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August 7, 1990

Dr. Robert Browning
Director
U. S. Nuclear Regulatory Commission
Division of Waste Management
Mail Stop 623-SS
Washington, DC 20555

Dear Bob:

At the ACNW meeting on July 30, 1990, you suggested that we might try to get together to discuss some potential issues on HLW and TRU waste disposal standards before the September 15 Board of Radioactive Waste Management Seminar. Since I'm on an OTA Advisory Panel meeting in Washington on September 5, would sometime during the afternoon of September 6 be a good time for you?

A copy of the summary of a recent SNL report pointing out that DOE is confident that they can meet 40 CFR 191 for WIPP is enclosed.

Sincerely,

Robert H. Neill
Director

RHN:ct
Enclosure

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WM-1
NH01, 1/1

SANDIA REPORT

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Status Report: Potential for Long-Term Isolation by the Waste Isolation Pilot Plant Disposal System

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under Contract DE-AC04-76DP00789

EXECUTIVE SUMMARY

Before the Waste Isolation Pilot Plant (WIPP) may begin service as the United States' first repository for the permanent disposal of transuranic radioactive waste, the Department of Energy (DOE) must establish compliance with applicable environmental and safety regulations. This report addresses one major regulation, the United States Environmental Protection Agency's (EPA) *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes* (40 CFR Part 191 in U.S. EPA, 1985), hereafter referred to as the Standard. The report does not address compliance with other regulations.

This report summarizes Sandia National Laboratories' (SNL) early-1990 understanding of the WIPP Project's ability to comply with the long-term performance requirements set by Subpart B of the Standard. The report also reviews the current understanding of questions critically affecting compliance. Options available to assure that radionuclide releases will remain within regulatory limits are outlined, and the report concludes that SNL has reasonable confidence that compliance is achievable. Regulatory compliance cannot be formally evaluated at present because the Standard has not been reissued since it was vacated in 1987 by a Federal Court of Appeals. Available data and models are insufficient for complete simulations of repository performance; however, current simulations are adequate for programmatic guidance. Research in progress will increase confidence in predictions of performance, and if necessary, design modifications could assure regulatory compliance. Effective and feasible options for improving repository performance are being researched so that they will be available if needed, and the relative costs and benefits of these options are being assessed. The major question remaining is not whether the WIPP can comply with the Standard, but rather how it should comply.

Performance assessment and experimental research programs for the WIPP Project are conducted by SNL, the Scientific Advisor for the Project. Potential modifications to the present design of the disposal system are being evaluated by the Engineered Alternatives Task Force (EATF), assembled by International Technology Corporation for Westinghouse Electric Corporation, the Management and Operating Contractor for the Project.

Compliance with the Individual Protection Requirements, applicable to undisturbed performance, appears certain for the repository as presently designed. Preliminary calculations indicate that if the repository remains undisturbed,

no radionuclides whatsoever will be released during the period of regulatory control. Expected undisturbed performance satisfies regulatory limits by orders of magnitude.

Currently, compliance with the Ground Water Protection Requirements is not relevant because no "special source of ground water," as defined by the Standard, exists at the site. The brines present in small quantities in the Salado Formation that contains the repository and in larger quantities in the overlying units are highly saline, and none is a source of drinking water.

Preliminary calculations also suggest compliance with the Containment Requirements can be achieved for the repository as currently designed. The compliance evaluation is dominated by inadvertent human intrusion. Calculations suggest that releases following intrusion by an exploratory borehole possibly could exceed regulatory limits if several extremely unfavorable circumstances coincide. Those circumstances have been assumed for the most pessimistic simulations. Performance-assessment work has therefore concentrated on better simulating consequences of human intrusion to determine effects on compliance and to determine what, if any, modifications might be needed to assure compliance.

The limits set by the Containment Requirements of the Standard are defined probabilistically. One limit is specified for releases resulting from events or processes with a probability of greater than 1 chance in 10 during the 10,000 years following decommissioning of the repository. A second, higher limit is specified for releases that might result from less-likely circumstances with probabilities of occurrence between 1 in 10 and 1 in 1000. Radioactive releases resulting from circumstances with less than 1 chance in 1,000 during the 10,000-year period are not limited.

