

**Analysis and Recommendations
Mixed Waste Landfill
Corrective Measure Study Final Report
U.S. Department of Energy and Sandia National Laboratories**

Prepared for

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by

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I. Summary

- A. Department of Energy and Sandia National Laboratories (DOE/SNL) recommend a modification to their hazardous waste permit that would result in implementation of a soil cover with a barrier to limit intrusion of animals as the corrective measure to be applied at its Mixed Waste Landfill (MWL). The permit modification is supported by a Corrective Measure Study Final Report (CMSFR). (DOE/SNL, 2003) which is the sole source of information cited in the SNL proposed permit modification. (DOE/SNL, 2004a). Background information regarding the location, site characteristics and waste management history of the MWL are available in the CMSFR as well as SNL, 1999, NMED, 2001 and Robinson, 2002, among other sources.
- B. If adopted, the SNL Permit Modification, as drafted, would result in a Corrective Measure Implementation (CMI) Plan for the proposed corrective measure that provides for no further efforts to investigate:
1. The extent of contamination at the site;
 2. The full inventory of radioactive and chemical constituents of concern;
 3. Decomposition or deterioration of wastes and waste forms; or
 4. Options for retrieval of hazardous or radioactive materials at the site.
- C. The New Mexico Environment Department is the “Administrative Authority” identified in the DOE/SNL Hazardous Waste Permit - Permit HWB-SNL-01-025, EPA No. NM5890110518 (NMED 1997) - that the DOE/SNL proposal would modify. According to that Permit, at Module IV.S.5.c, any Permit Modification based on the CMSFR must, among other applicable standards:
1. attain compliance with corrective action objectives for hazardous constituents in each medium as established in Module IV.S (CMS Scope of Work);
 2. control sources of releases;
 3. meet acceptable waste management requirements; and
 4. protect public health and the environment.
- D. This review demonstrates that the DOE/SNL Permit Modification fails to meet these and other applicable standards due to deficiencies in the CMSFR on which it is based.
- E. **The CMSFR fails to comply with corrective action objectives for hazardous constituents in each medium because it fails to address long-term risks to groundwater at the MWL** This concern is of fundamental importance as the MWL site overlies the groundwater supply that provides drinking water for the Albuquerque area. Groundwater contamination has been demonstrated at SNL waste disposal sites regulated by the NMED Hazardous Waste Permit for DOE/SNL. Though the regional groundwater level – water table – lies 400 feet or more below SNL, groundwater contamination at that depth - caused by Trichloroethene (Nitrate), Nitrate, Ethylbenzene, Toluene or Xylene has been detected at least four SNL waste disposal sites. (SNL, 1999, p. 4 – 36).

- F. Rather than address this demonstrated contaminant release pathway, SNL chose to eliminate consideration of groundwater contamination risk and analysis by stating “field studies and supporting modeling indicate that tritium from the landfill will not impact groundwater, which occurs approximately 500 feet” below ground surface. (CMSFR, 2003, p. 29). The CMSFR fails to acknowledge that, prior to detection of groundwater contamination, SNL filed studies that supported modeling that predicted releases from landfills would not impact groundwater.
- G. **The CMSFR is deficient as it fails to propose a corrective measure remedy that “controls source of releases” as it does not accurately identify the volume, concentration and physical form of all potential sources of releases, the radioactive and hazardous constituents at the MWL.** Instead of addressing “sources of releases” as required, DOE/SNL chose to prepare a CMSFR that focuses on releases already detected, not the sources of the releases or the radioactive and hazardous wastes at the site. The waste inventory provided in the CMS does not identify the volume or distribution of all known hazardous constituents in the landfill. For example, SNL lists “multiple fission products” rather than specific isotopes and radioactivity content; unspecific amounts of radioactive and hazardous constituents in “classified materials;” and fails to identify the amount and distribution of organic solvents and heavy metals for each of the pits and trenches at the MWL.
- H. **The CMSFR is deficient as it fails to propose a corrective measure that meets acceptable waste management standards including standard to protect human health and the environment at 40CFR264.111.** By proposing a simple cover with institutional controls on land use DOE/SNL proposes a remedy that requires perpetual active maintenance and leaves hazardous waste in place where leachate generation and hazardous waste decomposition will be allowed to continue. The CMSFR recommended alternative therefore fails to provide a remedy either, “minimizes the need for active maintenance and controls, [or] minimizes or eliminates . . . post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff or hazardous waste decomposition products to ground or surface waters or to the atmosphere.”
- I. The CMSFR fails to provide a corrective measure that protects public health and the environment because the corrective measure recommended would leave an aquifer currently providing public water supplies - an aquifer has already suffered contamination from unlined waste sites at SNL - vulnerable to contamination in perpetuity and only considers institutional controls for a 100-year period, after which CMSFR assumes administrative controls will fail.
- J. As the CMSFR fails to support provide a waste management that meets applicable standards NMED should, at a minimum:
- 1) Reject the proposed DOE/SNL not adequate to demonstrate compliance with applicable standards;
 - 2) Identify all necessary information to include and address in a revised CMSFR, including specific requirements related:

