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October 22, 2004

Mr. David Cobrain
State of New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East
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Reference: Work Assignment No. 06110.290.0002; State of New Mexico Environment Department, Santa Fe, New Mexico; Human Health and Ecological Risk Assessment Support; Summary of Sandia National Laboratory's Mixed Waste Landfill Risk Assessments, Task 2 Deliverable.

Dear Mr. Cobrain:

Enclosed please find the deliverable for the above-referenced work assignment. The deliverable consists of additional modifications to the summaries of risk assessments associated with the Sandia National Laboratory's Mixed Waste Landfill. The modifications were made at the request of Mr. Will Moats (NMED).

The document is formatted in Word. The deliverable was emailed to you on October 22, 2004 at David_Cobrain@nmenv.state.nm.us. A formalized hard (paper) copy of this deliverable will be sent via mail. If you have any questions, please call me at (303) 763-7188 or Ms. Paige Walton at (801) 451-2978.

Sincerely,

June K Dreith

June K. Dreith
Program Manager

Enclosure
cc: Mr. John Kieling, NMED
Mr. James Bearzi, NMED
Mr. William Moats, NMED
Ms. Tannis Fox, NMED
Ms. Paige Walton, TechLaw

TASK 2 DELIVERABLE

SUMMARIES OF RISK ASSESSMENTS ASSOCIATED WITH THE SANDIA NATIONAL LABORATORY'S MIXED WASTE LANDFILL

Human Health and Ecological Risk Assessment Support

Submitted by:

TechLaw, Inc.
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Submitted to:

Mr. David Cobrain
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In response to:

Work Assignment No. 06110.290

October 22, 2004

F. Risk Assessment of the MWL

Baseline Risk of Current Releases of Contaminants – On order to assess risk associated with the MWL, the DOE/SNL conducted a baseline human health and ecological risk assessment and a risk assessment associated with each of the remedial alternatives due. The results of these assessments are reported in the CMS Report. The baseline human health risk was modeled after modified residential and indoor worker scenarios, while the risk associated with each of the remedial alternatives were based upon only on industrial land use. The results of the human and ecological risk assessments are discussed below.

Baseline Human Health Risk

The baseline risk assessment assumed current conditions and no institutional controls. The baseline assessment provides an indication of total risk if no action was taken at the MWL. For the residential scenario, it was assumed that the resident resided off-site of the MWL. For the baseline industrial scenario, an indoor worker at the MWL was addressed. For the residential scenario, the hazard index (HI) for noncarcinogenic constituents of concern (COCs) is 10, and the excess cancer risk is 9.0E-05. For comparison, assuming maximum background concentrations, the HI of background conditions is 0.48 and the excess cancer risk is 5.0E-05. For radiological COCs, the DOE/SNL estimated a total exposure dose equivalent (TEDE) for the resident is 9.3mrem/yr with an excess cancer risk of 4.4E-05. For the indoor worker, the HI is 0.07 and the excess cancer risk is 3E-06. For comparison, assuming maximum background concentrations, the HI of background conditions is 0.01 and the excess cancer risk is 2.0E-06. For radiological COCs, a TEDE for indoor worker is 3.3E-01mrem/yr with an excess cancer risk of 2.2E-06.

Baseline Ecological Risk

The baseline ecological risk assessment evaluated a deer mouse, a burrowing owl, and plants and assumed current conditions with no institutional controls. Individual HQs were less than one for all COCs with the exception of barium for the omnivorous and insectivorous deer mouse. However, the overall hazard indices (HIs) exceeded the target limit of one (1). Although the risks are slightly elevated, the fact that the assessment was a screening level assessment and that several levels of conservatism were built into the assessment lends NMED to believe that the MWL does not pose undue harm to ecological receptors. Total radiation dose to the deer mouse and the burrowing owl are each estimated to be 1.6E-03 rad/day, which is less than the benchmark of 0.1 rad/day.

Risks Evaluated by the CMS -- The CMS report outlines four remedial alternatives for the MWL. Part of the review criteria for selecting the most appropriate alternative is that the remedy should be protective of both human health and the environment. As such, a risk assessment evaluating chemical and radiological risks to both human and ecological receptors was conducted for each of the potential remedies. For the human health risk assessments, both an on-site industrial worker and an off-site resident (baseline only) were evaluated. In addition to assessing risk associated with the four potential remedies, a baseline risk assessment was also evaluated. The baseline assessment represents current conditions with no further action (NFA) or institutional controls. The results of the risk assessments were weighed in selecting the preferred remedial alternative for the MWL.

