Department of Energy
Carlsbad Area Office
P. O. Box 3090
Carlsbad, New Mexico 88221

AUG 23 1995

Mr. Benito Garcia
New Mexico Environment Department
P.O. Box 26110
Santa Fe, N.M. 87502

Dear Mr. Garcia:

Enclosed are responses to comments on the *Compliance Status Report for the Waste Isolation Pilot Plant.* Your ideas were valuable to the Carlsbad Area Office (CAO) as we prepared the Draft Compliance Certification Application, the Draft No-Migration Variance Petition, and the Resource Conservation and Recovery Act Part B Permit Application-our "new compliance documents." The CAO does not plan to revise and reissue the Compliance Status Report (CSR). Instead, we plan to focus our attention toward our new compliance documents.

I would like to emphasize that the most recent Waste Isolation Pilot Plant information relative to regulatory compliance is contained within the new compliance documents; in effect, the CSR has been superseded by these documents. Every effort has been made to ensure that the responses to your comments on the CSR do not conflict with the information provided in the new compliance documents. If you have any questions, please contact James Maes of my staff at (505) 234-7470.

Sincerely,

Michael H. McFadden
Assistant Manager
Office of Regulatory Compliance

Enclosures

ATTORNEY GENERAL OF NEW MEXICO
COMMENTS ON THE COMPLIANCE STATUS REPORT FOR THE WIPP
(DOE/WIPP 94-019, Rev. 0)

AG-1 COMMENT

COVER LETTER

We request that these comments be taken into account in the SPM-2 phase of the Systems Prioritization Method review.

AG-1 RESPONSE

This was done to the extent that the comments were also provided during the SPM stakeholder meetings and comment periods.

AG-2 COMMENT

COVER LETTER

Please advise whether a revised version of the CSR is to be issued, and, if so, on what schedule.

AG-2 RESPONSE

Comments to the CSR will be addressed, however, the CSR will not be revised.

AG-3 COMMENT

1.0 INTRODUCTION

This chapter provides background information. It should be noted that the NAS study cited (NAS-NRC, 1957, cited at 1-3) proposed that a salt site be employed if regulatory issues were resolved before the site is developed (Id.4).

AG-3 RESPONSE

Regulations are written in terms of safe disposal, independent of the media in which disposal is to occur. The reference to the NAS-NRC report was intended to indicate that salt had been considered for radioactive disposal as early as 1957.

AG-6 RESPONSE

This statement was intended to indicate that the DOE believes that portions of the WIPP Test Phase NMD will be applicable to and should be carried through to any future NMD for WIPP disposal. Some portions however, specifically those that only applied because of the test phase focus, will likely not be reasonable precedent. The EPA will make the final determination regarding what precedents will be applicable and appropriate for future compliance decisions.

AG-7 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

This chapter ought to contain the critical data about the proposed repository's performance which will be employed in creating and validating models for performance assessment. Thus, this chapter may be the most important one in the CSR. However, the discussion varies markedly in the depth of treatment of different aspects of the site. Presumably, the discussion of geologic features (e.g., 2-1 through 2-10) is offered as general background. Occasionally, specific detail is furnished (2-11 through 2-21), sometimes without citation, sometimes with (see 2-21). However, the text fails to convey the extent of uncertainty and conflict on critical issues and largely consists of conclusions rather than supporting data (Id.). If the purpose of the CSR is to enable the reader to assess the status of scientific data on points relevant to compliance, it does not help to mask questions of data sufficiency and interpretation by stating summary conclusions.

AG-7 RESPONSE

At the time when this document was developed it was thought that the CSR would have a broad audience. For this reason, we strived for a balance between the needs of the scientific community and the needs of the general public. To address the needs of both groups, it was DOE's intention to have the CSR discuss technical issues in a readable format. For that reason, citations were kept to a minimum. For example, the so-called summary conclusion statements in the part of the CSR that this comment notes (p. 2-21) were derived from the Beauheim and Holt article (1990) that is cited in the first part of the paragraph starting on page 2-17.

AG-9 **COMMENT**

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.2.1 Physical Hydrogeology of the Shallow Flow Regime

There is extended narrative description of alternative models (confined aquifer and groundwater basin) but no concrete presentation of either, and no choice among them is stated. The CSR also states that a physical transport model is necessary (2-30). Clearly so, but it would advance study of the compliance status to set forth with citations the most current relevant data, rather than paraphrasing without citation.

AG-9 **RESPONSE**

The CSR was not intended to serve as the primary scientific document for everything that supports or fails to support compliance. Rather, in most cases it served only as a source reference document to direct the reader to the primary sources of the raw data, which will for the most part be found elsewhere. This comment, however, provides important insight as to the detail that may be needed within or associated with the Compliance Certification Application.

AG-10 **COMMENT**

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.2.1 Physical Hydrogeology of the Shallow Flow Regime

The CSR fails to express the current state of uncertainty about Culebra flow and transport. Large-scale pumping tests in the Culebra have shown the heterogeneity of the transmissivity of the rock body. The local-scale flow model is based on calibrated transmissivities using various data sources, as recently explained in the May 3-5, 1994 meeting with EPA. This model is based on limited borehole data and calibration to observed undisturbed and transient data. DOE must defend the sufficiency of the borehole data to characterize transmissivity in light of the observed heterogeneity of that rock body.

DOE must also set forth in detail, and justify, the calibration methods. There is a question whether existing data are sufficient to describe the size and characteristics of the apparent high-transmissivity zone in the area of boreholes H-15, DOE-1 and H-11.

Among the concerns raised by the GXG were the subjectivity inherent in the manual calibration approach used in the 1991 PA and the manual assignment of transmissivities to the pilot points. The 1992 PA attempted to address some of the concerns raised by the GXG, but it was recognized that a method was needed to verify the pilot point calibration methodology. This task was given to the GXG, which has now been engaged for several years in an international exercise designed to test various inverse methods for solving the calibration problem presented by the WIPP transmissivity data. Although some preliminary work has already been published by some of the GXG panel members, the final report on this calibration effort has not yet been generated.

REFERENCES

Beauheim, R. L. 1986. *Hydraulic-Test Interpretations for Well DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site*. SAND86-1364. Albuquerque, NM: Sandia National Laboratories.

Beauheim, R. L. 1987a. *Interpretations of Single-Well Hydraulic Tests Conducted At or Near the Waste Isolation Pilot Plant (WIPP) Site, 1983-1987*. SAND87-0039. Albuquerque, NM: Sandia National Laboratories.

Beauheim, R. L. 1987b. *Interpretations of the WIPP-13 Multipad Pumping Test of the Culebra Dolomite at the Waste Isolation Pilot Plant (WIPP) Site*. SAND87-2456. Albuquerque, NM: Sandia National Laboratories.

Beauheim, R. L. 1987c. *Analysis of Pumping Tests of the Culebra Dolomite Conducted at the H-3 Hydropad at the Waste Isolation Pilot Plant (WIPP) Site*. SAND86-2311. Albuquerque, NM: Sandia National Laboratories.

Beauheim, R. L, T. F. Dale, and J. F. Pickens. 1991. *Interpretations of Single-Well Hydraulic Tests of the Rustler Formation conducted in the Vicinity of the Waste Isolation Pilot Plant Site, 1988-1989*. SAND89-0869. Albuquerque, NM: Sandia National Laboratories.

Cooper, J. B., and V. M. Glanzman. 1971. *Geohydrology of Project Gnome Site, Eddy County, New Mexico*. United States Geological Survey Professional Paper 712-A. Washington, D.C.: United States Geological Survey.

Treatment of Culebra transport in the final PA will be justified in the CCA.

AG-12 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.2.1 Physical Hydrogeology of the Shallow Flow Regime

More basically, it is not yet certain that double-porosity behavior is the nature of transport in the Culebra; the INTRAVAL analysis indicates the possibility of channel behavior.

AG-12 RESPONSE

See the response to AG-11 above.

AG-13 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.2.1 Physical Hydrogeology of the Shallow Flow Regime

The May 4, 1994 presentation by-Sandia to EPA brought forth shortcomings in the current transport models (heterogeneous and anisotropic), including their inability to match hydraulic and tracer data, inability to reflect horizontal and vertical variability, inability to validate the conductivity tensor, limitations of the slug injection technique, and failure to study problems of scale. These issues seem to require further data, possibly tracer test data. Whether the proposed single well and multiwell tracer tests themselves can satisfactorily identify and characterize double porosity behavior is uncertain. The data generated will pertain only to a specific portion of the area of interest. Extrapolation remains an unanswered question. Parts of the area display heterogeneity or anisotropy in different behavior for different transport paths.

AG-13 RESPONSE

The comment is a general description of the types of uncertainty associated with characterizing the flow characteristics of a site, with particular emphasis on the supra-Salado rocks, and mentions the single and multiwell tracer tests in progress. While the comment does not pose a question, many of the 'shortcomings' mentioned therein are in fact addressed by a variety of

results of the examination of integrated phenomena in column tests?

7. As to analyses of integrated phenomena (e.q., intact rock column experiments), can they contribute to the resolution of problems of scale and heterogeneity? What is the basis for extrapolating data generated from studies of a limited number of cores across the entire area of interest?

AG-14 RESPONSE

This comment has seven parts:

1. The lab tests are designed to provide information that can be used to develop local-scale process and parameter information. This information can be used to bound the effects of a process or range of parameters expected at larger scales. How this is accomplished cannot be pre-judged, but rather is largely by inference on the part of the Principle Investigator based on observations made during core selection, preparation, and experimentation. The inferences relate to such observable and documentable features such as the number of fractures in core versus the number in formation, and may also include numerical modeling exercises. Methods are available for the stochastic quantification of uncertainty between sample points; these will be applied to the column experiments, as appropriate.

2. Sufficient data are available for characterizing the Culebra for modeling purposes. These data will be used in two general ways-- modeling processes explicitly where adequate data exist to justify a parameter range and mechanistic model, and through modeling assumptions to capture uncertainty about the possible effects of a process or model where adequate data does not exist to justify a particular implementation.

3. No additional data are required. Current implementations of the Culebra fracture model are primarily based on conservative interpretation of existing data from multiwell tests. As more data are collected, such as from single or multi-well tracer tests, the basis for modeling assumptions and treatment in PA of Culebra flow will be re-evaluated and modified if need be. The final PA

the Culebra aquifer are inconsistent with the direction of groundwater flow indicated by measured potentiometric heads. (Ramey 1985, at 21, 23-24). Areas of lower transmissivity would be expected to contain higher amounts of dissolved solids, but the reverse is shown by the data. Flow paths shown by transmissivity data conflict with the data on total dissolved solids in that same direction.