The EPA's intent was to link regulatory limits to the probability of release, allowing compliance to be judged on the probable circumstances of the next 10,000 years, rather than on the worst conceivable circumstances. As a consequence of this approach, performance assessments used to evaluate compliance must be probabilistic. The SNL performance-assessment team must determine probabilities for future events, including human intrusion, and must assign probabilistic distribution functions to all uncertain or variable parameters that may affect long-term performance.

Multiple simulations using a complex modeling system and an extensive database will be needed to generate probabilistic predictions. Because some model components and portions of the database are still incomplete, predictions to date have been based in part on conservative assumptions. Available

predictions are therefore believed to be pessimistic: actual performance is highly unlikely to be worse than predicted and may be substantially better. An expanded database and improved models will permit more accurate predictions that may show less-pessimistic estimates of radionuclide releases.

All performance assessments to date have pessimistically assumed that any plugs installed in an intruding borehole will deteriorate to be no more effective than sand and rubble. This report presents analyses to show that if future drillers recognize the implications of their mistake and plug the borehole as effectively as the repository will be sealed upon decommissioning, long-term radionuclide releases should not occur. In this case, even with the current design for the repository and waste, the WIPP will remain in compliance with Subpart B of the Standard.

All performance assessments to date have also assumed that intrusion will occur. The possibility cannot be ruled out, but research is in progress to design a passive marker system that will significantly reduce the probability of intrusion. Because future human actions cannot be quantified by conventional research methods, the potential effectiveness of markers will be evaluated by a panel of experts. Qualitative judgment will determine the appropriate probability of intrusion.

Uncertainties about the consequences of gas generation within the repository further complicate performance simulations. Available evidence suggests that gas generation and a rise in pressure will not degrade undisturbed performance. Significant radionuclide transport requires a liquid medium, and increased gas pressures could keep the repository too dry for transport to occur. Gas generation has the potential, therefore, to enhance undisturbed performance. If intruders penetrate a pressurized repository, however, radionuclide releases could be larger than presently predicted. Research is in progress to develop the database and models needed to make more accurate predictions and to determine what steps, if any, should be taken to mitigate the effects of gas generation. Consequences of gas generation have not been explicitly addressed in the calculations thus far.

If future simulations of performance following intrusion continue to show a possibility of releases exceeding potential regulatory limits, design modifications may be necessary to reduce the potential for radionuclide transport up a borehole. This report presents analyses to show that significant reductions in the porosity and permeability of the waste or in radionuclide solubility through engineered modifications could assure compliance with Subpart B of the vacated Standard even without effective borehole plugs.

Engineered modifications being researched could reduce waste permeability and radionuclide solubility and alleviate potential problems of gas generation. These modifications would be designed to reduce the removal of radionuclides during and after an intrusion. Alternatives that are feasible with present technology are available and could assure acceptable performance. Experimental data and interpretations made during testing could indicate, however, that extensive engineering modifications are not required; furthermore, health and safety risks from waste treatment could be unacceptably high relative to benefits for long-term isolation. It would be inappropriate to recommend specific engineered modifications at this time.

SNL believes the WIPP Project can achieve compliance with Subpart B of the 1985 Standard. The Project is pursuing concurrent and parallel paths to assure compliance. Following the original path, SNL will continue to acquire the database and develop the models needed for adequately predicting repository performance as currently designed because this design is considered adequate. Research will evaluate methods to mitigate gas effects and better calculate their consequences. Because the outcome of ongoing research cannot be predicted now, however, two additional paths, implementing passive institutional controls and investigating alternative waste forms and repository designs, are being examined simultaneously to provide more confidence in compliance. Repository-design or waste-form modifications may or may not be required, but they are being evaluated and tested so that they will be available if necessary.

Scientific and engineering investigations are now directed at finding the optimal solution to the "reasonable expectation of compliance" required by the 1985 Standard.