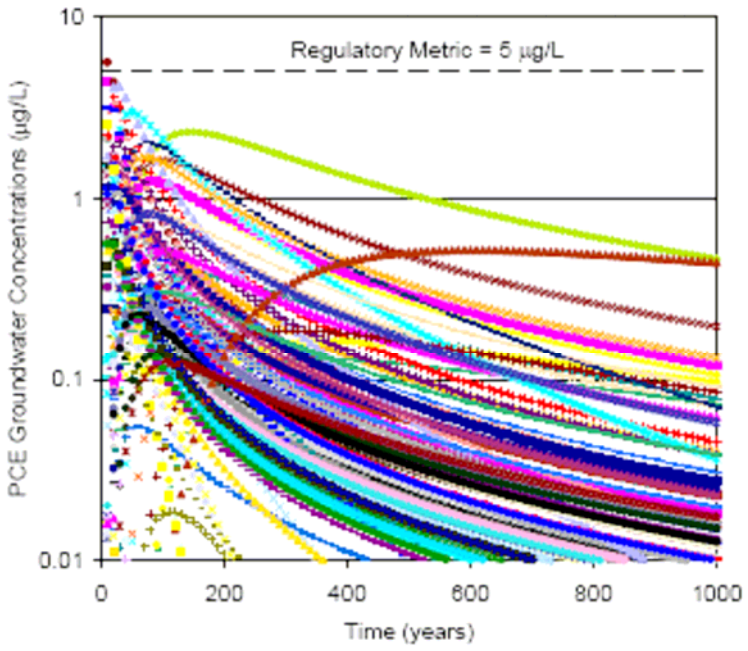

Figure 22. Simulated PCE groundwater concentrations for 100 realizations.

"Figure 22 shows the simulated PCE concentrations in the groundwater as a function of time for all 100 realizations. The majority of the realizations show the aquifer concentrations peaking before 50 years. Depending on the time of disposal, this corresponds to peak concentrations occurring by 2010 – 2040. So far, no detectable amounts of PCE have been found in the groundwater at the MWL. This is still consistent with the simulations, which show a large amount of variability in the simulated concentrations resulting from uncertainty included in the input parameters (see next section)." FTM at 54 –55.

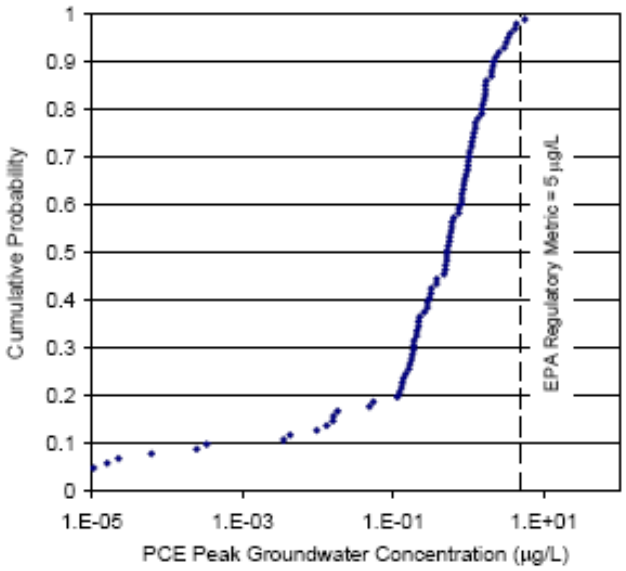

Figure 23. Cumulative probability for simulated PCE peak groundwater concentrations for 100 realizations.

CITIZEN ACTION

Advocating for clean up of Albuquerque's nuclear waste dump

February 7, 2006

Mr. John E. Keiling
Program Manager
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Dr. East, Bldg. 1
Santa Fe, New Mexico 87505

Dear Mr. Kieling:

Attached are comments compiled by Paul Robinson, Research Director for the Southwest Research and Information Center, on behalf of Citizen Action New Mexico regarding the Sandia National Laboratories' Corrective Measures Implementation Plan (CMIP) and Fate and Transport Model (FTM) for the Mixed Waste Landfill (MWL) required by the New Mexico Environment Department (NMED) as part of the Class 3 permit modification for the MWL.