- a. Identify the volume and conditions are all hazardous constituents at the MWL;
- b. Complete risk assessments and risk evaluation for alternatives that consider human health and environmental consequences of the full range of radioactive and chemical hazardous constituents in the MWL;
- c. Identify remedies that reflect demonstrated remedial technologies and verifiable waste management costs;
- d. Identify risks associated with the deterioration of wastes and waste forms associated with corrective measures that result in waste remaining in place at the MWL;
- e. Identify a corrective measure proposal that provides for full retrieval of wastes at the MWL unless DOE/SNL establishes an enforceable financial guarantee - based on a model such as the Trust Fund established for the Mixed Waste Landfill at Oak Ridge Tennessee while Governor Richardson was DOE Secretary (summarized with citations to original decision documents in Robinson, 2002) - to insure that such a remedy will be implemented fully; and
- f. Support a Public Hearing to provide an opportunity to comment on any proposed action by NMED regarding the DOE/SNL proposed Permit Modification for the MWL.

Additional analysis, based on a review of the CMSFR is provided below.

II. Criteria for Review of the Proposed DOE/SNL Permit Modification and CMSFR

- A. The basis for the requirement to produce a Corrective Measures Study Final Report and Summary (CMSFR) in the Sandia National Laboratories (SNL) Resource Conservation and Recovery Act (RCRA) Permit is found at Module IV Part N that states:

“If the Administrative Authority determines that contaminants present a threat to human health or the environment given site specific exposure conditions, the Administrative Authority may require a CMS and shall notify the Permittee in writing. The notification may also specify remedial alternatives to be evaluated by the Permittee during the CMS.”

This notification was provided to SNL by NMED Secretary Pete Maggiore in October, 2001. (CMSFR, 2003, p. 9)

- B. Permit Module IV Part P requires that,

“P.1. [t]he CMS Final Report and Summary shall discuss the results of investigations of each remedy studied and of any bench-scale or pilot tests conducted. It must include an evaluation of each remedial alternative. The CMS Final Report shall present all information gathered during the CMS, and must contain adequate information to support remedy selection. In the CMS Final Report, the Permittee shall propose a corrective action that shall:

1. Attain compliance with corrective action objectives for hazardous constituents in each medium as established in Module IV.S (CMS Scope of Work);
2. Control sources of releases;
3. Meet acceptable waste management requirements; and
4. Protect public health and the environment.

“P.2. After the Permittee submits the CMS Final Report and Summary, the Administrative Authority will either approve or disapprove them in writing:

“If the Administrative Authority determines the CMS Final Report and Summary do not fully meet the objectives stated in Module IV.S the Administrative Authority may disapprove the CMS Final Report and Summary. If the Administrative Authority disapproves the Report, the Administrative Authority shall notify the Permittee in writing of the Reports Deficiencies and specify a due date for submittal of a revised Final Report and Summary...”

“P.3. Based on preliminary results and the CMS Final Report, the **Administrative Authority may require the Permittee to evaluate additional remedies or particular elements of one or more proposed remedies.**” (emphasis added)

“Q. Within 15 days of NMED approval of the CMSFR, the “Permittee shall submit a Permit Modification request according to Module IV.B.3, for corrective measure (remedy) selection, based on the approved CMS Final Report.”

C. Per Module IV.S.5.c., the CMSFR is required to include, at a minimum,

“... **a proposed corrective action that will attain compliance with the concentration level objectives, control sources of releases, meet acceptable waste management requirements and protect human health and the environment.**”(emphasis added) Detailed criteria for the CMS are listed at IV.S.4.

D. In its January 5, 2004 letter conveying its determination that the CMSFR was complete, NMED stated:

“At the end of the 60-day comment period, the NMED may request additional information from DOE/SNL concerning the permit modification. Once NMED is satisfied that all necessary information has been submitted in support of the request, NMED will prepare a draft permit and conduct a public comment period of no less than 45 days. It is anticipated that a public hearing will be scheduled as part of the public participation process. Be advised that the remedy incorporated in the draft (and final permit) prepared by NMED may differ from that preferred by DOE/SNL. Additionally NMED may require monitoring, maintenance and physical and institutional controls that are different than those specified in the CMS Report, and that such requirement will be based on the final selected remedy.” (NMED, 2004)

E. The DOE/SNL permit and NMED actions require compliance with regulations adopted pursuant to the Resource Conservation and Recovery Act which, at 40 CFR 264.111, establish a standard for closure of hazardous waste landfills that states:

“The owner or operator must close that facility in a manner that:

- 1. Minimizes the need for further maintenance; and**
- 2. Controls, minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run off, or hazardous waste composition products to the ground or surface waters or to the atmosphere....”**

- F. In January, 2001, NMED notified SNL and the public that the RCRA permit provisions addressing the MWL will be required to provide for:
- 1) “evaluation of the effectiveness of the cover at specified time intervals,
 - 2) monitoring, and
 - 3) should monitoring reveal a significant problem, other remedial measures, including excavation and removal of the landfill contents” (NMED, 2001).