The CSR offers a model in purported explanation, citing Lambert (1989), which model hypothesizes that the flow direction has changed from easterly to southerly since recharge took place (CSR 2-40). The CSR cites four data sources, none of which is persuasive:

Hydrogen and oxygen isotopes in groundwater are said to differ from those of known modern meteoric waters, indicating that no modern recharge has taken place. (Siegel et al. 1991) (2.2.2.2). However, Chapman (1986) shows that isotopic data from Rustler waters correspond to modern waters, suggesting recent recharge.

Radiocarbon dating of groundwater is said to establish a minimum age of 10,000 years (2.2.2.3). No reference is given; presumably Lambert (1987) is meant. However, that work rejected 12 of 16 sampled values on the basis of supposed modern contamination, which was not established.

The CSR interprets the stratified distribution of Strontium ratios in the Rustler to reflect a lack of vertical flow, but such conclusion is not inconsistent with recharge more recent than 10,000 years (2.2.2.4).

Finally, the CSR relies upon uranium-isotope disequilibrium data to postulate a recharge source and an ancient west-to-east flow pattern in the area of Nash Draw (Lambert and Carter, 1987) (2.2.2.6). Such hypothesis is inconsistent with potentiometric data and must be doubted. The CSR states that the conceptual model derived from such data is "hydrologically improbable." (2.2.2.6). Thus, the model advanced by the CSR is unsatisfactory, and there is no indication of plans to resolve the situation. We note that comments by the Environmental Evaluation Group (EEG) date November 22, 1994 criticize the use of uranium-isotope disequilibrium data in some detail. **These points require a reply.**

ratios of Rustler Formation groundwaters with isotopic data from regional groundwaters and surficial waters. Chapman cited evidence for short residence times of Culebra groundwaters and postulated that recharge from the surface could account for the less concentrated groundwaters south of the WIPP Site. That explanation, however, is not supported by interpretations of isotopic and solute data presented by Lambert, Siegel, and others. Specifically, radiogenic isotopic signatures suggest that the age of the groundwater in the Culebra is on the order of tens of thousands of years (Lambert, 1987; Lambert and Carter, 1987; Lambert and Harvey, 1987). An alternative conceptual model was put forth by Siegel et al. (1991a, and references therein). Those authors contend that there has been a change in the location and amount of recharge since the last glacial maximum and that the present distribution of solutes and isotopes in the Culebra is a relict of a flow regime of a wetter climate, in which the recharge area was in the vicinity of Nash Draw resulting in an eastward paleo-flow direction. The current distribution of hydrogeochemical facies according to this interpretation, therefore, represents a rock-water system that is still slowly reaching a new chemical and physical equilibrium.

Currently, the issue of the relationship between water chemistry and groundwater flow in the Culebra remains unresolved. It is possible that the lack of resolution reflects the way the problem has been posed. Previous discussions, for example, have focused on flow directions but not flow rates. Computer models of flow in the Culebra suggest that flow rates are orders of magnitude slower in the region of the NaCl facies than in the region of the $CaSO_4$ facies (see for example, Lavenue et al., 1990). It is possible that the geochemical signature of flow from the NaCl facies to the CaSO4 facies is not observed because only minute amounts of water flow along this path. In addition, some of the previous studies have not considered, or have ruled out, transport of solutes from units above and below the Culebra. For example, the region of the NaCl facies correlates well with the extent of halite in strata above and below the Culebra. The possibility that the NaCl facies results from vertical advective or diffusive transport into a region of extremely slow flow in the Culebra has not been investigated in depth. Preliminary results of three-dimensional calculations using the groundwater basin approach suggest that it will be helpful in addressing these issues to treat the hydrology as three-dimensional, transient system. The DOE will address this issue, as appropriate, in the

without packers, and to packer-sealed boreholes. In certain cases, evidence for flow is no longer observed where it once was; in others, flow has begun where it had not been previously observed. In many cases, observations and experiments must last for months or years to obtain conclusive results.

In part because of design requirements such as duration, few quantitative data have been obtained for certain lithologic units within the Salado Formation. However, much direct, qualitative experience exists regarding the behavior of flow crossing the repository walls.

A single model supported by three different theories can be used to explain the varied data and observations on brine inflow. According to one of the theories—the far field flow theory—brine flows from the far field in response to potentiometric gradients through naturally interconnected intergranular pore spaces. Experimental evidence supports this theory in anhydrite interbeds and in some non-anhydrite intervals. But experimental results from very pure halite are ambiguous. The results can be interpreted either as very low permeability (near-complete absence of interconnected pore spaces) or as a lithology in which fluid is not responsive to applied pressure gradients. Thus, other theories are also used as part of the model to explain the brine inflow data and observations.

One of these theories focuses on brine flow from the Disturbed Rock Zone. According to this theory, interconnected pore spaces do not exist naturally in most lithologic units in the Salado Formation. Interconnected networks form due to fracturing and creep around excavations. Potentiometric flow occurs in interconnected networks, but because the interconnectedness is of limited extent, the volume of brine that can flow is severely limited compared to the naturally interconnected case. This theory was proposed to explain the flow of brine to boreholes in the Small-Scale Brine Inflow (SSBI) program with more realistic parameters than would be required to model the same data using a naturally interconnected potentiometric model (McTigue, 1993).

A third theory for brine inflow, the clay consolidation model, arises from observation made as part of the Brine Sampling and Evaluation Program (BSEP). The theory proposes that clay layers exposed by excavation are the most significant sources of brine. According

AG-17 RESPONSE

This comment is addressed in the response to AG-16.

AG-18 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.2.3 Physical Hydrogeology of the Salado/Castile Flow Regime

Currently, Sandia is gathering data for core tests of various Salado components. Porosity, intrinsic permeability, threshold pressure, capillary pressure, relative permeability, and rock compressibility are to be measured under various stress conditions. Test cores are to be taken from certain WIPP shafts and rooms. Test results will have to be justified, inter alia, with respect to the heterogeneity of the rock bodies examined and the sufficiency of data as bases for extrapolation over a wider area of interest.

AG-18 RESPONSE

The DOE will justify all data used and all conclusions drawn based on those data in its compliance submittals. Any uncertainty such as that resulting from extrapolation will be characterized and treated if important to the results of PA.

AG-19 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.2.3 Physical Hydrogeology of the Salado/Castile Flow Regime

The CSR states that the Castile brine reservoir "highly permeable portions" are "limited in extent" and that about 5% of the overall brine volume is stored in large open fractures (2-42). There is no statement about the areal extent of such reservoirs.

AG-19 RESPONSE

Uncertainty about the areal extent of brine reservoirs near the WIPP site is large. We do have information about the volume of the brine reservoirs that have been tested at WIPP-12 and ERDA-9, but those data only relate to reservoir volumes, not their areal extent. Time-domain electromagnetic (TDEM) surveys conducted at the WIPP site have indicated the possible presence of

reservoirs in these characteristics. However, because the brine reservoirs alter the electromagnetic response of the rocks which host them, due to their transmissive fractures and electrolytic fluids, regions which likely host brine reservoirs in the Castile can be distinguished from those that likely do not, from the surface. The WIPP Project has adopted in past PA's the assumption that separate, isolated brine reservoirs underlie the site, similar in character to WIPP-12 based on analogy, with a chance of interception commensurate with the electromagnetic indications of reservoir extent. The DOE considers this reasonable and intends to continue this treatment in the final PA for the CCA.

AG-21 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.3 Resources

The CSR refers to the FEIS for estimates of the volume and location of potash, oil and gas resources. This information is important and should appear in the CSR itself. DOE should specify the resource data which it deems most appropriate for use in compliance determinations. We understand that New Mexico Tech has been requested to perform a study; this arrangement should be described.

AG-21 RESPONSE

It is correct that the NMBMMR was contracted to prepare estimates of the mineral values for the WIPP Land Withdrawal Area (LWA). This re-examination of resources is being prepared so that the DOE's discussions of resources in compliance documents will be current. The NMBMMR is expected to make the report available in the near term.

AG-22 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

It would be helpful to include a description of administrative practices governing drilling within and adjacent to the land withdrawal area. It would also be helpful to include an account of current drilling practices in the Permian Basin as they may arguably be pertinent to characterization of future human intrusions.

AG-24 RESPONSE

The additional level of detail you request was intentionally not included in this Status Report as we explained in response to a previous comment. All the processes you mentioned will be addressed in either the scenario screening process, or they will be treated for in the final PA. Justifications for the decisions will be provided in the CCA, as appropriate.

AG-25 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.7.1 Gas Generation

This section states that two different gas-generation models are in various stages of development, but they are described only in general terms. There is not enough information from which to identify further data needs. There is no citation to any source which describes the models, their assumptions, and further data needs. The presentation should be compared with the much more detailed one by Larry Brush at the July 1993 technical meetings with EPA in Albuquerque. At that meeting Brush explained the progress of his reaction-path model and future steps. He explained that anoxic corrosion of aluminum and hydrolysis of cellulosics are omitted. Uncertainties as to waste inventory and brine availability must be resolved. There are further uncertainties as to how the conceptual model should deal with equilibrium behavior, possible methanogenesis, and the effect of pressure on microbial action. The CSR does not state how these issues may be addressed. The CSR does state that hydrologic and geomechanical models will be used in conjunction with the gas generation model to characterize brine, gas, and volume within the repository. The timing and elements of that effort should be further described.

AG-25 RESPONSE

The uncertainties you mention will be treated for in the final PA modeling. Those uncertainties that are important to system performance will be accounted for through conservatism in modeling assumptions and/or through sampling within ranges for parametric input when variables are imprecisely known. The requisite level of justification will be provided in the CCA, as appropriate.

AG-27 RESPONSE

The objective of the ongoing Actinide Source-Term Program (see Phillips and Molecke, 1993) is to provide a basis for model predictions of actinide concentrations in WIPP brines to the performance assessment process. Specific information needs include both solubilities and colloids and the model is based on experimental data. The current plan is to use this experimentally based actinide concentrations model to support the compliance application. The validation of the model will be accomplished in accordance with Sandia QAP 19-1, Computer Software Requirements.

Reference:

Phillips, M.L.F., and M.A. Molecke. 1993. *Technical Requirements for the Actinide Source-Term Waste Test Program*. SAND91-2111. Albuquerque, NM: Sandia National Laboratories.