We understand that Tech Law will be reviewing the CMIP and FTM for the NMED as well as reviewing comments submitted from members of the public concerning the CMIP and FTM during the public comment period.

Due to the number of deficiencies found in our review of the CMIP and FTM, the state's reliance on an outside contractor to review the CMIP and FTM as well as review public comments we would like to request that the NMED convene a "technical discussion group" with SNL representatives, NMED, and interested stakeholders to further evaluate both studies before the CMIP and FTM are determined to be complete by the NMED. This request has been included in our comments and recommendations.

P. O. BOX 262 Sandia Park New Mexico 87047 (505) 262-1862 www.radfreenm.org

We would also like to request copies of Tech Law's review and comments on the CMIP and FTM, including their comments on any revisions of studies.

If you have any questions please feel free to contact me at (505) 262-1862. Thank you for your consideration, and we look forward to your responses to our comments.

Sincerely yours,

Susan Dayton, Director
Citizen Action New Mexico
(505) 262-1862

4300 Bryn Mawr NE #51
Albuquerque NM 87107-4831
28 January 2006

Mr John Kieling, Program Manager
Hazardous Waste Bureau-NMED
2905 Rodeo Park Drive East, Bldg 1
Santa Fe NM 87505-6303

Dear Mr Kieling:

I have reviewed Paul Robinson's "Preliminary Sandia National Laboratories Mixed Waste Landfill Corrective Measure Implementation Plan and Fate and Transport Models: Comments and Recommendations." I am in agreement with all contained therein and as a result have further comments of my own. In addition, I am deeply disturbed by the implication of Robinson's comments that the plan was devised with economy more than safety in mind.

With regard to the biological transport of contaminants, I wish to point out that in addition to the numerous species of herbivorous, carnivorous, insectivorous and burrowing reptiles, mammals, birds and amphibians that might carry contaminants to higher levels in the food chain and spread them far beyond the landfill, there are many species of insects, spiders, worms and similar invertebrates that must be identified and the effects of their activities identified. In addition to surface flora, subsurface fungi, molds, bacteria and related species need to be taken into consideration. Soil bacteria that readily become airborne in high winds during drought conditions, as well as possible virus species, should have special attention. The agent that causes valley fever may well be subject to a high rate of mutation in the radioactive

environment of the landfill.

Human intrusion appears to be a far more serious matter than it has heretofore been considered. In this era of international terrorism and domestic hate organizations, the Mixed Waste Landfill might be considered an ideal location to create a "dirty bomb" by an explosion set off within or next to the materials deposited there. I can, for instance, imagine a hostile band tunneling into the landfill from outside the restricted area in order to create such an explosion.

I am told that New Mexico's oversight is limited to effects predictable within the next thirty years. There is one adverse effect possible within that time period that is indirectly subject to dangers that are believed to not reach a critical stage well beyond that limit. This is the effect of knowledge of inadequate attention to dangers to which the Mesa del Sol development might be subject. Even the threat of adverse impacts on the water, air and safety within the development area could seriously impact land values, thereby preventing the University of New Mexico from receiving full benefit from that project. It might even make the university and the state liable for any damages that do actually result.

I must, as a result, strongly urge that the Corrective Measure Implimentation Plan and the Fate and Transport Models be reconsidered.

Sincerely,

David M Brugge

David M Brugge

25 January 2006

Mr. John Kieling, Program Manager
Hazardous Waste Bureau - NMED
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505-6303

Dear Mr Kieling,

I would like to submit *comments on the Sandia National Laboratories – MWL CMI Work Plan*.

As an owner of 3 properties in the Kirtland Addition of Albuquerque, I am concerned about the possible contamination of groundwater resulting from spread of toxins now lodged in the SNL Mixed Waste Landfill. If indeed the Fate & Transport Model is correct that this could happen in as little as 50 years, then my investments could easily be trashed, and the whole neighborhood dependent on Burton Well is likely to be only the first of many to be abandoned.

What a bummer! There is much good housing stock here – close to UNM and easily accessible to downtown and the "historic Nob Hill District." I would be very disappointed if my future grandchildren could not return to their parents' childhood haunts because they had been condemned as unlivable.