III. Deficiencies in the CMSFR and bases for revision of the CMSFR and the DOE/SNL Proposed Permit Modification

- A. The CMSFR upon which DOE/SNL’s Proposed Permit Modification is based fails to provide all necessary information to demonstrate that the “... proposed corrective action that will attain compliance with the concentration level objectives, control sources of releases, meet acceptable waste management requirements and protect human health and the environment” as required by the existing DOE/SNL permit.
- B. Deficiencies in the CMSFR include, but are not limited to, its failure to:
1. Identify or consider information related to demonstrated waste characterization, sorting and remediation technology alternatives in use at DOE sites,
 2. Address the risks associated with all radioactive and hazardous constituents as the “sources of risks” at the MWL in risk evaluation and assessment activities, and
 3. Provide for an effective ground water protection measures sufficient to address the perpetual risk to groundwater presented by the waste in place at the MWL.
- C. These major defects and numerous others shortcomings and omissions have been identified in the CMSFR and documents cited by its authors. These deficiencies have been identified in comments identified in this report from NMED and members of the public, including a wide range of institutions and individuals.
- D. Significantly, DOE/SNL has failed to acknowledge or respond to the information presented regarding those deficiencies. A brief and superficial mention of “input” from the public, or bodies other than NMED is found at CMSFR, 2003, p. 29. **Nowhere are the substantive comments and recommendations of any public, governmental or publically funded independent reviews either identified or addressed in the CMSFR.** The CMSFR fails to cite any documents that constitute substantive information from the “public” in the sources of “input” listed on p.29. The CMSFR also fails to accurately reflect the content or conclusions of the sources

of input. It notes only that “excavation with above ground retrievable storage and partial excavation of hot spots (e.g., the classified area) were options proposed by the public” but fails to present the specific details provided in the “cover with future excavation” scenario in any of the documents prepared by the members of the public identified at CMSFR, p. 29. The sole “citizen entity” SNL identifies on p. 29 appears to no longer exist - “Albuquerque Citizen’s(sic) Advisory Board.” A website for the Citizens Advisory Board SNL/DOE at <http://www.abqcab.com/cabinfo.html> provides no information on activities or membership of any kind since the year 2000. SNL fails to identify or consider any of the reports or written input on MWL activities provided by *Citizen Action* or any other members of the public including failing to identify any specific comments provided during the public meetings noted at CMFRS, p. 29.

- E. As a result, DOE/SNL’s CMSFR fails to consider and respond to detailed technical comments and remedial recommendations) regarding “design and implementation precautions, including special technical problems, additional engineering data required, permits and regulatory requirements, access, easements, and right of way, health and safety requirements, and community relations activities” as required by Module IV.S.5.c. These technical comments include, but are not limited to, reports provided by two Peer Review Panels convened by Waste Education Research Consortium (WERC), and technical comments in a 2001 Resolution by the Albuquerque/Bernalillo County Groundwater Protection Advisory Board (GPAB, 2001), among others.
- F. The CMSFR fails to provide all appropriate and necessary information regarding sources of radioactive and chemical hazard in the MWL because its fails to identify the full range of radioactive and hazardous constituents at the site. As a result the CMSFR fails to consider the full range of risks posed by the MWL in the near-term and the long-term and the full cost of managing those risks for the near-term or long-term future. These concerns have been identified in both WERC Peer Review Reports and other documents that are not among the concerns or input identified in the CMSFR.
- G. A variety of documents are available that identify waste constituents and waste forms ignored in the CMSFR. For its inventory of waste constituents, the CMSFR relies on a reference listed as SNL/NM June 1998, titled “Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Feasibility Investigation, Dated September 1996,” June 5, 1998, without revision. (CMSFR, p. 18 and 68)
- H. A range of documents developed between 1998 and the 2002 compilation of the CMSFR address waste content and form matters concerns ignored in DOE/SNL June 1998 and the CMSFR. Waste constituent and waste form information available to, but ignored by SNL in its CMSFR:

1. Documents received by *Citizen Action*, in response to a Freedom of Information Act request provided to NMED and SNL, and summarized at the *Citizen Action* website at <http://www.radfreenm.org/pages/whatwhen.htm>.
 2. Information regarding sources of the unspecified “fission products” listed in SNL/NM June 1998 have been compiled by Dr. H. Eric Nuttall, Professor of Chemical and Nuclear Engineering, University of New Mexico, in a 2003 white paper titled “Sandia Mixed Waste Landfill/Nuclear Spent Fuel Disposal.” This information has been provided to NMED in hard copy and electronic version. Dr. Nuttall’s paper identifies a range of SNL documents that provide specific information on nuclear fuel melting experiments that were sources of material disposed of at the MWL that have not been identified in SNL/NM June 1998 or other SNL documents related to the MWL.
 3. “Review of the Risk Screening Assessment for the Mixed Waste Landfill, SWMU76,” by Dr. Marvin Resnikoff, Ph.D., Radioactive Waste Management Associates, July 2001 at: http://www.radfreenm.org/pages/resnikoff_review.htm also previously provided to NMED in hard copy and electronic version.
 4. “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, February, 15, 2002 (http://www.radfreenm.org/pages/hakonson_full.htm);
 5. "Is 'Trust Us, We're the Government' Really a Guarantee?" A Review of Financial Assurance Options for Long-Term Stewardship at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, New Mexico, USA”, Paul Robinson, Southwest Research and Information Center, June, 2002 (http://www.radfreenm.org/pages/robinson_full.htm) and
 6. Problems related to the accuracy and completeness of waste characterization and waste form information provided in the WERC Peer Reviews as reviewed below.
- I. The CMSFR also fails to provide necessary information to fully comply with the objectives of Module IV.S.5.c and includes failure to provide information necessary to address “special technical problems, additional engineering data requirements...” and other deficiencies noted by The WERC Peer Review and the Albuquerque/Bernalillo County Groundwater Protection Advisory Board (GPAB, 2001).
- J. Reports compiled by the two WERC Peer Reviews address a wide range of issues beyond the single item of “input” noted by the CMSFR authors. The lack of discussion of the range and scope of those reports demonstrates the lack of effective consideration of independent technical and public input by DOE/SNL in preparation of their CMSFR.
- K. WERC published reports of these panels as:
1. “Independent Peer Review of Department of Energy Sandia National Laboratories’ Mixed Waste Landfill,” August 31, 2001 at <http://www.werc.net/landfill/files/Final%20MWL%20peer%20review%20rep>