AG-28 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.7.4 Room Closure Processes

The material on the disposal room performance model (2.7.4.1) and waste compaction (2.7.4.2) merely relates the general processes and does not adequately describe the available data or the current status of modeling efforts. Compare the detailed presentation by Fred Mendenhall at the July 1993 DOE-EPA technical exchange. The section on waste compaction refers to the difficulty of modeling corrosion or decomposition of waste but does not state the importance of this problem or what is to be done about it.

AG-28 RESPONSE

The CSR was not intended to be a statement of compliance or a demonstration of compliance. Its intent was to serve as a tool to focus WIPP program resources on areas necessary to ensure complete, accurate, and timely submittal of compliance applications. The DOE will address the issues in your comment in the CCA.

AG-31 COMMENT

2.0 SITE DESCRIPTION/SITE CHARACTERIZATION

2.7.6 Coupling Between Processes

It is not news that the processes of gas generation, brine and gas flow, brine chemistry, room closure, and room pressurization are interrelated processes and that preliminary efforts to depict such coupling have been made in the PA process. The CSR refers to the porosity surface used in PA and the possible use of deterministic coupled codes, such as PHENIX. The 1992 PA says, however, that the PA department plans to examine sensitivity to closure. (1992 PA, v. 2, 7-5). It is not stated what has been done along those lines or what role the SANCHO code will have in representation of room deformation.

AG-31 RESPONSE

The use of a fully coupled mechanical and multi-phase fluid flow model is not now practicable because, (1) no such general model currently exists for material undergoing time-dependent deformation (creep) and, (2) the computational effort required by such a model would preclude its use in probabilistic PA calculations where many hundreds or thousands of simulations are required.

Recent verification studies of the PA implementation of the porosity surface indicate satisfactory prediction of pressure and porosity during creep consolidation (Arguello and Stone, 1994a; Arguello and Stone, 1994b; Arguello and Stone, 1993). The implementation is verified under conditions of undisturbed repository, human intrusion, and high brine saturation cases. This suggests the resources required to develop and use a fully coupled model are not warranted.

Reference

Arguello, J.G. and C.M. Stone. 1994a. *Corrections to Errata in Memo Entitled: "Performance Assessment Verification Calculations - Revised SANCHO Calculation for Comparison with BRAGFLO Run #63."* Memo. Albuquerque, NM: Sandia National Laboratories.

Arguello, J.G. and C.M. Stone. 1994b. *Performance Assessment Verification Calculations - Revised SANCHO Calculation for Comparison with BRAGFLO Run #63.* Memo. Albuquerque, NM: Sandia National Laboratories.

necessary for the Systems Prioritization Method phase of the compliance process.

AG-34 RESPONSE

The SPM process included consideration of potential Long-term performance related impacts of engineered barriers. The DOE/CAO is also, currently, conducting an Engineered Alternatives Benefit and Detriment Study to assess not only the long-term repository performance related benefits, but also to assess DOE's waste management system-wide impacts of such Engineered Alternatives. This study will be completed in the latter portion of 1995.

AG-35 COMMENT

3.0 FACILITY DESCRIPTION

3.4 Engineered Barriers

Certain statements concerning the shaft sealing system should be corrected. The CSR states that "crushed salt components, emplaced with sufficient precompaction, will sufficiently reconsolidate within 100 years after emplacement to meet performance requirements." (at 3-11). The cited work (Van Sambeck et al., 1993) in fact declares uncertainty as to the critical requirement as to the length of reconsolidated salt above the shaft station (at 96), notes unresolved concerns about the use of bentonite (at 72), crushed salt (at 76), compressed-salt blocks (id.), concrete (at 77), and quarried-salt blocks (at 85), and concludes that "a fully defensible recommendation of any of the presented alternatives cannot be made." (at 97).

AG-35 RESPONSE

The DOE has sufficient information to conclude that a reconsolidated salt seal can achieve very low permeabilities—approaching that of the host rock—in 100 years. This performance is tied intimately to the ability of the short-term seal to prevent brine or gas ingress into the shaft. Tight permeabilities in the salt long-term seal are also dependent on how well the material can be placed in large volumes. The DOE is mindful that such a compaction demonstration has never been performed.

AG-37 COMMENT

3.0 FACILITY DESCRIPTION

3.4 Engineered Barriers

It should also be noted that the projection of room closure in 100 years, contained in the discussion of system performance (3.6), assumes no gas generation. With gas generation closure is projected to require far longer and ultimately to reverse itself (Davies et al., 1991).

AG-37 RESPONSE

The performance assessment modeling includes the effects of gas generation and pressure buildup. In general, the repository rooms are expected to achieve their maximum closure between about 60 and 200 years after a room is filled. The modeled effect of gas generation is that the degree of closure (porosity reduction from the initial condition) is somewhat less than would be the case without gas generation. However, the room closure rate is relatively fast compared to predicted rates of gas generation and pore pressure buildup (despite pore volume reduction due to compaction), so that accounting for reasonable uncertainties in gas generation rate does not produce large differences in time required for maximum closure. Continuing gas pressure buildup after the time when maximum closure is achieved can cause the porosity in the compacted waste and backfill to increase. It should be recognized that referring to this as a "reversal" of room closure is true only in a very general sense.

AG-38 COMMENT

3.0 FACILITY DESCRIPTION

3.6.3 Passive Controls

There is no plan for passive institutional controls. Such a plan must be part of a compliance demonstration.

AG-38 RESPONSE

A plan for passive institutional controls will be part of the compliance demonstration.

AG-41 COMMENT

4.0 WASTE DESCRIPTION

Likewise, the CSR fails to explain the plans to use the System Prioritization Method to develop performance-based Waste Acceptance Criteria ("PBWAC"), as was set forth in the June 14-15 exchanges. The CSR does not contain the current schedule under which the draft TRU Waste Characterization Quality Assurance Program Plan ("QAPP") was issued in July 1994 and will be revised, the Waste Characterization Program Plan ("WCPP") was to issue in October 1994, and generator sites will institute development of Quality Assurance Project Plans ("QAPjP's"). Thus, there is no explanation of how the PBWAC developed in the SPM will be integrated into the development of the QAPP, WCPP, and QAPjP's.

AG-41 RESPONSE

The inventory as reported in the Baseline Inventory Report (BIR) will form the basis for future input to the PA process. The PA process will in turn identify the parameters critical to repository performance that must be controlled to demonstrate compliance. Any additional criteria based upon the repository performance will be added to the existing Waste Acceptance Criteria (WAC) as Performance Based WAC (PBWAC). The QAPP sets data quality objectives for the programs that will characterize and certify waste to the WAC. The QAPjPs and Certification Plans are the documents generated by the generator site describing how they will meet the requirements of the WIPP WAC and QAPP.

AG-42 COMMENT

4.0 WASTE DESCRIPTION

Further, the CSR has no explanation of the development of the QAPP and the Sampling and Analysis Guidance Manual, as was presented at the June 14-15, 1994 technical exchange, and thus there is no defense of the statistical sampling methods proposed for that purpose.

AG-42 RESPONSE

The Transuranic Waste Characterization Quality Assurance Program Plan has since been revised and was issued in April, 1995. Sampling and analysis activities will be conducted consistent with these

AG-44 COMMENT

4.0 WASTE DESCRIPTION

We also have EEG's comments on the preliminary draft BIR, which was made available to EEG, and note that the following issues raised by EEG seem to deserve response:

1. When will the "expanded" inventory information required for the MWIR be furnished to DOE headquarters?

2. What is the status of the "NID"; is it still preliminary? What quality control measures are planned?

3. What changes will be incorporated in the scheduled March 1995, December 1995, and December 1996 submissions?

4. What data will PA use to support the use of "process knowledge" in preparing the BIR? How will inventory uncertainty be estimated and dealt with in generating uncertainty and sensitivity analyses?

5. What inventory data will DOE use in support of the disposal no-migration petition?

6. What characterization information is needed for PA? Will the answer emerge only when the SPM gives rise to PBWAC?

7. Will pre-1970 waste be listed in the BIR? Will such waste be unearthed and classed as "newly generated" waste?

8. How will process knowledge and expert judgment underlying the BIR be validated for PA purposes?

9. What support exists for statistical methods used in preparing the BIR?

Further, at the July 21, 1994 State-DOE quarterly meeting, a DOE presentation by Jeff Williams stated that data generated in site characterization activities pursuant to QAPjP's now in development would be fed back into the BIR to revise its characterization information. The scope and timing of this effort must be set forth.

sampling and analysis program will be used to characterize waste prior to shipment to the WIPP. The information collected can among other things, be used to improve process knowledge if such improvement is necessary. Expert judgement, in the classical sense, was not a part of BIR development. Knowledge of the waste generating processes is documented, reviewed, and approved by individuals with the requisite level of knowledge to do so accurately.

9. The BIR did not use statistical methods in the development of the inventory data, but rather combined the various data of the MWIR, the NID and the IDB to present the anticipated TRU waste inventory. The BIR presents this data in a format that allows for reasonable estimates of the various waste matrix materials for input to the PA and permit reporting processes. A scaling factor was developed to allow the extrapolation of this inventory information to the complete repository disposal inventory capacity.

AG-45 COMMENT

4.0 WASTE DESCRIPTION

We note too that a version of the BIR has now been made available, and there are certain conflicts with the CSR. For example, the list of generator sites is different from the list in the CSR (at 4-2).

AG-45 RESPONSE

The BIR has used the list of TRU waste generators reported in the MWIR. The CSR has listed the ten major waste generator sites. The sites that generate smaller amounts of TRU waste may choose to participate in the waste acceptance criteria certification programs of nearby larger generators, or otherwise develop a WACCC approved certification plan and be subject to the same certification program assessment and verification as the larger generators.

AG-46 COMMENT

4.0 WASTE DESCRIPTION

4.1.5 Radionuclide inventory

The CSR does not state the date at which the Curie content of the radionuclide inventory should be

transuranic wastes to be isolated with about the same degree of effectiveness" [U.S. Environmental Protection Agency, Preamble to Proposed 40 CFR Part 191, 47 FR 58200, December 29, 1982.] Furthermore, the Draft EIS stated that the reference values of 1 million curies of TRU waste and 1,000 MTHM of spent fuel "were selected so that about the same fraction of transuranic radionuclides would be retained for either high-level or transuranic waste" [US EPA, "Draft Environmental Impact Statement for 40 CFR 191: Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," EPA-520/1-82-025, December, 1982, p. 116]. These estimates had been made based on looking at the number of TRU curies in 10 year old spent fuel and rounding to the nearest arithmetic order of magnitude.