I am sure that digging up the mess and finding someplace less hazardous to large human populations would be more costly than dumping more dirt on top of the MWL. But I for one would be willing to help foot the bill as a gift of foresight to generations hence. I would be very grateful if you would be willing to see your constituency as extending to the yet-unborn and would be willing to invest in their wellbeing. I am curious to hear your determination.

Sincerely,

Donna Detweiler
3500 Anderson Av SE
Albuquerque, NM 87106

316 Washington N.E.
Albuquerque, N.M. 87108

January 28, 2006

Mr. John Kieling, Program Manager
Hazardous Waste Bureau - N.M.E.D.
Public Comments;
Ref: Sandia National Laboratory's
Mixed Waste Landfill Corrective Measure
Implementation Plan and Fate and Transport
Models:

Sandia's F&T model is not a comprehensive study and neglects to consider a number of areas of serious concern:

1. The model fails to consider biological transport of contaminants.
2. The model fails to consider human intrusion.
3. The model fails to consider beryllium and metallic sodium as potential contaminants of concern.
4. The model fails to consider animals, plants, and humans as "triggers."
5. The model fails to consider appropriate "trigger levels" for all contaminants in the known inventory.
6. The model should consider conducting a risk assessment for the F&T model

(cont'd)

that includes all waste types buried at the landfill, not just the risk posed by tritium, which is all the current assessment includes.

7. The data used for the F+T model are outdated. New data gathering should be used to verify the validity of the modeling.

These are just a few of the factors that should be reassessed. The people of New Mexico deserve to have the laboratories of this state comply with every possible safety procedure. The model for containment currently planned by Sandia Laboratory for the Mixed Waste Landfill does not insure the safety of our groundwater and soil for the long term.

There is still time to continue to study and reassess these multiple problems. The New Mexico Environment Department has an obligation to require Sandia National Laboratory to complete these necessary reassessments.

(cont'd)

3/

I expect a response from NMED with regard to each of the concerns I have enumerated. We in New Mexico value our environmental department and trust that you will give due consideration to all of our valid concerns.

Sincerely,

Floy J. Barrett
316 Washington N.E.
Albuquerque, N.M. 87108

John Tauxe, PhD, PE

550 Kiva St.
Los Alamos, NM 87544
7 Feb 2006

Mr. John Kieling
Program Manager
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Dr. East, Bldg 1
Santa Fe, NM 87505

Mr. Kieling:

In response to NMED's Public Notice No. 05-18, calling for public comment regarding Sandia National Laboratories' (SNL) Mixed Waste Landfill (MWL) Corrective Measures Implementation Work Plan (including fate and transport model), I would like to submit the following comments regarding the fate and transport model, published as "*Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories*", SAND2005-6888. The intent in submitting these comments is to enhance the technical aspects of the modeling in a constructive manner.

1. General approach

The general approach taken in this effort is proper and commendable. Aimed at identifying appropriate locations and properties or constituents for long-term monitoring, the stochastic (probabilistic) modeling provides information for performing a sensitivity analysis, which in turn informs the monitoring program. This is an example of appropriate application of stochastic modeling, which is becoming more common around the Department of Energy (DOE) complex and within the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA). The Waste Isolation Pilot Plant (WIPP) Performance Assessment (PA) Group at SNL has been using the probabilistic approach to good effect for years, of course. While the general approach is acceptable, there are, however, several technical flaws that bring the overall results into question. These are identified in the following comments.

2. Inventory uncertainty distribution

The uncertainty distribution for the inventory of radionuclides in the MWL is undefended, applying a uniform distribution with a minimum at the values reported in SNL (1993) (see document references) and a maximum of only twice the minimum. No justification for this distribution is provided in the document, and in fact it is rather narrow given the uncertainties about the inventory apparent in the source document. First of all, it is highly unlikely that all inventory constituents share the exact same uncertainty distribution, so the uniform(x,2x) distribution seems *ad hoc*. Given that inventory uncertainty is often the greatest source of modeling uncertainty at other DOE sites, a more thorough analysis of these distributions should be performed. A common choice of distributional form, for example, is log-normal, which can be reflected in a statement such as "We believe with 95% confidence that the actual inventory is within a factor of 10 of the values stated in SNL (1993)." (Note that the values in that statement are made up for the purposes of illustration.) The current distribution would be stated as "We believe that the actual inventory cannot be less than the values in SNL (1993),

and cannot be more than twice those values, with equal likelihood that they lie somewhere in between." This is a much more constrained statement, and would require a more rigorous justification. Such justification is not provided in the document.