[ort.pdf](#) , a project funded by a specific Congressional appropriation to provide an independent assessment of monitoring activities at the MWL, and

2. “Independent Technical Peer Review of the of Department of Energy Sandia National Laboratories’ “Working Draft” Corrective Measure Study (CMS) November 2002 Mixed Waste Landfill,” January 31, 2003 at: <http://www.werc.net/cms/index.htm>, a project funded by an allocation from the Department of Energy.
- L. WERC retained independent technical professionals in both cases. Those experts produced detail technical reports identifying observations and recommendations derived from review of documents and presentations prepared by DOE/SNL’s MWL CMS research team and members of the public. The reports identify and request attention to a diverse range of concerns including, but not limited to, “design and implementation precautions, including special technical problems, additional engineering data required, permits and regulatory requirements, access, easements, and right of way, health and safety requirements, and community relations activities” as required by the DOE/SNL permit. Neither of the WERC Reports are identified or acknowledged in the SNL CMSFR. As such, DOE/SNL completely ignore the WERC reports, including the August 2003 Peer Review Report comments on the excavation alternatives and their associated costs as CMSFR Appendix H – MWL Alternative V.b – Complete Excavation with off-site Disposal” is dated November 22, 2002, more than two months prior to public meetings of the WERC Peer Review Panel in January 2003 and more than 10 months before the Panel’s Final Report.
- M. Albuquerque/Bernalillo County Groundwater Protection Advisory Board (GPAB) adopted a “Mixed Waste Landfill Resolution June 18, 2001,” following presentations by SNL representatives, City of Albuquerque technical staff, that identifies a range of findings and recommendations. GPAB was created in 1998 to as a means to implement the City of Albuquerque/Bernalillo County Groundwater Protection Policy and Action Plan formally adopted by the Albuquerque City Council and Bernalillo County Commission. The GPAB Resolution is neither cited nor summarized in the CMSFR. GPAB findings including:
- “1) Install a cover to prevent airborne transport of contaminants, limit infiltration of water into the landfill, prevent intrusion, and prevent erosion at the site.
 - 2) Continue monitoring efforts at the landfill until remediation activities are completed. Current efforts by Sandia National Laboratories and the Department of Energy to identify technologies for improved monitoring of contaminants in the environment and for waste recovery and/or stabilization of contaminated sites should be continued.
 - 3) Place a condition in Sandia National Laboratories' Resource, Conservation and Recovery Act (RCRA) permit that remediation of the landfill be evaluated every five years, or when a change of property ownership occurs, or when monitoring indicates a change of conditions within the landfill.
 - 4) Excavate the landfill and properly stabilize and dispose of the landfill materials when either:

- a) radiation levels decrease to levels acceptable for remediation activities, or
- b) the waste is determined to present an unacceptable risk to human health and the environment.

5) Sandia National Laboratories and the Department of Energy should develop a mechanism by which financial assurance can be provided to the City of Albuquerque, Bernalillo County, and the State of New Mexico to maintain adequate institutional control over the landfill as long as waste is present at the site. This financial assurance should include a provision for adequate technical and fiscal resources necessary to complete waste removal, disposal, and remediation activities at the site.

6) Work with the City of Albuquerque and Bernalillo County on land use constraints for the landfill that will prevent inappropriate development near the site.” (GPAB, 2001)

- N. DOE/SNL’s decision to ignore the specific comments of GPAB constitutes a deficiency in the CMSFR related to “design and implementation precautions, including special technical problems, additional engineering data required, permits and regulatory requirements, access, easements, and right of way, health and safety requirements, and community relations activities.”
- O. Therefore, in order to insure that all necessary information related to the proposed corrective measure is addressed in the CMSFR, NMED should require that the CMSFR be revised and expanded to address observations and recommendations related to matters identified in Module IV.S including, but not limited to, the documents listed in this section. The lack of a serious or substantive response any of the wide range of detailed technical comments from the public constitutes a DOE/SNL’s failure to effectively engage in fundamental “community relations activities” of formally acknowledging and responding to “design and implementation precautions, including special technical problems, additional engineering data required, permits and regulatory requirements, access, easements, and right of way, health and safety requirements.” NMED should therefore reject the streamlined CMSFR for its failure to address detailed technical comments and special technical problems identified by the public.
- P. CMSFR fails to respond or address NMED comments in its November 5, 2003 Letter Re: Notice of Deficiency MWL CMSFR including, at General Comment 2, “...NMED is unlikely to accept the operational cover [proposed in the CMSFR] because of the lack of documentation on its design, expected performance, the materials that it is constructed of, and the lack of construction quality data.” (NMED, 2003). DOE/SNL did not address this comment in its December 19, 2003 “Responses to the NMED” Notice of Deficiency. (DOE/SNL, 2003a).
- Q. CMSFR fails to address or demonstrate how the corrective measure it proposes will, with certainty, attain compliance with regulatory standards for hazardous waste landfills at 40 CFR 264.301. The regulation requires compliance with requirements for double liners and leachate collection systems all permitted landfills except, at 264.301b, if the Administrative Authority finds, “...based on a demonstration by the