Data collected during the Phase I and Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs) were used to identify the nature and extent of contamination in surface soil, subsurface soil, and groundwater. A limited amount of air sampling for radon was also conducted. Contaminants that were found to be above natural background concentrations were carried forward as COCs for the risk assessment. While both the Phase I and Phase II RFIs indicated some low-level releases of metals, organics, and radionuclides in soil, the primary COC identified was tritium. Both RFIs concluded that groundwater had not been impacted by contaminants from the MWL.

Methodology

The first step in identifying COCs was to compare detected concentrations to natural background levels, where appropriate. Organic chemicals do not exist naturally in background and were conservatively carried forward as COCs. NMED-approved background values were applied. For the baseline risk assessment and

the future excavation scenario, data collected from all surface and subsurface soil samples were evaluated. For the other remedial alternatives, only soil from zero (0) to five (5) feet below ground surface (ft bgs) were evaluated. For the ecological assessment, soil data from 0 to 5 ft bgs was applied. The exposure depths are consistent with Environmental Protection Agency- (EPA) approved methodologies.

The DOE/SNL proposed to further narrow the list of COCs by comparing concentrations to proposed Subpart S action levels. The Subpart S action levels were the precursors to currently applied preliminary remediation goals (PRGs). However, the Subpart S action levels were never promulgated and are presently not accepted in industry. As the DOE/SNL did not actually include this step in data reduction, no problems were noted. The exclusion of any data reduction in the risk assessment does result in a conservative estimate of COCs and overall risk.

The second step in the risk assessment was to look at the fate and transport of potentially released COCs in soil. This evaluation also provided a qualitative discussion as to the likelihood that detected COCs could migrate to groundwater. The DOE/SNL concluded that due to the arid environment, natural chemical degradation and decay, and depth to groundwater (approximately 500 ft bgs), the potential for COCs to migrate to groundwater is negligible. As future groundwater contamination was not anticipated and presently no groundwater contamination had been noted, the groundwater pathway was excluded as an exposure pathway.

After the COCs had been identified, the human health and ecological risk assessments were conducted. The assessments were conducted using standard EPA-and NMED-approved methodologies and algorithms. While some of the exposure parameters and toxicological data may not represent current input values, the data is consistent with EPA- and NMED-approved exposure parameters at the time of the drafting of the CMS. Revising the assessment to reflect the most current input data would not likely affect the overall conclusions of the risk assessments. Radiological COCs were evaluated using the RESRAD code, which is also standard practice.

Human Health Risk Results

The results of the risk assessment for the baseline scenario indicate that for the chemical COCs, both noncancer (hazard index of one) and cancer (1E-06) target levels were exceeded for the residential scenario. However, for the industrial scenario, the risks were within acceptable levels (hazard index of one and cancer risk of 1E-06). The EPA has set a range of risk of 1E-04 to 1E-06 as the acceptable risk range. The NMED enforces a limit of 1E-05, which was also exceeded. For radiological exposure, the DOE and the Nuclear Regulatory Commission (NRC) generally enforce a TEDE limit of 25mrem/yr. However, the EPA applies a more conservative value of 15mrem/yr. Both the industrial scenario and the residential TEDEs were below the EPA limit of 15mrem/yr. Cancer risks due to exposure to radionuclides were acceptable for the industrial scenario but exceeded the target level of 1E-06 for the residential scenario.

Radiological and chemical risks to the industrial worker and off-site resident for Alternatives I.a (no further action with institutional controls), III.b (vegetative soil cover), and III.c (vegetative soil cover with bio-intrusion barrier) were within acceptable levels. For the future excavation scenario (Alternative V.e), the TEDE was exceeded for a worker excavating the landfill.