3. Biotically-induced contaminant transport

Perhaps the most significant oversight in the contaminant transport (CT) modeling of the MWL is the lack of any contributions to transport by biotic activity, which should have been identified in the preliminary exercise of identifying significant features, events, and processes affecting (and effecting) CT at the site. Recent PA work at other DOE sites (Los Alamos National Laboratory -- see the 1997 draft TA-54 RFI by LANL; Nevada Test Site -- see Cochran et al.'s Greater Confinement Disposal Boreholes PA by SNL, 2001) has found that biotic activity in the form of plant uptake and redistribution of contaminants and animal translocation of bulk (contaminated) materials can be significant or even dominant modes of CT. In arid environments, plants tend to extend roots to surprising depths in search of water. Ants have been found to construct nests to depths of several meters. A cap thickness of a meter (the MWL PA document reports and defends a proposed thickness of 3 ft.) is ineffective at keeping these biota out of the waste. If allowed to intrude, ants and plants can contribute to significant CT from the waste to the ground surface, resulting in increased doses from surface exposures and larger source terms for atmospheric dispersion. It is suggested that the SNL MWL Model take these processes into account.

4. Translocation of radon-222 parents

The document includes the development of a method for predicting the ground surface flux of radon-222 (^{222}Rn) above the MWL, as a linear function of the concentration of its parent, radium-226 (^{226}Ra), at depth. This model is fine under the assumption that all the ^{226}Ra stays at depth, but if biotically-induced transport of waste materials is included as a CT process, this parent material (as well as its parents, such as uranium-238 [^{238}U]) will move into the cap itself and onto the ground surface. This does not fit the current radon diffusion model assumptions, and must be modeled by more sophisticated techniques.

5. Ingrowth of decay products of radon-222

Although the inclusion of the decay products of ^{222}Rn does not affect its transport, they must nevertheless be accounted for for the purposes of assessing dose from and exposure to radionuclides involved in surface processes. In particular, ^{222}Rn decays through a series of short-lived radionuclides (which would be accounted for in a summation of dose conversion factors) to lead-210 (^{210}Pb), which in turn decays through another series of short-lived radionuclides to stable lead. These decay cascades can produce significant doses, and should not be neglected in the dose assessment process. When coupled with biotic processes in the cap, even in a cap too thick to allow biotic access to emplaced waste, the CT link of diffusing ^{222}Rn to ^{210}Pb deposited in the cap to biotic uptake or exhumation should be expected to bring ^{210}Pb and its decay products to the ground surface and near surface. Where there is ^{222}Rn, there will be ^{210}Pb, and it needs to be included in CT and exposure pathways to potential future receptors.

6. External exposure pathway

A potentially significant exposure pathway was overlooked in the model: external exposures from radionuclides in the ground surface and near surface. This exposure, colloquially known as "shine", should be included along with inhalation of gases and particulates and incidental ingestion of soils by potential future receptors who would have access to the site. Dose conversion factors for the external exposure pathway can be found in the EPA's Federal Guidance Report 12 (Eckerman and Ryman 1993).

7. Institutional control and future receptors

Although the SNL MWL PA Model takes cues from PA guidance published by DOE in locating a future receptor next the MWL rather than directly atop the MWL, this assumption is difficult to justify given the local context of Albuquerque's aggressive growth. At some point over the period of performance (set at 1000 years), is it not likely that the MWL would be overrun by development? To be fair, it is an open question, and answers may be had in the form of expert elicitation. At any rate, it would be safer (more conservative, and arguably more realistic, policy notwithstanding) to assume that the MWL could be forgotten and simply built over. Precedent exists for building residential communities directly atop waste sites (recall Love Canal, which was never even forgotten). Institutional controls are likely to fail (see *Risk and Decisions*, National Research Council, 2005, and Institutional *Controls or Emperor's Clothes? Long-Term Stewardship of the Nuclear Weapons Complex*, Applegate and Dycus, 1998). Therefore, a reasonable potential future receptor scenario is that of a residence built directly atop the MWL. This would trigger the analysis of additional exposure pathways as well, such as exposure to indoor air with its elevated concentrations of gaseous radionuclides and volatile organic carbon (VOC) compounds.