owner or operator that alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents in the ground water or surface water at any future time.” Hazardous constituents have been demonstrated to have migrated into ground water at the SNL from at least four locations at unlined hazardous waste landfills (SNL, 1999 p. 4-36) in a hydrologic setting similar to the MWL.

- R. While the DOE/SNL CMSFR concludes at p. 29, “contaminants are unlikely to reach groundwater...,” it does not provide a rigorous or independent demonstration to support a conclusion by the Administrative Authority that the CMSFR proposal is a closure plan that is a set of “alternative design and operating practices, together with location characteristics, [that] will prevent the migration of any hazardous constituents in the ground water or surface water at any future time.” Therefore, the corrective measure proposed in the CMSFR is not sufficient to support an exemption to hazardous waste landfill requirements found at 264.301b. As the CMSFR does not provide a basis for the exemption, NMED must require a corrective measure design sufficient to attain the landfill design and closure standards of 40 CFR 264.301.

IV. The CMSFR is deficient, as the remedy it proposes fails to fully address and meet objectives in Module IV.S related to the requirement to “evaluate performance based on the effectiveness and useful life of the corrective measure,” with “useful life” defined as “the length of time the level of effectiveness shall be maintained.”

- A. Module IV.S.4.d.1.a.1. requires that, “the Permittee [in its evaluation of alternative corrective measures] shall evaluate performance based on the effectiveness and useful life of the corrective measure,” with “useful life” defined at s.4.d.1.a.1.b “as the length of time the level of effectiveness shall be maintained;” and
- B. IV.S.4.d.1.c. “Human Health -- The Permittee shall assess each alternative in terms of the extent to which it mitigates short- and long-term potential exposure to any residual contamination and protects human health both during and after implementation of the corrective measure...for management of mitigation measures, the relative reduction of impact will be determined by comparing residual levels of each alternative with existing criteria, standards and regulations acceptable to the Administrative Authority.”
- C. In sharp contrast to the “as long as needed” standard for assessment in IV.4.d.1.a.1. and 1.c, SNL only addressed a 100 year period for maintenance and institutional controls for corrective measure alternatives in the CMSFR, see p. 29 for example, rather than a period that would comply with the requirement to address “the length of time the level of effectiveness shall be maintained” in the Permit.
- D. At p. 9, and p. 51, the CMSFR states that SNL has “assumed that institutional controls (ICs) would be maintained at the MWL for the next 100 years.” The CMSFR supports this approach with the assertion that 100 years is, “the longest time period

that active ICs can be relied on for purposes of conducting performance assessment (NRC 10 CRF 61 2002).” DOE/SNL considers this a reasonable assumption given that the MWL is located in TA-3, a remote area of SNL/NM that the DOE or another federal entity will control for the foreseeable future” (p. 29 and 51). 100 years is an inappropriately short period of time to provide for control of a hazardous waste site, as the chemical hazards and a significant portion of the radioactive hazardous materials will be sources of risk for centuries beyond a 100 year period after site closure.

- E. The term “foreseeable future” as used in the CMSFR is not defined and does not correspond to the regulatory requirement to insure that corrective measures are established for “the length of time the level of effectiveness shall be maintained” as required by the applicable NMED regulations.
- F. The wastes at the MWL includes very long half-life radioactive constituents such as plutonium, uranium, depleted uranium and other identified and unidentified fission products and an unspecified amount of hazardous constituents such as lead, chromium, cadmium and a variety of organic solvents (as listed in CMSFR Attachment H – Table J.1.2 – “Waste Inventory and Distribution” and elsewhere). These constituents of concern present essentially perpetual sources of risk and that will require a corrective measure capable of an “effective useful life” much longer than 100 years.
- G. Significantly, the CMSFR fails to address human health concerns identified in IV.S.4.D.1.c. for the period beyond 100 years, including comparing residual levels of risk at the site between:
 - i. alternatives in which wastes are excavated and isolated from the environment so that no “residual level” remain and
 - ii. alternatives in which wastes are left on site that result in all waste at the site remaining as “residual levels” of radioactive and hazardous waste constituents at the MWL.
- H. Because the risks posed by the wastes at the MWL – including long-lived radioisotopes of plutonium, uranium and identified fission products and hazardous metals such as lead, chromium and cadmium among other hazardous materials - present hazards that require effective corrective measures that have a useful life much longer than 100 years, SNL’s decision to “limit the period of maintenance for institutional controls (ICs) at the MWL to only 100 years” results in the CMSFR remedy failing to comply with Permit requirement to “fully meet the objectives in IV.S” including an evaluation of corrective measure alternatives “the length of time the level of effectiveness shall be maintained.”
- I. The CMSFR fails to address the risk and uncertainty associated with future deterioration of waste forms - the containers or matrix holding the specific sources of risk - and potential releases or re-combination of hazardous conditions that could result. As a result it ignores critical long-term concerns that, if considered, prevent the

DOE/SNL preferred corrective measure from serving as a permanent closure remedy that meets the IV.S.4.d.1.c. Human Health standard that, “mitigates short- and long-term potential exposure to any residual contamination and protects human health both during and after implementation of the corrective measure...”