Additionally, the DOE/SNL made a number of assumptions regarding potential exposures from chemical and radiological COCs in the cases of excavation and post-excavation workers. In the case of the excavation worker, the radiological risk is most likely underestimated and no chemical risks were estimated. Actual risk to the excavation worker would be significantly higher than presented in the CMS. For the post-excavation worker, a risk is best determined after the landfill has been excavated and using data from confirmation samples obtained post remediation. However, for the purpose of estimating risk for the CMS, an assumption was made that exposure would be the same as the baseline; however, this assumption does not account for all potential COCs that could be encountered as residual contamination from waste and results in an underestimation of risk. Regardless, it is clear that excavation of the landfill in the near-term could pose substantial risk to excavation workers.

Ecological Risk Results

The ecological risk assessment evaluated the plant community, a deer mouse, and a burrowing owl from exposure to both radiological and chemical COCs. The risks due to chemical COCs were slightly elevated above the target hazard index of one for all but the herbivorous deer mouse. However, none of the risks exceeded a value of 2. The assessment was a screening analysis and several conservative assumptions were built into the ecological assessment, including the use of no-observed-adverse-effect-levels (NOAELs). The DOE/SNL concludes that unacceptable risks to ecological receptors would not be anticipated. Based upon the conservativeness of the screening assessment, it is agreed that ecological risk is acceptable.

Acute Risk

Risks that could occur while implementing the remedial action alternatives were also quantified in the assessment. The risks included transportation-related injury and fatalities. The DOE/SNL concluded that the risks due to transportation accidents far outweighed the risks associated with chemical and/or radiological exposure.

Additional Comments

One of the corrective action objectives as outlined in Section 2.2 of the CMS report was to ensure radon emissions to ambient air do not exceed 20 pCi/square meter/second (limit set forth in 10 CFR §834). It was recently recognized that the report does not appear to provide estimations of radon flux. However, the issue of radon flux was addressed in a separate document: Radon Flux Testing at the Mixed Waste and the Adjacent Classified Waste Landfills, Technical Area III, SNL/NM" , dated January 18, 1998. Review of this report reveals that radon flux measurements were taken. The testing was conducted using 4-inch diameter activated charcoal canisters, which were sent to Thermo NuTech for analysis by gamma spectroscopy. The results of the sampling indicate that the criterion of 20 pCi/square meter/second has been met.

H. *Review of the Risk Screening Assessment for the Mixed Waste Landfill, SWMU 76,* July 2001, by Marvin Resnikoff, Ph.D.

Introduction--Dr. Marvin Resnikoff was asked by Citizen Action to review the risk assessment associated with the MWL Phase II RFI and assess whether the objectives of the report had been met and if additional analyses were warranted. Dr. Resnikoff's paper identified the Phase II RFI objectives as being to "determine thoroughly the contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and recommend remedial action if warranted." His general conclusion was that the contaminant source had not been identified and that potential risks posed by the landfill had not been fully evaluated.

Dr. Resnikoff's paper indicates that the Phase II RFI concluded that contaminants potentially released from the MWL will not pose significant threat to human receptors via the groundwater or inhalation pathways and that no significant health risks will be present for an industrial worker. Based upon his review of the Phase II RFI, tritium was identified as the primary constituent of concern (COC).

Background -- In the Background section of the paper, Dr. Resnikoff provides and overall summary of the risk assessment provided in the Phase II RFI. In addition, he iterates that the Phase II RFI indicates that for subsurface soil, the dominant exposure pathway for humans is ingestion of groundwater contaminated by COCs percolating through the landfill and soil. Dr. Resnikoff differs in his evaluation of the exposure pathways and indicates that the primary exposure pathway is inhalation and ingestion of COCs transported off-site via wind erosion. NMED agrees that for an off-site resident, the primary pathways would be inhalation and ingestion. These pathways were addressed in the baseline risk assessment associated with the CMS report, which replaces the Phase II RFI risk assessment.

Dr. Resnikoff also provides contrasting information to the conclusion drawn by Sandia in the Phase II RFI that groundwater has not been impacted. He indicates that low-levels of contaminants have been detected in groundwater and suspects that they may be the result of reactor cooling water that was disposed of in Trench D and/or the result of non-solidified liquids being placed in the landfill prior to 1975.

Baseline Risk Assessment -- Dr. Resnikoff categorizes his comments on the Phase II RFI baseline risk assessment into three categories: comments related to data collection and evaluation, exposure assessment, and risk characterization.