(b) The Final Supplement to EIS, 1990, v.2, at B18-19 discusses the use of the inventory in developing the initial source term for transport calculations. The waste unit upon which the release limits were based in the technical support reference, Lappin et al., 1989, was calculated using the estimated inventory at decommissioning. These are two separate concepts. The waste unit and release limits must be calculated from an initial inventory at the same point in time; transport calculations must take into account the decay of the radioactivity over the course of the 10,000 years of regulatory concern. What the FSEIS reports is the assumption used to start transport calculations, which began after the end of active institutional controls. Table B.2.13 presents the initial radionuclide inventory in CH TRU waste for the assessment of long-term performance, and Table B.2.14 gives the modified inventory, which was modified by assuming that the radioactivity has decayed for 100 years. Table B.2.13 is the source of the waste unit, which may be seen to be 6.66 by summing the activities of TRU radionuclides with halflives greater than 20 years and dividing by 1 million. This is consistent with the method in the technical support document cited by DOE (A. R. Lappin, R. L. Hunter, D. Garber, and P. B. Davies, eds., 1989; Systems Analysis, Long-Term Radionuclide Transport, and Dose Assessments, Waste Isolation Pilot Plant (WIPP) Southeastern New Mexico, March 1989, SAND89-0462, Sandia National Laboratories, Albuquerque, New Mexico).

sensitivity of specific parameters and may call for new or increased waste characterization beyond what was previously planned or performed. The CSR should contain DOE's plan to employ the PA or SPM to define and apply ranges of acceptability as to various criteria.

AG-48 RESPONSE

If the sensitivity studies indicate that variables require additional control, such requirements may be candidates for addition to the WAC as performance based requirements (PBWAC).

AG-49 COMMENT

4.0 WASTE DESCRIPTION

4.3 Waste Characterization

It is not clear what further waste characterization efforts will be undertaken to establish compliance. The Experimental Program Plan (DOE/WIPP 94-008) refers to characterization efforts (at 3-38, 4-14), and the Disposal Decision Plan (March 23, 1994) states that DOE will "provide supplemental inventory data to PA based on waste characterization plan" in December 1995. These efforts should be referred to in the CSR.

AG-49 RESPONSE

Characterization information and data will be included in future documentation as they become available. The PA will identify any waste related parameters that need additional characterization effort to verify the parameter assumptions and/or ranges. If additional characterization activities are the appropriate solution they will be planned and pursued at the point in time.

AG-50 COMMENT

4.0 WASTE DESCRIPTION

The CSR says that physical waste form parameters of interest will be presented based on the average content of the total TRU waste inventory and not on a drum-by-drum basis (at 4-40). It also suggests that the parameters have not yet been determined. DOE has not yet demonstrated the adequacy of characterizing waste-including characterization according to undetermined parameters--on a repository-wide basis.

AG-52 RESPONSE

WIPP will drive future waste generation, to some extent, through the implementation of WIPP approved characterization and certification programs at each generator site that will ship waste to WIPP. The requirements of the WIPP WAC, the QAPP, and the TRAMPAC will require the implementation of special programs and controls at the generator sites. These programs will be structured to meet the needs of these special programs.

AG-53 COMMENT

4.0 WASTE DESCRIPTION

The CSR description of RCRA-related waste characterization raises several questions. How will DOE establish TRU waste baseline inventory based on "maximum allowable physical waste form parameters that will not result in the migration of hazardous constituents above health-based limits" (4-41)? How will DOE show that headspace sampling and analysis reflects the content of inner layers? What practice will generator sites use to determine whether waste is hazardous? There is reference to process knowledge; what demonstration will be made to support its sufficiency? What sampling and analysis procedure will be used for solid process residues? (4-41, 4-42).

AG-53 RESPONSE

The baseline inventory will be established by the BIR. The BIR totals will be used as input to the PA process which in turn, will evaluate repository performance by calculating reasonable estimates for constituent release that will be measured against the applicable regulatory performance based limits for release.

Testing is being conducted at the INEL to correlate the results of headspace and inner confinement layer gas analysis. Some of this sampling was performed during the Test Phase between 1991 and 1992 with good correlation of test results which has indicated that communication of the gasses between the headspace and inner confinement layers is complete. If additional modeling assumptions are determined the appropriate course of action to mitigate uncertainty, the DOE will consider this option as well.

The strict requirements of product quality and concerns for safety in the handling of the radioactive wastes

implemented per the requirements in the QAPP, implementing QAPjPs, and applicable sampling and analysis guidance.

AG-55 COMMENT

4.0 WASTE DESCRIPTION

When will the WIPP Sampling and Analysis Guidance Manual be revised (4-43)?

AG-55 RESPONSE

The Transuranic Waste Characterization Sampling and Analysis Methods Manual, DOE/WIPP 91-043 was published in August 1995.

AG-56 COMMENT

4.0 WASTE DESCRIPTION

Does the reference to "performance standards specified in the QAPP" (Id.) refer to the revised QAPP?

AG-56 RESPONSE

The performance standards and data quality objectives (DQOs) will be included in the Disposal Phase QAPP.

AG-57 COMMENT

4.0 WASTE DESCRIPTION

The CSR states that the FFCA Interim MWIR will be used to assess the available waste repackaging and treatment capabilities (4-43). Does this mean that the MWIR will project treatment capabilities for WIPP-destined waste, and, if so, on what basis will such capabilities be identified in that report?

AG-57 RESPONSE

The MWIR and Site Treatment Plans will provide insight to the various treatment options and capabilities for the various waste forms. Currently however, the DOE does not plan to treat TRU waste except possibly treatment to meet the WAC. The TRU waste will be characterized and certified to the requirements of the WIPP WAC, QAPP, and the TRAMPAC. Currently, only waste that meets these requirements will be considered for shipment to WIPP.

CSR), compared to the roughly 220,000 liters required to fully corrode all the susceptible metal.

(Note: The reason brine availability is discussed on a representative 200-year time scale is that this is about the period, after a repository room is filled, in which salt creep is expected to drive maximum compression of the room contents. The initial pore volume of the waste is so high, and initial gas generation rate is so low, that gas generation makes little or no significant difference in pore pressure until the room's volume has been greatly reduced. Beyond about 200 years, gas generation in the repository can result in sufficient increase in repository pore pressure to impede further brine transport to the repository.)

The estimates made on the basis of observed brine transport in the Salado must certainly be regarded as representative of the most probable repository conditions. However, consideration must also be given to the fact that field data necessarily informs us only about the existing flow pattern. Some attention must be given to the possibility that in the long term, the presence of the repository itself could alter brine transport. Modeling studies relative to brine transport have shown that the scenario that lead to the greatest potential brine availability is based on an assumption that unfilled and partially filled fractures in the anhydrite beds within the Salado formation provide continuous, high transmissivity pathways for brine migration along these layers. Given that conservative assumption, it would then be possible that brine could be drained from a large volume of the halite and transported to the vicinity of the repository. Modeling this scenario led to an upper bound estimate for brine availability of 150,000 liters in 200 years. The modeling programs have further assumed that the 150,000 liter figure is similar enough to the full potential figure for gas generation (200,000 liters) that the full potential gas volume assumption has been made conservatively as well.

Radiolytic Enhancement of Biodegradation

Investigation and modeling of gas generation processes is continuing, as indicated in the CSR. The possibility does exist that radiolysis of some of the organic materials in the waste could alter the materials into forms that are more susceptible to biodegradation. However, it should be kept in mind that the rate of radiolytic action on these compounds is going to have

AG-61 RESPONSE

Additional discussion of breccia pipes will be provided in scenario development and scenario screening text to be included in the CCA..

AG-62 COMMENT

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

B. Borehole and shaft plugging: These are correctly stated to be an open issue.

AG-62 RESPONSE

The DOE agrees that this is still an open issue. It will however be resolved in the CCA and other final compliance submittals, as appropriate.

AG-63 COMMENT

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

C. Brine reservoirs: The text (at 6-3) correctly says that brine reservoirs are an "open" issue. The table (at 12-4) says that DOE is evaluating standard drilling procedures to see whether a driller would "stop drilling operations prior to encountering a Castile Brine Reservoir." How the driller could do so is not explained. How DOE would incorporate the results of an analysis into an assessment of human intrusion probabilities is also unexplained.

AG-63 RESPONSE

What Table 12-1 (at 12-4) was intended to say about brine reservoirs is that DOE is evaluating standard drilling procedures in the region "to determine *if it is reasonable to expect that a driller would soon detect the repository* and stop drilling...prior to encountering a Castile Brine Reservoir." (Emphasis supplied). Thus, the question referred to in the table at 12-4 is not whether a driller penetrating an unaffected portion of the Salado would stop drilling before encountering a brine pocket, but rather whether a driller who penetrates the repository would identify the situation as unusual and stop drilling, and if so,

equivalent disposal room assuming 1 percent initial, intact porosity. Some of the brine will remain in the pore structure and cannot contact waste in the repository. The clay consolidation mechanism likely provides much less brine to disposal rooms; it is likely that this mechanism would have, for the most part, ceased by the end of the disposal phase and brine inflow from clay consolidation during the period modeled by Performance Assessment would be negligible.

Tests relevant to the determination of a reasonable Salado fluid flow model were considered in DOE decision making as to future experimental efforts for compliance. Those results were provided earlier this year.

AG-65 **COMMENT**

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

E. Dissolution: Lambert (1983) concludes that deep dissolution is not a significant threat to the underground facility. Also, after the drilling and analysis of DOE-2 in 1987, EEG was able to conclude that there is no issue of a threat to the integrity of the repository from advancing dissolution at depth (Letter, Neill to Tillman, Sept. 9, 1987). (Such dissolution may be distinguished from the question of karst drainage features in the Rustler (see G) and from the issue of more subtle transmissivity variations caused by dissolution.) Most basically, for DOE to discount all possible effects of dissolution at depth, it should set forth much more fully the data and models which DOE considers accurate so that EPA and the stakeholders can evaluate DOE's position.