- J. As a result of these and other deficiencies, the remedy proposed by the DOE/SNL in the CMSFR fails to provide compliance with Module IV and its underlying regulatory and legal requirements.
- K. Therefore, the CMSFR should be revised to provide a corrective measure remedy that:
 - 1. Meets the objectives of Module IV.S.4.d.1.a, 1.b, and d.1.c;
 - 2. Addresses the full useful life appropriate for a closure and post-closure remedy for the MWL,
 - 3. Is based on risk assessments and risk evaluation that consider the complete consideration of the hazardous characteristics of the wastes at the site and
 - 4. Compares residual levels of hazardous constituents projected to remain in the MWL for each alternative with existing applicable standards identified by NMED.

V. The CMSFR fails to fully comply with the requirements of IV.S.4.D.1.d. as the CMSFR uses cost estimates that rely on cost assumptions unsupported by any reference material while, at the same time, failing to consider demonstrated remediation methods and costs.

- A. Permit Module IV.S.4.1.d “Cost Estimate” requires the Permittee to “develop an estimate of the cost of each corrective measure alternative and for each phase or segment of the alternative. The cost estimate shall include capital and operation and maintenance costs.”
- B. The CMSFR includes an “Appendix F – Additional Cost Details” that provides “the assumptions behind long-term monitoring costs, the estimation of waste volumes and waste characterization and disposal costs.” Significantly, CMSFR fails to provide any reference material, citations, or authors for information presented in Appendix F.
- C. At p. F-3, the CMSFR states: “Waste characterization costs are based on characterization costs determined during CWL (Chemical Waste Landfill, a landfill at SNL) excavation. Characterization of soil will cost \$1000/yd³. Characterization of debris will cost approximately \$10,000/yd³. Waste shipping and disposal costs are a function of whether the waste is radioactive or mixed waste. All debris from pits and trenches is considered mixed waste. All excavated soil is considered radioactive waste. The estimated disposal cost for mixed waste is \$8100/yd³. The estimated disposal cost for radioactive waste is \$810/yd³. These costs were obtained directly from the SNL/NM Radioactive and Mixed Waste Management Facility (RWMF).”

- D. No citations, personnel communication or other reference to identifiable, reviewable sources are provided for the information presented regarding Chemical Waste Landfill remediation or its application to the CMSFR for the MWL in Appendix F. The CMSFR References listed at pp. 67 – 70 fail to identify any sources of information that refer to the either Chemical Waste Landfill or Radioactive and Hazardous Waste Facility at SNL.
- E. CMSFR cost estimates for all alternatives corrective measures are summarized at CMSFR Table 3-2 and in Appendix B – “Cost Summary Reports for MWL Corrective Measures Alternatives.” The CMSFR authors, employing a computer program called RACER to develop cost information, using the unsubstantiated cost information in Appendix F as data inputs for the RACER cost estimates. Costs for corrective measures alternatives involving excavation, alternatives V.a – V.e on Table 3-2 range from \$72,512,261 - \$702,088,516. Table 3-3 provides “Cost Breakdown for Individual Excavation Alternatives. The cost of excavation, characterization and transportation represent:
- 77% of costs for alternative V.a. option A;
 - 88% of costs for alternative V.a Option B;
 - 93% of costs for alternative V.b Option A;
 - 92% of costs for alternative V.b Option B;
 - 70% of costs for alternative V.c Option A;
 - 76% of costs for alternative V.c Option B;
 - 88% of costs for alternative V.d Option A;
 - 83% of costs for alternative V.d Option B; and
 - 65% of costs for alternative V.e (the only excavation alternative to pass the screening level evaluation in the CMSFR).
- F. As this brief analysis shows, the dominant portion of the costs for each of the excavation alternatives are for the portion of corrective measure activity for which no specific or cited supporting cost data is identified from either SNL or independent sources. Effective use of a computer program such as RACER is dependent on the quality of the data underlying its calculations. The defects in the underlying cost estimates used in the RACER model prevent the acceptance of the RACER data in the CMSFR from being accepted as reasonable or accurate by NMED.
- G. The failure to identify cost estimate for corrective activities from independent or verifiable sources, including independent sources at DOE sites with aspects similar to the SNL MWL, results in the CMSFR failing to fully meet the objectives of Module IV.S as the accuracy of the cost estimates and their relevance to MWL corrective measure alternatives cannot be evaluated or verified by NMED or other reviewers.
- H. Regarding existing demonstrated remedial technology, the CMSFR fails to identify or consider any sources of performance evaluation or cost information for corrective measure technologies used by DOE at SNL or other sites, or corrective measure technologies used by other federal agencies at other federal sites. Available sources

for remediation technology cost information include the **Federal Remediation Technology Roundtable** at www.frtr.gov, **315 Technology Cost and Performance Case Studies** available at <http://costperformance.org/search.cfm> and information regarding the design and implementation of waste retrieval activities at INEEL Pit 9. DOE and other agencies have made enormous investments in development and demonstration of remediation technologies. Therefore, DOE/SNL's failure to acknowledge or incorporate that information into the CMSFR without a supporting explanation is an inappropriate and unreasonable response to the requirements for implementable corrective measure technologies.