8. Period of performance

The period of performance for this analysis is 1000 years, also taken from the DOE PA guidance. If this analysis were in support of a genuine DOE Order 435.1-style PA, such a period might be justifiable, but this analysis is not subject to these constraints. The rather arbitrary selection of 1000 years, rather than the previous DOE Order 5820.2A's recommendation of 10,000 years, or the National Research Council's recommendation of modeling to peak potential dose, is not justified. This is recognized at some level in the document, since hints are made about analyses considering concentrations and doses at times exceeding 10,000 years. The 1000-year and 10,000-year benchmarks may be useful for comparisons with other sites, but the peak dose analysis should also be included. This reviewer recognizes that at some point, the times required become so excessive (the peak ground surface radon flux and associated potential doses generated by a ^{238}U parent will occur some time between 10 and 100 million years) that modeling them becomes impossible, given considerations of climate change and even geological change, but such an analysis can still be useful in providing perspective on the long-term significance of waste disposal.

9. Future releases and decay products of PCE

The MWL has a significant inventory of tetrachloroethylene (PCE), a fairly common "bad actor" VOC. Transport and fate of PCE is modeled reasonably, including decay from biotic degradation (although future releases of PCE from as-yet unbreached containers seems to have been neglected). The decay products, however, are not modeled, and yet can be significant (in fact they should be regarded as being

more significant) sources of cancer risk. PCE decays to TCE (trichloroethylene), which decays in turn to isomers of DCE (dichloroethylene), and then to VC (vinyl chloride). Some of these decay products have higher hazard indices than that of PCE, and cancer risk from them should be included in the model. It is also likely that biodegradation rates will vary with location in the model.

10. Conservatism

The model touts itself as being conservative in its assumptions, but this philosophy was applied inconsistently, with the location of a future residential receptor a case in point. But there is a more fundamental problem in attempting to be conservative, in that what is conservative is often not known, and cannot be predicted. For example, large infiltration rates may be considered conservative for a groundwater pathway, since infiltration will tend to drive contaminants down to groundwater faster. This is exactly not conservative, however, for surface pathways for the same reason. If contaminants are being removed from near-surface soils by infiltration of meteoric water (or the substantial water applied to residential landscaping), they are not available to contribute to exposures to potential receptors at the surface. If, on the other hand, infiltration is minimized, contaminants will tend to remain in the near surface, or at least in the waste zone, making a "conservative" assumption for surface receptors, but underestimating contributions to the groundwater pathway. In this example, the model could be run two different ways, each way being conservative for one of these pathways, but there are other perhaps hidden assumptions that will bias the analysis one way or another as well. This reviewer recommends abandoning the attempt to be "conservative" in favor of trying to be realistic in all assumptions. This actually works well with a probabilistic analysis, if input parameter distributions and CT mechanistic models are honest reflections of the modeler's state of knowledge, rather than some assumed bias attempting (and in some cases failing) to be conservative.

11. Monitoring of tritium and radon

The document suggests that monitoring of tritium and radon be conducted at the site boundary. This reviewer suggests that more valuable and interesting data are to be obtained by monitoring these constituents on the MWL itself as they emanate from the cap. Such monitoring will provide a more immediate and sensitive indication of gas emanation than can be provided by monitoring at the boundary.