The attached paper by R.Y. Anderson highlights the interrelated problems of dissolution, climate change, and the modeling of Culebra flow. As Anderson relates, Nash Draw is an obvious karstic dissolution feature, and the occurrence of dissolution within the Rustler even closer to the WIPP site is not excluded by the absence of surface effects. Nash Draw itself was formed in the most recent 500,000 years. Extending northeast from Nash Draw is a high-transmissivity "finger" characterized by rapid movement of tracers, relative absence of gypsum in fractures, and halite dissolution above the Rustler. Pre-Culebra strata at the WIPP site show enlargement by dissolution. The Culebra itself shows wide variations ln transmissivity.

statements. The 1991 PA states that the observed dike was not followed by similar occurrences in the Pliocene and Pleistocene and that, therefore, "a change in the geologic processes at this location has occurred." (1991 PA, v. 1, 4-23). Further explanation is required beyond such conclusions.

AG-66 RESPONSE

Igneous activity in the vicinity of the site has not occurred for over 30 million years.

An early radiometric determination for the dike yielded an age of 30 ± 1.5 million years (Urry, 1936). More recent work (Calzia and Hiss, 1978) on dike samples is consistent with early work, indicating an age of 34.8 ± 0.8 million years. This is because the tectonic regime has become stable with no active extensions in evidence within this basin.

Volcanic ashes found in the Gatuña Formation were airborne from distant sources such as Yellowstone and represent no volcanic activity at WIPP (Powers and Holt, 1993). DOE considers this issue resolved.

REFERENCE

Powers, D. W., and R. M. Holt. 1993. "The Upper Cenozoic Gatuña Formation of Southeastern New Mexico." In *Geology of the Carlsbad Region, New Mexico and West Texas*, D. W. Love et al., eds., Forty-Fourth Annual Field Conference guidebook, pp. 271-282. New Mexico Geological Society, Socorro, New Mexico.

AG-67 COMMENT

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

G. Karst: There has been debate about the occurrence of Karst features at the WIPP site, as the text notes (6-6). The issue is said to be resolved, however, based on citations to the Bachman (1985 and 1987) and Lappin, et al. (1989) studies. The CSR should make a fuller factual explanation of the exclusion of this scenario. Bachman (1987) in fact notes the occurrence of numerous Karst features of greatly varying ages.

More importantly, the impact of Karst formations on the effort to model the Culebra is not accounted for. See

March 16, 1993), it would not be appropriate to deal with climate variations simply by limiting the recharge "expectation" to the range of variation seen in the past 10,000 years.

AG-69 RESPONSE

Too little is known about global circulation patterns to accurately predict precipitation levels over the next 10,000 years. The long-term stability of patterns of glaciation and deglaciation, however, do permit the conclusion that future climatic extremes are unlikely to exceed those of the late Pleistocene. Furthermore, the periodicity of glacial events suggests that a return to full-glacial conditions is highly unlikely within the next 10,000 years.

Both floral and faunal evidence indicate that annual precipitation throughout the region during the late Pleistocene was up to approximately two times greater than today's values. PA modeling to date has treated climate variations based on the above assumptions. Relevant discussions will be included in the scenario development and screening text in the CCA.

AG-70 COMMENT

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

J. Resources: The CSR text says this issue is "closed," but the table says it is "open." (6-9, 12-7). The issue of the frequency and nature of human intrusions is plainly open. We inquire whether the quantity of oil, gas, and potash resources have been established for the site insofar as such information is part of the process of estimating future human intrusions. Until that issue is decided, the issue is open. A recent EEG report, Silva, Implications of the Presence of Petroleum Resources on the Integrity of the WIPP, EEG-55 (1994), illustrates that DOE has selectively endorsed or rejected resource calculations in past PA analyses. Reference should also be made to the plan to obtain a further study by New Mexico Tech.

AG-72 COMMENT

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

L. Seismic activity: This office is not now in a position to assess the seismic data. If the data are accurate, it would seem that the design value exceeds the expected value for 1,000 year acceleration. It must be kept in mind that compliance is tested over a 10,000 year period. It should be explained why the 1,000 year value is relevant.

AG-72 RESPONSE

Structures at the WIPP site must be designed to withstand an appropriate level of seismic event. A design standard that substantially exceeds the expected value for the 1,000 year event has been selected. The structures at the site are not going to be in use for 1,000 years, so this design standard is quite conservative. The 10,000 year requirement for isolation of the waste applies to the waste in the subsurface repository. Accelerations associated with ground motion are not relevant to containment within the repository. Although faulting is, of course, an aspect of seismic activity, the possibility that faulting at or near the repository might open a pathway for contaminant release is dealt with separately under Issue O, Tectonic Stability/Faulting (page 6-12).

AG-73 COMMENT

6.0 TEST PROGRAMS

6.1.1 Geological/Geochemical Compliance Issues

M. Specific site geological characteristics: salt depth, thickness, purity, etc. It is difficult to determine what is included in this issue. The CSR should state exactly what characteristics, and what quantities, are specified. In any case the statement in the table that the "WIPP facility is adequately characterized" (12-9) is overbroad, as shown by the ongoing efforts to characterize the Culebra, Salado, Castile, etc.

AG-73 RESPONSE

The geological characteristic of salt depth is included in this issue as a depth between 1,000 and 3,000 feet

AG-75 RESPONSE

(1) Citation for maximum acceleration and the upper magnitude limit for WIPP can be found in the Final Safety Analysis Report for the Waste Isolation Pilot Plant (DOE 1990) and the Final Safety Analysis Report for the Waste Isolation Pilot Plant (DOE 1990). (2) Major faulting can be found in Geology of the Pecos County by V.C. Kelley (1971) and reports by Hayes and Bachman (1979) and Muehlberger et al. (1978). (3) The seismic activity citations are to be found in Powers et al (1978), Sanford et al (1978 and 1980), Keller et al (1981), and the Final Safety Analysis Report for the Waste Isolation Pilot Plant (DOE 1990). (4) The determination of subsidence can be found in Balazs (1978 and 1982), Holt and Powers (1988), Beauheim and Holt (1990), and the Final Environmental Impact Statement, Waste Isolation Pilot Plant (DOE 1980). (5) Citation information on intrusive features across the WIPP site are found in reports by C.L. Elliot (1976a,b), Griswold (1977), Powers et al. (1978) and Calzia and Hiss, (1978). (6) Geothermal gradient citation are found in Basic Data reports for Drillhole WIPP 13, 15 & 32, ERDA 6 & 9 (1979, 1981, 1980, 1983a,1983b). The DOE considers this issue resolved.

REFERENCES

Balazs, E.I., 1978. Report on First-Order Leveling Survey for Sandia Laboratories Waste Isolation Pilot Plant (WIPP) Project, Rockville, MD, National Geodetic Survey.

Balazs, E.I., 1982. Vertical Movement in the Los Medanos and Nash Draw Areas, New Mexico, As Indicated by 1977 and 1981 Leveling Surveys, NOAAQ Technical Memorandum NOS NGS 37, Rockville, MD, National Geodetic Survey.

Beauheim, R.L., R.M. Holt, 1990. "Hydrogeology of the WIPP Site", Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico, Geological Society of America 1990 Annual Meeting Field Trip #14 Guidebook, Dallas TX., Dallas Geological Society, pp. 131-179.

Muehlberger, W.R., R.C. Belcher, and L.K. Goetz, 1978. "Quaternary Faulting in Trans-Pecos Texas", Geology, Vol. 6, No. 6, pp. 337-340.

Powers, D.W., S.J. Lambert, S. Shaffer, L.R. Hill, W.D. Weart, 1978, Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico. SAND78-1596, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL) and U.S. Geological Survey (USGS), 1979. Basic Data Report for Drillhole WIPP 13 (Waste Isolation Pilot Plant—WIPP), SAND79-0273, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL) and U.S. Geological Survey (USGS), 1980. Basic Data Report for Drillhole WIPP 32 (Waste Isolation Pilot Plant—WIPP), SAND80-1102, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL) and U.S. Geological Survey (USGS), 1981. Basic Data Report for Drillhole WIPP 15 (Waste Isolation Pilot Plant—WIPP), SAND79-0274, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL) and U.S. Geological Survey (USGS), 1983a. Basic Data Report for Drillhole ERDA 6 (Waste Isolation Pilot Plant—WIPP), SAND79-0267, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL) and U.S. Geological Survey (USGS), 1983b. Basic Data Report for Drillhole ERDA 9 (Waste Isolation Pilot Plant—WIPP), SAND79-0270, Sandia National Laboratories, Albuquerque, NM.

Sanford, A. R., S. Sandford, F. Caravella, L. Merritt, J. Sheldon, and R. Ward, 1978. A Report on Seismic Studies of the Los Medanos Area in Southeastern New Mexico, New Mexico Institute of Mining and Technology, Socorro, NM.

Sanford, A. R., S. Sandford, T.C. Wallace, L.J. Barrows, J. Sheldon, and R.M. Ward, 1980. Seismicity in the Area of the Waste Isolation Pilot Plant (WIPP), SAND80-7096, Sandia National Laboratories, Albuquerque, NM.

AG-78 COMMENT

6.0 TEST PROGRAMS

6.1.2 Issues in Rock Mechanics

B. What is the best approach to simulating salt creep?

1. We cannot yet concur on the validity of the modeling approaches. Once our office is equipped with expert assistance we may be able to concur in the stated resolution.

2. We have not had a chance to review the cited materials and to obtain expert assistance in this area and cannot yet agree that the constitutive model and material properties of salt are adequately described. Further, any model which omits fracture behavior of salt is inadequate to describe the room closure process.

AG-78 RESPONSE

The Munson-Dawson creep formulation, coupled with revised treatment of the stratigraphy, description of transient creep and work hardening, and properties measured for the argillaceous salt, provides a significant improvement in the correlation of modeling results to observed room closure rates. The statement of an issue regarding salt creep is not intended to imply that fracturing is not included in analyses where it is known to be important. The issue regarding creep exists because of unsatisfactory results that were obtained with the creep law that was used in initial modeling studies.

However, the importance of halite fracturing should not be prejudged. Munson's analysis (cited in the CSR) indicates that far field fracture behavior will be dominated by slip on the weak clay interbed layers, which are weaker than the salt. This is part of the revised stratigraphic description which has contributed to improved correlation with observed behavior. Near field fracturing (specifically, in the DRZ) is relevant to some performance issues (such as seals performance and communication to nearby migration pathways), but will not have much impact on the long term porosity reduction (which is the aspect of the problem toward which the discussion in the CSR was directed). The important issues in the long term room closure modeling are the compaction of the waste (and backfill) and the

AG-81 RESPONSE

The DOE agrees with the Attorney Generals Office that this is an unresolved issue. A set of simulations will be performed to test the proposed hypotheses in relation to the inconsistency surrounding flow in the Culebra.