- I. With respect to waste characterization technologies alone, the "Technology Cost" and "Performance Case Studies" include two examples from SNL related to RCRA permit activities not identified or considered in the CMSFR. These technologies provide for separation of radioactive and hazardous materials from non-radioactive or non-hazardous materials at remediation sites using commercially available "segmented gate systems" (SGS). SGS technologies provide the capacity to reduce soil volume requiring off-site disposal at cost a small fraction of the un-cited cost estimates in CMSFR Appendix F.
- J. Based on the documentation available, SGS technologies offer a corrective measure alternative already tested at SNL that demonstrate potential to significantly reduce the enormous cost the CMSFR presents using its unsubstantiated assumption that all soil and debris at MWL will require characterization, excavation, transport and disposal as either radioactive or mixed waste at the unit costs listed in Appendix F. NMED should require alternatives cost estimates based on published and verifiable remediation technology costs should be required for all cost estimates in a revised CMSFR.
- K. One SGS study, "Thermo NUtech's Segmented Gate System at Sandia National Laboratories, ER Site 16, Albuquerque, New Mexico" summarized at <http://costperformance.org/profile.cfm?ID=244&CaseID=244> addresses a "full scale" clean-up within the scope of the SNL RCRA permit at a site where depleted uranium – a contaminant of concern at the MWL - occurred at concentrations as high as 4100 pCi/g. The summary of this technology states that more than 660 yd³ were treated by this technology resulting in a 99.9% reduction in the volume of soil requiring site disposal at a cost of \$236/yd³.
- L. A second SNL SGS case study, "Thermo NUtech's Segmented Gate System at Sandia National Laboratories, ER Site 228A, Albuquerque, New Mexico" summarized at: <http://costperformance.org/profile.cfm?ID=245&CaseID=245> also addresses a "full scale" clean-up at a site covered by the SNL RCRA permit also where depleted uranium was the contaminant of concern. In this case, 1,325 yd³ were treated resulting in a 99.5% reduction in the volume of soil requiring off-site disposal at a cost of \$154/yd³.

- M. Full reports are available on these case studies and contacts for SNL personnel familiar with this study are identified on the case study websites.
- N. This data contrast sharply with, and contradicts, the CMSFR information in Appendix F by documenting technology costs 1/7th to 1/70th of the unsupported baseline assumption, “[c]haracterization of soil will cost \$1000/yd³. Characterization of debris will cost approximately \$10,000/yd³.”
- O. CMSFR at Appendix F states without citation to any experience at any site, “[a]ll debris from pits and trenches is considered mixed waste. All excavated soil is considered radioactive waste. The estimated disposal cost for mixed waste is \$8100/yd³. The estimated disposal cost for radioactive waste is \$810/yd³. These costs were obtained directly from the SNL/NM Radioactive and Mixed Waste Management Facility (RWMF).”
- P. The CMSFR fails to provide any analysis, supporting documentation, or basis for its conclusions that “all debris from pits and trenches is considered mixed waste” or why “all excavated soil is considered radioactive waste.” No basis is provided for conclusion regarding the determination that all debris would retain characteristics that require it to be defined as “mixed waste.” No basis is provided for the determination that all excavated soil would be defined as “radioactive waste,” or the specific category of radioactive waste it would become. The demonstrated full scale experience for the SGS technologies include a noteworthy performance measure of waste volume reduction of greater 99%. This data demonstrates that the CMSFR is both incomplete and inaccurate in with respect to the review of the performance and cost of technologies for waste characterization and waste minimization. The CMSFR should rejected for these reasons and a revision required that provides for provides verifiable, demonstrate data for corrective measure technologies to be considered.
- Q. The CMSFR assumptions regarding unsupported unit cost and unsupported determination that all materials retrieved become radioactive or mixed waste have the effect of significantly inflating cost estimates for corrective measures requiring characterization and remediation technology.
- R. The CMSFR fails to identify or incorporate documented experience in mixed or radioactive waste management at SNL, Idaho National Engineering and Environmental Laboratory (INEEL) or other DOE sites.
- S. THE CMSFR fails to identify or incorporate remedial cost or technology information developed for the Idaho National Engineering and Environmental Laboratories (INEEL) Radioactive Waste Management Complex Pit 9. This facility is undergoing a “retrieval demonstration test” as part of a remedy being applied by DOE/INEEL under the regulatory authority of the State of Idaho Oversight Bureau.