1. Data Collection and Evaluation

Dr. Resnikoff concludes that the contaminant source has not been fully characterized. Without understanding what constituents are present in the landfill, adequate risk/dose cannot be estimated and container failure cannot be estimated. He indicates that the entire inventory (classified and unclassified) should be provided. Dr. Resnikoff provides an example highlighting the importance and effect of the lack of the full waste inventory. Even without the waste inventory, Dr. Resnikoff concludes that the presence of activation products and actinides could render the landfill hazardous "essentially forever."

Dr. Resnikoff also outlines three concerns associated with Sandia's quality assurance/quality control (QA/QC) procedures:

A. Use of filtered versus unfiltered water samples. While Dr. Resnikoff notes that Sandia collected unfiltered samples, he is unclear whether the laboratory may have filtered the samples. This would result in potential underestimation of metals and radionuclides.
B. Samples with high concentrations were in some cases considered suspect and rejected, but no samples with unusually low concentrations were rejected. While the results from one laboratory were questioned, it appeared that the laboratory QA/QC procedures were correct, but the sample was still rejected. Overall the data set may be biased low.
C. Conflicting soil measurements for plutonium were obtained from three different laboratories, but without the core sample, the sample cannot be re-analyzed.

2. Exposure Assessment

In general, Dr. Resnikoff disagrees with the DOE/SNL's conclusion that the MWL is eligible for unrestricted release for four reasons: future risk under realistic scenarios was not considered; a full waste inventory has not been provided; there are high gamma exposure rates over some of the pits that have not been addressed; and the direct gamma rates are greater than 15mrem/yr. In response to the above concerns, Dr. Resnikoff would like the DOE/SNL to conduct a residential risk assessment at year 100, with a hypothetical resident and/or farmer residing on the MWL. The assessment should assume a complete lack of institutional controls, and include an assumption that crops could be grown and cattle raised on the MWL. In addition, a scenario in which a well is drilled through the contents of the MWL be considered.

Dr. Resnikoff acknowledges that the DOE/SNL proposes to use a vegetative cap as the preferred remedy. He discusses some of the drawbacks to this remedy, including providing for cap maintenance and prevention of burrowing animals. If the vegetative cap is the final remedy, Dr. Resnikoff believes a maintenance and monitoring dedicated trust fund should be established.

3. Risk Characterization

Dr. Resnikoff expressed some concern over the use of older dose conversion factors. The use of the older conversion factors does not allow for the estimation of dose to a child or fetus. The result is potentially an underestimation of dose. While NMED acknowledges more recently available dose conversion factors do allow for estimation of dose to a fetus and child, the position is that the site will be retained for industrial use only, and that risks due to a person residing over the MWL will be prevented. The restriction will be enforced both through the Consent Order and the permit. His other primary concern is that the cancer risks from chemical and radiological exposure were not considered as cumulative risk. This too provides an underestimation of overall risk. This concern is noted, and under RCRA, risks to radionuclides are

included in overall chemical risk when toxicity data are available. For example, uranium is typically included in the chemical risk assessment. NMED agrees that exclusion of the radionuclides in the chemical risk analysis could result in an underestimation of risk.

Conclusions --In conclusion, Dr. Resnikoff indicates that while some low levels of contaminants may have been detected in groundwater, the overall expectation for migration of COCs to groundwater is minimal. His recommendations for Sandia are:

1. Provide the entire waste inventory;
2. Conduct a risk assessment on future scenarios based at 100 years and with no institutional controls; and
3. A dedicated maintenance and monitoring plan be in place if waste is to remain in place.

A primary concern, as noted in conclusion No.2, is the evaluation of a resident at the end of the 100-year post-closure period. It appears that all parties agree that direct exposure to contents within the MWL to a resident would result in undue risk. Therefore the MWL is to be closed under an industrial scenario. Under both the Consent Order and permit conditions, DOE/SNL will be required to enforced the restriction of industrial use as long as DOE/SNL are the owner of the property. In the event that at some time in the future DOE/SNL transfers the property to another owner, the industrial restrictions would be transferred; if the buyer were a non-government entity, this would occur as deed restrictions. Thus, the potential that a resident will reside directly over the MWL or a farmer will grow crops or raise cattle will be prevented through these controls.