AG-82 COMMENT

6.0 TEST PROGRAMS

6.1.3 Issues Related to WIPP Hydrology

C. Rustler formation recharge: This question is also open.

AG-82 RESPONSE

We agree that this issue is still open.

AG-83 COMMENT

6.0 TEST PROGRAMS

6.1.3 Issues Related to WIPP Hydrology

D. Model for Culebra flow and transport: This question is also open. The CSR refers to plans to conduct non-sorbing tracer tests, which we have not had the opportunity to review.

AG-83 RESPONSE

The issue will be reexamined as results become available from the current tracer tests.

AG-84 COMMENT

6.0 TEST PROGRAMS

6.1.3 Issues Related to WIPP Hydrology

E. Transmissivity variation in Culebra dolomite: The CSR notes the sparsity of data and the need to quantify the uncertainty of interpolations. We agree on the need.

AG-84 RESPONSE

Comment noted.

AG-88 COMMENT

6.0 TEST PROGRAMS

6.1.4 Performance Assessment (PA)

A. CCDF confidence bounds: The CSR correctly notes that this issue is open and will be addressed in compliance criteria.

AG-88 RESPONSE

Comment noted.

AG-89 COMMENT

6.0 TEST PROGRAMS

6.1.4 Performance Assessment (PA)

B. Scenarios: The CSR discussion involves only the use of a logic diagram procedure to construct combinations of events. It may be considered resolved that scenarios can be constructed in disregard of the order of events, but the various possible orders of events still must be considered in analyzing scenarios.

AG-89 RESPONSE

Scenario development is discussed in detail in the DCCA and will be included in the CCA. The time of events (e.g., human intrusion) is considered in analysis of scenario consequences.

AG-90 COMMENT

6.0 TEST PROGRAMS

6.1.4 Performance Assessment (PA)

C. Complexity and realism of PA models: It is unclear what is said to be "resolved," and therefore we cannot agree. The entirety of the codes and models cannot be deemed resolved.

AG-90 RESPONSE

Comment acknowledged. The issue will be resolved prior to submittal of the CCA and other relevant compliance submittals.

recognizes—as was also stated in the CSR—that this issue may be reopened by 40 CFR Part 194. Resolution of comments on the 1992 PA are being pursued separately. The 1992 PA was preliminary and the results were not intended to be used as the basis for a compliance decision. The final PA will serve this purpose in development of the CCA.

AG-93 COMMENT

6.0 TEST PROGRAMS

6.1.4 Performance Assessment (PA)

F. Climate change: The climate change issue is correctly shown as open. We do not agree that climate change is correctly dealt with in the 1992 PA, in that the range of prospective climate change is unduly limited. See also our comments at pages 15-16 above. It is not clear from the CSR (at 6-27) whether the planned regional flow model will be incorporated in PA.

AG-93 RESPONSE

Too little is known about global circulation patterns to accurately predict precipitation levels over the next 10,000 years. The long-term stability of patterns of glaciation and deglaciation, however, do permit the conclusion that future climatic extremes are unlikely to exceed those of the late Pleistocene. Furthermore, the periodicity of glacial events suggests that a return to full-glacial conditions is highly unlikely within the next 10,000 years.

Both floral and faunal evidence indicate that annual precipitation throughout the region during the late Pleistocene was up to approximately two times greater than today's values. PA modeling to date has treated climate variations based on the above assumptions. Relevant discussions will be included in the scenario development and screening text in the CCA.

AG-94 COMMENT

6.0 TEST PROGRAMS

6.1.4 Performance Assessment (PA)

G. Two-phase flow and gas generation: The need to include two-phase flow in PA is resolved.

and radionuclide solubility behavior as it affects the source term for transport, are of particular concern because they are processes that will only occur in the future (hence they cannot be studied *in situ* now) and are also potentially issues that could be controlled through applying Engineering Alternatives. The waste form will be altered over time by compaction due to room collapse and by chemical processes such as corrosion and decomposition. The waste form can also be modified by pre-treatment before emplacement. Radionuclide concentrations in brine available for transport out of the repository will be influenced by factors such as brine availability, the distribution of brine in the waste, and Ph. Conceptual models for these processes are complex and may be subject to considerable debate and uncertainty over issues such as the degree to which plastic materials will decompose or the volume of waste that will actually be contacted by brine, the saturation, and the fraction of brine that is then mobile and subject to expulsion as gas pressure rises.

While the processes are very complex, and inevitably will always be subject to uncertainty, the resultant variables that are actually important to performance may be much simpler. Repository pressure, for example, is important in assessing possible migration, but the particular reaction pathways for gas generation leading to development of that pressure have no impact on the relevant mechanism-effect of the pressure in driving transport. Even a difference between, for example, 500 years and 1000 years to achieve a particular pressure may not be particularly significant when assessing performance over a 10,000 year period. Critical variables for migration are pressure, concentrations of radionuclides and hazardous chemical constituents, mobile volumes of brine and gas, and (with rather less impact in many cases) factors such as permeability and brine stratification in the repository. Thus a wide variety of differing conceptual models of processes can be examined (in terms of their impact on performance) by investigating the uncertainties induced in the transport parameters. Only a conceptual model with effects so unusual as to change the driving mechanisms of transport would present a problem.

AG-99 RESPONSE

Activities are underway to ensure that the models which are used in performance assessment adequately capture all processes of concern at the WIPP site over the regulatory period. The results of these processes will be included, as appropriate, in the CCA and other compliance submittals, as appropriate.

AG-100 COMMENT

6.0 TEST PROGRAMS

6.1.4 Performance Assessment (PA)

M. Events/process screening: The described review process confirms that this issue is open.

AG-100 RESPONSE

Comment noted.

AG-101 COMMENT

7.0 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The CSR states that quality assurance will be governed by forthcoming Quality Assurance Requirements and Description, which will cover both future-generated and existing data. Thus, the compliance status of QA is a state of flux, and there is little object in commenting at this time.

AG-101 RESPONSE

The referenced forthcoming document, "Quality Assurance Requirements and Description," was issued in June 1994 as CAO-94-1012, *U.S. Department of Energy Carlsbad Area Office Quality Assurance Program Description*.

The requirement for QA has been constant throughout the WIPP Program. Implementation has been through a series of requirements that have evolved over the years to provide emphasis on areas of growing importance for the preservation of safety and protection of human health and the environment. The WIPP QA program will remain a viable management system, reflecting necessary changes in requirements as they become effective.

AG-105 COMMENT

8.0 COMPLIANCE ANALYSIS

8.1.2.1 Model Validation

The CSR treatment of methods of model validation is conclusory and does not explain how models may be validated—or confidence can be provided—in specific instances.

AG-105 RESPONSE

Model validation is an ongoing process. This process will be subject to the same scrutiny as the performance assessment codes themselves. Note that validation in the narrow sense of demonstrating that mathematical models correctly predict the behavior of a system is not possible for natural processes operating over such long periods of time (10,000 years). Validation of PA models will therefore focus on demonstrating that they are consistent with available information, and that they provide a simulation of the system that is reasonable for the needs of compliance assessment.

AG-106 COMMENT

8.0 COMPLIANCE ANALYSIS

8.1.2.2. Model Verification

The CSR states that complete verification of all PA codes has not been completed; thus, this is an open item.

AG-106 RESPONSE

Please see the answer above [reference is to AG-105].

AG-107 COMMENT

8.0 COMPLIANCE ANALYSIS

8.1.4.5.2 Inadvertent Human Intrusion

The CSR refers to matters to be examined in future PA's (e.g., at 8-21, 8-24, 8-42). Since annual and biennial PA's are no longer contemplated, the CSR should state what PA analysis will deal with such issues.

depend on the details of the final modeling system, and cannot be specified in advance.

AG-110 COMMENT

8.0 COMPLIANCE ANALYSIS

8.2.1 Role and Use of Expert Judgment

The CSR fails to note that expert judgment is also employed in numerous phases of the PA process, such as in experimental design and in assessing the sufficiency of data.

AG-110 RESPONSE

It was not the intent of this section to enumerate all possible uses of expert judgment. Rather, the intent was to give a broad overview of how expert judgment will be used in performance assessment. The conclusion in this section that "appropriate use of expert judgment must be evaluated on a case-by-case basis and is driven by individual circumstances" (at 8-30) was intended to encompass the specific situations identified in this comment.

AG-111 COMMENT

8.0 COMPLIANCE ANALYSIS

8.2.2 Treatment of Uncertainty Associated With Alternative Conceptual Models

The CSR states that a formal process will be adopted. It should be borne in mind that, if the process involves expert judgment, special safeguards should be incorporated. The text should refer to the work of the Conceptual Model Uncertainty Group and explain what further plans exist for that group.

AG-111 RESPONSE

The DOE is committed to ensuring that the models and codes adequately capture events and processes of concern at the WIPP site over the regulatory period. As stated earlier, model and code development are ongoing processes that are subject to continued scrutiny from stakeholders. This scrutiny includes the ability to look at the processes followed in developing a particular model, which seems to be the concern expressed here.

CSR fails to note that EPA has stated in its draft guidance for the presentation of no-migration petitions that performance assessments must account for such intrusions, (EPA 1992(b), at 34).

AG-114 RESPONSE

The current DOE position is that human intrusion modeling, such as the type done for compliance with 40 CFR 191, is not required for compliance with 40 CFR 268. On page 9-6 of the CSR, DOE states that "Human-induce events, which may affect the isolation capabilities of the unit, must also be addressed." Section 9.2.2 summarizes information provided by EPA in the WIPP no-migration determination regarding human intrusion. DOE has not received any additional guidance from EPA related to this topic. EPA has stated, with regard to this and other topics, that the Agency must be consistent in its interpretation and application of RCRA regulations at all hazardous waste facilities. To date, DOE believes that the use of institutional controls to preclude human intrusion events is consistent with EPA's interpretation and application of the RCRA regulations.

AG-115 COMMENT

9.0 REGULATORY COMPLIANCE ASSESSMENT

9.5.1 Active Institutional Controls

CSR should acknowledge that no long-term plan for active institutional controls yet exists.

AG-115 RESPONSE

A conceptual plan for active institutional controls covering 100 year exists and has been included in the DCCA.

AG-116 COMMENT

9.0 REGULATORY COMPLIANCE ASSESSMENT

9.5.2 Monitoring

No long-term monitoring plan exists. That issue will also be dealt with in 40 C.F.R. Part 194.

AG-119 RESPONSE

Comment noted.