- T. Pit 9 at the Radioactive Waste Complex (RWMC) at INEEL is a relevant analog to the SNL MWL as Pit 9:
1. contains a mixture of radioactive and chemical constituents of concerns;
 2. includes legacy waste from DOE facilities generated during the 1950s, 1960s, 1970s and 1980s, and
 3. has resulted in documented vadose zone contamination.
- U. Selected overview references regarding the PIT 9 remediation process include:
1. “[Governor] Kempthorne declares INEEL Pit 9 waste retrieval a success,” March 2, 2004
<http://www.oversight.state.id.us/cleanup/GovsPit9NewsRelease.htm>
 2. “INEEL begins excavation at Pit 9 demonstration facility” -
<http://cleanup.inel.gov/news/default.cfm?FuseAction=Display&Fuse=Recent&Cat=6&ID=59>;
 3. “Excavation begins at Pit 9 Demonstration Facility”
http://cleanup.inel.gov/publicdocuments/documents/Pit9_factsheet_G1046-02.pdf ;
 4. “Completing Waste Retrieval” at: <http://cleanup.inel.gov/rwmc/>
 5. “The Radioactive Waste Management Complex” at:
<http://cleanup.inel.gov/publicdocuments/documents/rwmc-factsheet.pdf>
- V. The full compilation of regulatory documents on INEEL, including the management of buried waste at Pit 9 is found at: <http://ar.inel.gov/home.html> the “INEEL Clean-up and Waste Management Administrative Record and Information Repository.”
- W. Information at: <http://ar.inel.gov/home.html> can be accessed by “Waste Area Group” and Operable Unit Number.” Pit 9 is WAG 7 – Operable Unit 10 and information regard it is found at: http://ar.inel.gov/owa/select_by_ou_2?F_OU=7-10 .
- X. The failure of the CMSFR to identify or consider a broad range of corrective measures technologies and its associated costs already in use at DOE sites and other federal sites results in SNL having eliminated, without any consideration whatsoever, technologies that have been successfully applied is a major defect in the Report. DOE/SNL’s reliance on qualitative language without reference to supporting documentation provides a basis for NMED to reject the CMSFR and require a revision that relies on verifiable and demonstrable technology performance and cost information.
- Y. The CMSFR should be revised to:
1. Incorporate published literature on remedial technology options and their performance and cost related to DOE facilities in all proposed Corrective Measure alternatives and
 2. Determine, based on performance and cost information reviewable by NMED and the public, whether such alternatives provide an opportunity to fully comply with RCRA and Permit Module IV requirements,

3. Determine whether such information provides for a corrective measure remedy that achieves significant waste disposal volume reduction, and
 4. Determine whether such information demonstrates that the cost of corrective measures that involve “excavation-and redispisal-of-a-minimum-volume-of-hazardous-material” represent a small percentage of that presented in the CMSFR where all soil and debris excavated require full treatment as radioactive or hazardous wastes.
- Z. By ignoring published data for corrective measures at SNL the CMSFR appears to grossly overestimate the amount of material requiring disposal and the cost of the characterization of that material. Were the SGS technologies, Pit 9 technologies, or other identified existing remediation technologies incorporated into a revised CMSFR, significantly different cost estimates for alternative corrective measure analyses, waste characterization, and wastes handling, as well as significantly reduced waste volumes would be projected for MWL corrective measures options.
- AA. SNL has failed to provide reliable, accurate, referenced, or optimized technology and technology cost information with respect to the alternative corrective measure identified in the CMS. As a result of the failure of the CMSFR to reference cost and technology selection considerations, NMED has strong basis for requiring a wholesale revision of the CMSFR and ensure that the revised CMSFR accurately reflects the cost of a full range of corrective measure technologies, including waste characterization technologies and other technologies applicable to the MWL, but ignored in the CMSFR.

VI. References

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- GPAB, 2001 Groundwater Protection Advisory Board, "Mixed Waste Landfill Resolution," April 12, 2001, Albuquerque, NM. Hard copy available from the author of this report and has been provided with original of this report or by contacting: GPAB c/o City of Albuquerque Public Works Department, P.O. Box 1293, Albuquerque, NM 87103, (505) 768-3632, or <http://www.cabq.gov/waterresources/index.html>.
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Research and Information Center, June, 2002
(http://www.radfreenm.org/pages/robinson_full.htm)

SNL, 1999

SNL, "Sandia National Laboratories/New Mexico Site-Wide Environmental Impact Statement," Albuquerque, NM October 1999, DOE/EIS-0281

VII. About the Author

William Paul Robinson is Research Director at Southwest Research and Information Center, a non-profit education and research organization with offices in Albuquerque, New Mexico, USA. He earned his Masters of Community and Regional Planning, with honors from the University of New Mexico 1992. His professional project was “Planning for Reclamation of the Uranium Waste Sites in the Former Eastern Germany.” He taught “Introduction to Environmental Problems” and Environmental Evaluation Methods” at University of New Mexico as an adjunct professor from 1983-1997.

His research publications have been published by New Mexico Bureau of Geology (former Bureau of Mines and Mineral Resources), Freiberg Technical University (Saxony, Germany), British Columbia Chamber of Mines, New Mexico Law Review, among others. His contract research clients have included: European Union Science and Technology Directorate, Western Governors Association, Centex American Gypsum Company, Atomic Industrial Forum in addition to a wide range of community organizations in the US, Canada and other countries.