12. *Ad hoc* sensitivity analysis

The sentivity analysis (SA) performed for this modeling captures the right idea of attempting to identify those model parameters and processes that most influence the results and recommending them for future monitoring. The SA, however, suffers from being rather *ad hoc*, rather than comprehensive. Details are missing, however, and this reviewer could be missing something, but it seems that the selection of parameters for SA may not have included all parameters in the model. Admittedly, a comprehensive SA, which would systematically assess the influence of every parameter in the model, is more difficult, but it is the only way to objectively determine what is sensitive. Selecting what might be sensitive based on professional judgment can result in missing sensitivities, which are often lurking in surprising places. In some cases, a poor choice of distribution can also mask what should be a sensitive parameter. For example, the unusually tight distributions selected for inventories (uniform varying only by a factor of two) may preclude the appearance of a constituent whose inventory really is more uncertain, and which really might be sensitive. It is recommended that a comprehensive SA be performed (and that the inventory distributions be revisited) or that, if this was done, that sufficient details be provided for the reader to understand the method.

I appreciate the opportunity for constructive input into this important contaminant fate and transport model.

Maurice A. Weisberg, M.D.
1677 Cerro Gordo Rd.
Santa Fe, NM 87501

To: John Kieling

Cover-up Plans for MWL

From its very onset, the AEC and DOE have been moving forward in what passes for its basic political vision, which will become a nightmare for communities and the environment. The goal is for the DOE to obtain variances for current environmental laws and obligations and walk away from doing actual, complete clean-up of its nuclear legacy.

What is going on is direct suppression and misrepresentation of the science. The DOE sees a result they want to achieve and they skew the data to get there.

The protection of the integrity of our aquifers is a matter of urgent national security, not only involving public health, but also the economic stability of the community.

The National Academy of Science in 2000 reported that most of the nuclear bomb sites will never be cleaned up enough to allow public access to the land and the plan for guarding these sites cannot guarantee the safety of the public. "At many sites the wastes will remain, posing risks to humans and the environment for hundreds of thousands of years. Complete elimination of unacceptable risks to humans will not be achieved now or in the foreseeable future." Even if the government declared certain areas permanently off-limits, it does not have the technology, money, or political will to prevent spread of the contamination. Some of the contaminants are already off-site and others will follow.

Biotransport of radioactive contaminants is likely to occur over time and increasingly over the long term (Hakonson). Another critic of the mythical "cap and cover" farce is Dr. Peter Montague, director of Rachel's Environment and Health Weekly, who indicated 5 or 6 reasons why dirt caps and vegetative covers fail. Among the problems are deep root systems extending as much as 20-30 feet below the surface; burrowing rodents and insects, erosions and cave-ins due to wastes and drums and debris collapsing.

Mr. Dick Fate of SNL believed there was so little risk that he referred to the capping of the MWL as an "elegant solution." This tribute to Sandia's science sounds like George Busch's congratulations of Brown at FEMA as a "heckava job" for Hurricane Katrina relief. It is well known that all dumps leak in wet or dry areas, especially if they are unlined and in porous or sandy soils.

Dick Fate at SNL objected that there are some materials in the site like radium, beryllium and cobalt, that if brought to the surface, would be unable to be moved to

another site. But, Dr. Eric Nuttalt said he thinks, “Sandia could move all the waste if they put their minds to it.”

At the rate tritium is moving laterally and deeply through the soil, we could expect contamination of the aquifer in less than ten years. TCE has reached the aquifer in area “V” at the liquid disposal area. At LANL, tritium is present in the drinking water and together with perchlorate and high explosive chemicals exist in springs that emanate from beneath LANL and feed the Rio Grande.

Such findings at LANL support the need for clean-up of waste sites that threaten ground water. This comparable situation at MWL demands the excavation of all mixed wastes buried in unlined, unregulated, and unpermitted pits and trenches to be stored in hardened facilities above ground.

Some of the SNL spokespeople have made unsubstantiated, erroneous, and blatantly false statements in public hearings that radioactive materials would not move through the vadose zone any further. Large quantities of liquid wastes were dumped into MWL before another facility was opened. Torrential rains do occur in the region. Dr. Arjun Makhijani of IEER (The Institute of Energy and Environmental Research) states that movement of nuclear debris through soil is much more rapid than the DOE and the nuclear labs have maintained. One of his charts shows the remarkable changes in estimates of travel time of Plutonium through the vados zone to the Snake river aquifer from 80 thousand years in 1965 to 30 years in 1997. Contaminants like Sr-90, tritium, and TCE move rapidly in plumes. Plutonium shows different rates of migration depending on local geologic conditions and probably takes preferred pathways as Canadian hydrogeologists have shown. It is Makhijani’s contention that the DOE and its contractors have proved unable to carry out a sound clean-up program because they lack strict criteria for expertise and experience relevant to the specific job, as well as accountability and openness.