AG-120 COMMENT

9.0 REGULATORY COMPLIANCE ASSESSMENT

9.5.6 Waste Removal

The compliance criteria will address this issue. DOE should be required to present a plan for the removal of waste during a period of 50 years after closure.

AG-120 RESPONSE

An analysis addressing waste removal exists and has been included in the DCCA.

AG-121 COMMENT

9.0 REGULATORY COMPLIANCE ASSESSMENT

9.9 Waste Acceptance/Waste Compliance

This section does not describe DOE's current plan, as outlined in the June 14-15, 1994 DOE-EPA technical exchange, to rely upon the Baseline Inventory Report for the characterization data underlying a compliance demonstration and to develop performance-based waste acceptance criteria ("PBWAC") through the SPM process to govern the receipt of waste. It is important to explain these new approaches and, notably, the prospect that PBWAC may change and DOE may seek to broaden the range of admissible waste through recertification proceedings.

AG-121 RESPONSE

The CSR presented the most current plan at the time of the document's release. Section 4.3.1 contains a description of the Baseline Inventory Report (BIR) and its relationship to the PBWAC. Future DOE documents will provide additional information regarding the use of the BIR in compliance evaluations.

AG-125 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

The term "encapsulating or stabilizing matrix" (part of the definition of "waste form") is not intended to include drums or boxes of the sort currently planned for emplacement of TRU waste. Such containers do not have a significant lifetime and do not inhibit movement of waste for any substantial time.

AG-125 RESPONSE

Comment noted.

AG-126 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

This definition would be better if it cited the authorities given to EPA pursuant to the WIPP Act and listed in 40 C.F.R. 191.12. Further, the reference to a DOE compliance determination raises the questions of the process, DOE participants, public participation, rules, and form of decision of that DOE procedure. They have not been adequately outlined to date.

AG-126 RESPONSE

Authorities assigned to the EPA and the DOE under 40 CFR 191.12 have been included in the interpretation. The issue regarding the administrative process was addressed in the response to a previous comment.

AG-127 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Whether the "reasonable expectation" standard can be compared with courtroom measures of proof is dubious. We are dealing with a scientific and technical process and one which projects future events. "Reasonable expectation" should be described in terms which emphasize the statistical measures of assurance and encourage the reduction of the subjective component of the assessment. Insofar as an agency's general "expertise" is a factor, that expertise must be documented.

AG-130 RESPONSE

Agreed. The wording of this text will be changed in the CCA and other relevant compliance submittals.

AG-131 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

The term "substantial and detrimental deviations from expected performance" appears in 40 C.F.R. 191.14(b), not in Appendix C. It is not clear what the stated definition means. Given the complexity of the PA process, it is best to focus monitoring on factors to which the PA seems to be sensitive and which can be effectively monitored.

AG-131 RESPONSE

For the purposes of potential future use, the text is revised to read ... Substantial and detrimental deviations from the expected performance are deviations that would potentially alter the finding that there is a reasonable expectation that the disposal system will comply with 40 CFR §191.13(a) requirements. To the extent practicable, monitoring will focus on factors to which the PA is sensitive and which can be effectively monitored. Ref.: 40 CFR §191.14(b)

AG-132 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Monitoring should not be restricted to parameters used in analysis of undisturbed performance. It should also address parameters related to disturbed performance, since disturbance of the site has a definite likelihood.

AG-132 RESPONSE

The DOE will monitor programs as required to comply with applicable regulatory criteria. The DOE has currently not identified any long-term monitoring of disturbed performance that would be meaningful.

AG-133 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

It is erroneous to limit monitoring to the period of active institutional control. The regulation requires

AG-136 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

If this discussion means that passive institutional controls will not be fully planned and designed at the time of the compliance certification submission, it is erroneous. DOE is not free to make changes in a plan which is the basis for certification.

AG-136 RESPONSE

The DOE approach is to describe current plans for active institutional controls and passive controls and to qualify this with the statement that plans may change as more is learned about effective ways to implement the controls. For example, if better materials are developed, it would be of benefit to have the flexibility to evaluate their efficiency and incorporate them into the design at that point in time.

AG-137 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

The interpretation which limits pertinent resources to those of current or near-term value is erroneous. The regulation speaks also of "any material that is not widely available from other sources" and "valuable geologic formations." 191.14(e).

AG-137 RESPONSE

Interpretation number 53 does not preclude materials not widely available. In fact, the last sentence of the interpretation covers these types of materials.

AG-138 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

The "documentation" referred to must satisfy the requirements of 191.14(e).

AG-138 RESPONSE

For the purposes of potential future use, the text is revised to read ... Because the WIPP site was evaluated and selected prior to promulgation of 40 CFR 191, compliance with the provisions of 40 CFR §191.14(e) may be demonstrated by documenting that the process used to select the site complied with the intent of 40 CFR

AG-141 RESPONSE

Comment noted.

AG-142 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

This language will also be superseded by 40 C.F.R. Part 194. It cannot simply be assumed that a driller would soon detect an intrusion into a repository. Proof of that fact would be required .

AG-142 RESPONSE

Comment noted.

AG-143 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Again, the language comes from the Appendix C guidance, which will be superseded. It is erroneous to assume compliance with drilling regulations when compliance is not the norm.

AG-143 RESPONSE

Comment noted.

AG-144 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

The language from Appendix C is not binding and, in any case, is under review in the issuance of 40 C.F.R. Part 194. Releases must be examined based on a supportable process of scenario selection, rather than being fixed a priority.

AG-144 RESPONSE

Comment noted.

AG-145 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 268.6

The term "reasonable degree of certainty" is not clarified by analogy with courtroom standards, since the issue is specifically scientific and technical. It

AG-147 RESPONSE

Regulatory interpretation #14 (for the RCRA interpretations) clearly provides for the consideration of human intrusion in a manner consistent with the EPA's draft guidance. As stated in interpretation #14, consideration of human intrusion shall be on a qualitative basis rather than a purely quantitative basis. This approach is supported by the EPA in its No-Migration Determination for the WIPP. The EPA states that:

More generally, EPA believes that, in the context of RCRA no-migration decisions, it should address the question of human intrusion by considering the likelihood of the intrusion, and imposing controls to make such intrusions unlikely. (EPA, 1990 @ 47720)

The DOE policy towards human intrusion under the RCRA program is consistent with EPA regulatory guidance.

AG-148 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 268.6

It is not clear what standard is set by the requirement that models be validated "to the extent practicable." There is obviously difficulty in validating a model which describes performance over 10,000 years. However, disposal without treatment is not legally favored, and there is no legal presumption that validation is possible at all; thus, there is no reason for an exemption based on impracticability.

AG-148 RESPONSE

The DOE does not intend to "set standard" with any language in this section. We agree that validation in the traditional sense is highly impractical for the PA. the interpretation should not be viewed as an attempt to provide "legal presumption". It is intended to clarify DOE's position that classic verification is not practical. Once the EPA agrees with us as well, we can work toward consensus on what is practical with respect to PA validation.

CONCERNED CITIZENS FOR NUCLEAR SAFETY
COMMENTS ON THE COMPLIANCE STATUS REPORT FOR THE WIPP
(DOE/WIPP 94-019, Rev.0)

CCNS-1 COMMENT

CSR FORMAT

The CSR format is both repetitious and confusing. Table 8-4 and the Compliance Summary (Table 12-1) are helpful. However, the references in Table 12-1 are not inclusive enough to direct the reader to the many different discussions about each of these issues, contained at various places in the CSR. Consequently, the Compliance Summary leaves the reader with the impression that conclusions have been reached about issues which are qualified or questioned in other areas of the Report. There are no references in Table 8-4.

CCNS-1 RESPONSE

The Table 12-1 is intended to summarize the data needs, both filled and unfilled, of the progress that DOE has made toward completing actions needed to demonstrate compliance with the two regulations that impose long term performance standards on the Waste Isolation Pilot Plant. Because of the inter-relationship between properties and processes, it is difficult to draw conclusions regarding the adequacy of data and analyses until all needed data are collected and all analyses are completed. Consequently, the CSR has served to focus on areas where additional data would be helpful to the compliance program.

Important assumptions used in the 1992 PA for consequence modeling of the WIPP disposal system are listed in Table 8-4 of the CSR. Additional information about these assumptions, and their implications on estimates of performance, can be found in SAND92-0700, Volumes 1 through 5.

CCNS-2 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for analysis of fracture behavior and topography (2-63, 2-66, 10-14).

CCNS-2 RESPONSE

The analysis of fracture behavior and topography is addressed in chapter 6 under issues related to WIPP hydrology. Issue D (page 6-21) Model for the Culebra Flow and Transport is an open issue relating to fracture behavior and topography. Transmissivity Variation in the Culebra Dolomite, issue E (page 6-21) and Effects of Gas Generation, issue G (page 6-23) are both open issues relating to fracture behavior and topography. Fracture modeling, issue K (page 6-29), is also an open issue related to fracture behavior and topography.

CCNS-3 COMMENT

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for radioactive and hazardous releases along vertical and lateral pathways (2-70, 10-9).

CCNS-3 RESPONSE

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

Radioactive and hazardous releases along vertical and lateral pathways are addressed in chapter 6 of the CSR. Issue B (page 6-2), Borehole and Shaft Plugging, is an unresolved issue relating to releases along vertical and lateral pathways. Issue D (page 6-21), Model for the Culebra Flow and Transport, is also an open issue relating to radioactive and hazardous releases along vertical and lateral pathways.

CCNS-4 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for the effects of climate changes on subsidence (2-71).

CCNS-4 RESPONSE

As noted in the 1992 preliminary PA (e.g., V. 1, p. 3-11, l. 16-19; V. 1, p. 6-3, l. 19-24), the effects on groundwater flow and radionuclide transport of subsidence related to potash mining will be examined using the regional three-dimensional hydrologic model

that has been developed since the 1992 PA was completed.

In the modeling, the scaling factor g is chosen to ensure that for the maximum value of A_R heads will be approximately at the elevation of the spill point of Clayton Basin, in the hypothesized recharge area consistent with the confined-aquifer conceptual model used in the PA. The decision to limit future heads to this elevation was made by WIPP PA analysts, and is discussed in Section 6.4.1 of Volume 4 of the 1992 PA. Values for other terms in Eq. 7-14 are discussed in a memorandum by Swift in Appendix A of Volume 3 of the 1991 PA (SAND91-0893/3), and are also discussed in Section 6.4.1 of Volume 4 of the 1992 PA. Note that Eq. 7-14 is not intended to predict future climate variability: rather, it is designed to permit examining system sensitivity to uncertainty in climatic change. If system-level sensitivity warrants, different values for all climatic parameters can be considered.