It would be prudent to follow the advice of the Idaho trout farmer, Why would you put your outhouse over your main source of water?

Sandia has had problems with other landfills leaching wastes into ground water as in the case of the Chemical Waste Landfill and the Liquid Waste Disposal Area adjacent to the research reactors. TCE, a carcinogen, was present in both areas, and drinking water fountains are within a mile of this facility.

A 1989 FOIA document stated that elevated concentrations of Tritium were found in vegetation 5 km from the landfill.

Liquids were dumped freely into MWL up until 1972, before the Chemical Waste Landfill was constructed.

J.M. Gould, in his book on Nuclear Power (*The Enemy Within*), states that radiation makes chemicals doubly carcinogenic. Rachel Carson first pointed this out in her book *Silent Spring*.

Bear VII documents that there is no safe dose of radiation. It is a basic scientific fact that all levels of radiation are potentially harmful and damage the genetic material of generations to come.

Dr. Arjun Makhijani of IEER has been urging the DOE to concentrate its energy on excavating buried nuclear waste sites as a priority for shipment to a suitable, safe repository rather than dealing with wastes that are stored above ground. Obviously, this has been to no avail. Officials at the DOE were more concerned with fulfilling antiquated regulations than with developing a workable plan to deal with the threat of buried wastes perched above at-risk aquifers in major cities in primitive, unlined pits and trenches. This is a real axis of evil. This idée fixe of the DOE/ Sandia group is indeed a scientific sham and shame. How often will the DOE continue to proclaim, "Trust us, it will never happen on our watch."? A vital decision for the MWL should involve more than quantitative and engineering factors. It must not put this city's vital resources in jeopardy.

Respectfully,

Maurice Weisberg

John Kieling, Program Manager
Hazardous Waste Bureau -- NMED
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Feb. 6, 2006

Dear Mr. Kieling:

Please accept the following comments on Sandia National Laboratories (SNL) Mixed Waste Landfill (MWL), submitted on behalf of the Loretto Community of Catholic Sisters and Co-members. Sisters of Loretto have been serving the people of New Mexico for 153 years and have a deep love for the citizens and environment of this Land of Enchantment.

The SNL Fate and Transport Model (FTM) concluded that contaminants from the MWL will reach Albuquerque's sole source aquifer, Albuquerque's current source of drinking water, within a mere 50 years. Considering the seriousness of potentially contaminated drinking water, the FTM and the Corrective Measure Implement Plan (CMIP) are dangerously inadequate.

The FTM needs to be revised to consider the following issues:
1. possible transport of contaminants through animals and plants.
2. the ineffectiveness of a rock bio-intrusion barrier
3. comprehensive modeling of institutional controls against human intrusion
4. comprehensive analysis of potential human intrusion
5. model for all hazardous chemicals and volatile organic compounds known or suspected to be in the MWL
6. model for all potential new compounds which could be formed as a result of mixing radionuclides with non- radioactive materials
7. plan for monitoring, testing and dealing with contaminants that may show up in the future
8. risk assessment for all waste types buried in the MWL
9. recent data to verify the validity of the FTM, since the data used is outdated by at least 10 years
10. analysis of possible deterioration of each type of "container" for each type of waste buried in the MWL.

The CMIP should then be revised to include:
1. all the analysis of the revised FTM
2. a full long-term monitoring and maintenance program for public review and comment
3. demonstration showing how the proposed monitoring system will detect migration of contaminants.

While the above suggestions would make the MWL more secure, we are nevertheless convinced that the best plan to prevent the spread of contaminants and protect Albuquerque's groundwater would be to excavate the MWL and develop a comprehensive clean up plan to contain the waste in a safer area.

Respectfully,

Penelope McMullen, SL
Regional J&P Coordinator
Loretto Community
113 Camino Santiago
Santa Fe, NM 87501

pmsl@cnsp.com