Results of climate-change modeling in the 1992 PA are presented in Section 6.5 of Volume 4 of the 1992 PA. They are also reported by Swift et al. (1994).

Additional analyses of climate change are included in ongoing three-dimensional regional groundwater flow modeling. The results of these analyses will be evaluated in the development of the CCA.

REFERENCE

Swift, P. N., B. L. Baker, K. Economy, J. W. Garner, J. C. Helton, and D. K. Rudeen. 1994. *Incorporating Long-Term Climate Change in Performance Assessment for the Waste Isolation Pilot Plant*. SAND93-2266. Albuquerque, NM: Sandia National Laboratories

CCN8-5 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for RH-TRU concerns (3-20, 8-32, 10-19).

CCN8-5 RESPONSE

The DOE is presently conducting a separate study on the

effects of RH TRU waste on the performance assessment of the WIPP repository. The study also includes a comparison of RH TRU waste with that of CH TRU waste. This study is mandated by the WIPP Land Withdrawal Act of 1992.

CCNS-6 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for Performance Based Waste Acceptance Criteria (PBWAC) bounding conditions (4-23, 9-15).

CCNS-6 RESPONSE

1. Many performance criteria that set boundary conditions already exist in the current WAC, TRAMPAC and QAPP.

2. As PA identifies other parameters that require boundary criteria in order to meet required repository performance, they will be added to these documents and submitted to the appropriate regulators.

CCNS-7 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for Culebra flow and transport models (6-21).

CCNS-7 RESPONSE

Issue D (page 6-21) Model for the Culebra flow and transport is an open issue. The DOE will characterize any uncertainty that remains in the Compliance Certification Application (CCA). Field tests and consequence evaluations will be conducted, as appropriate, to improve any inadequate level of resolution.

CCNS-8 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are

important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for evaluations of change in the DRZ with time (10-13).

CCNS-8 RESPONSE

Evaluations of change in the Disturbed Rock Zone (DRZ) with time are related to issues in chapter 6, section 1.2, Issues in Rock Mechanics. Issue B and sub-issue B.2 (page 6-15), What is the Best Approach to Simulating Salt Creep, is a resolved issue related to the change in the DRZ with time. Rock Mechanics Concerns in Seal Performance, issue C (page 6-17) is still an open issue relating to the change in the DRZ with time.

CCNS-9 COMMENT

PERFORMANCE ASSESSMENT LEVEL OF RESOLUTION

While discussions of some issues indicate that they are important to the Performance Assessment (PA), the CSR is not clear what level of resolution has been achieved for Actinide Source Term Tests (10-18).

CCNS-9 RESPONSE

This is an open issue covered in chapter 6, section 1.4 Issue D (page 6-26), Uncertainty in Radionuclide Solubility and Retardation. Experimental work is in progress in this area and will be considered in compliance evaluations for the DCCA.

CCNS-10 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for large seal tests and component performance for final evaluation of seal materials (3-16, 3-18, 6-17, 10-11).

CCNS-10 RESPONSE

Any necessary seal testing will be performed. The seal design and its compliance-based specifications for performance will be included in the CCA and other relevant compliance submittals, as required.

CCNS-11 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for application of the Munson-Dawson model to salt creep (3-19, 10-15, 12-13).

CCNS-11 RESPONSE

The MD creep model will be considered in compliance evaluations and will be discussed, as appropriate, in the CCA.

CCNS-12 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for experimental work becomes critical. The CSR is vague about the time frame for additional analysis of waste to determine acceptability for PBWAC (4-22).

CCNS-12 RESPONSE

As the need for additional criteria is identified by PA, the criteria will be considered for addition to the existing WAC as new performance based WAC (PBWAC). The required analyses and methods to control these new criteria will likewise be added to the existing WAC and QAPP and documented in the Compliance Certification Application, as appropriate.

CCNS-13 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for Culebra transport model quantification (6-22).

CCNS-13 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas

necessary to ensure complete, accurate, and timely submittal of the compliance documents. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-14 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for coupling of hydrological geomechanical modeling (6-23).

CCNS-14 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-15 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for radioactive solubility and retardation (6-26).

CCNS-15 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-16 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for coupling of creep closure process models with gas generation models (6-29).

CCNS-16 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-17 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for evaluation of the effects of pressure-dependent fracturing of the anhydrite interbeds in the Salado Formation (6-29).

CCNS-17 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-18 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame

for the experimental work becomes critical. The CSR is vague about the time frame for availability of the 3-D SECO TOUGH 2 analyses of brine and gas flow (6-30).

CCNS-18 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-19 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for conclusion of the reexamination and documentation of past screening activities for CCDF scenarios (6-30).

CCNS-19 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-20 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for experimental work becomes critical. The CSR is vague about the time frame for reviews of software for models and codes (7-5).

CCNS-20 RESPONSE

The review of models and codes is currently in process.

SNL reported to EPA, during the February 1, 1994 technical exchange that eight of fifty PA-related codes have been fully qualified; an additional three are in comment resolution, leaving another thirty-nine to be reviewed. The result of the model and code QA activities will be reported in the CCA and other relevant compliance submittals, as appropriate.

CCNS-21 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for verification of all PA codes (8-8).

CCNS-21 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-22 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for alternative conceptual models which include variations in assumptions about the natural and engineered barrier system (8-35).

CCNS-22 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. Decisions regarding experimental work on natural barriers were made and announced by the DOE in the spring of 1995. Evaluations of engineered alternatives are being

conducted currently. The DOE will continue to make decisions, as appropriate, throughout the compliance process.

CCNS-23 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for experimental work becomes critical. The CSR is vague about the time frame for collection of "sufficient waste characterization data to derive chemical prevalence or chemical concentration values" (9-16).

CCNS-23 RESPONSE

The DOE issued Revision 1 of the Baseline Inventory Report (BIR) in February 1995. The BIR provides a roll-up of waste parameters that are believed to be important to the assessment of disposal system performance. The BIR will continue to be updated as DOE sites continue to refine their knowledge of their waste.

CCNS-24 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for results of tracer tests to evaluate transmissivity in the Culebra (10-9).

CCNS-24 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. This particular test is currently underway at H-19.

CCNS-25 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for laboratory quantification of chemical retardation of radionuclides through the Culebra (10-10).

CCNS-25 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-26 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR i vague about the time frame for sensitivity analysis of closure (10-15).

CCNS-26 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-27 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for decision on whether to include ph, corrosion rates, and microbial degradation tests on backfill material (10-16).

CCNS-27 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely

submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-28 COMMENT

SCHEDULED TIME FRAME FOR EXPERIMENTAL WORK

Because the WIPP Disposal Decision Plan outlines an ambitious compliance schedule, the expected time frame for the experimental work becomes critical. The CSR is vague about the time frame for resolution of oversimplification of processes and possible omission of important parameters and processes in PA (10-26).

CCNS-28 RESPONSE

The time frame for experimental and performance assessment work is clearly an important issue. However, the CSR was compiled as a status report to serve as a tool to focus project resources on the areas necessary to ensure complete, accurate, and timely submittal of the compliance application. This issue will be addressed in the process of developing the CCA and other relevant compliance submittals, as appropriate.

CCNS-29 COMMENT

PERFORMANCE ASSESSMENT

PAGE 8-9

1. The CSR should demonstrate that the DOE's plan to use the mean CCDF as "the single representation of predicted repository performance" will satisfy the upper 90% confidence limit proposed for compliance criteria (6-24 and 6-5). What conditions on number, scope of scenarios or their sensitivity to PA will be imposed on the CCDFs to be included in the pool from which the mean CCDF is derived (8-9)?

CCNS-29 RESPONSE

Consistent with current regulatory standards and guidance, no conditions will be set on the number and scope of scenarios that will be used to construct the mean CCDF. The scenarios used in computations will be subsets of the theoretically infinite population of possible scenarios. Aggregation of scenarios into these subsets will be done to facilitate analysis while

preserving representativeness. Also consistent with current regulatory standards and guidance, criteria of probability, consequence, and regulatory requirements will be used in selecting the features, events, and processes used to construct scenarios. Thus, those features, events, or processes that can be shown to have either extremely low probabilities or extremely low consequences, or to be excluded by regulatory requirements or based on physical unreasonableness, will not be used in CCDF construction.

CCNS-30 COMMENT

PERFORMANCE ASSESSMENT

PAGE 8-10

2. The CSR should show how resolution will be achieved between bounding calculations, consequence analysis and data from the planned streamlining of the Monte Carlo Analysis (8-10)?

CCNS-30 RESPONSE

These topics will be addressed as necessary in the CCA. The reference to the "planned streamlining of the Monte Carlo Analysis (8-10)" is unclear. If the reference is to the use of the Latin Hypercube Sampling (LHS) technique to reduce the total number of samples required, more complete discussions of LHS can be found in Chapter 3 of Volume 2 of the 1992 PA, in Chapter 3 of Volume 1 of the 1991 PA, and in references cited in those places. Correlations between variables will be included when a defensible basis for such correlations is available. Unless currently unavailable data are pursued and acquired which could be used to defend such correlations, it is reasonable and appropriate to sample variables independently.

CCNS-31 COMMENT

PERFORMANCE ASSESSMENT

PAGE 8-13

3. CCNS believes that low probability scenarios must not be screened if they can be shown to involve a high consequence (8-13).

CCNS-31 RESPONSE

The DOE follows EPA regulations and applicable guidance

regarding the screening of scenarios in performance assessment. Your suggestion is not consistent with the screening methodology employed.

CCNS-32 COMMENT

EXPERT JUDGEMENT

PAGE 8-30

The CSR should explain how expert panels are chosen so that a range of views can be assured (8-30). The Environmental Evaluation Group's (EEG's) recent report, Implications of the Presence of Petroleum Resources on the Integrity of the WIPP, Matthew Silva, June 1994, (EEG-55), raises strong concerns about DOE's process in employing expert panels (EEG-55, pp. 2-30). In addition to panels, the CSR should be more clear about the role of expert judgment in methodological value judgments that go into PA processes like experimental design, default values, data sufficiency in modeling programs, or screening processes.

CCNS-32 RESPONSE

(a) SNL WIPP Quality Assurance Procedure (QAP) 9-3, Use of Expert Judgment Panel, is currently in review. It is based upon *Quality Assurance Procedures for Parameter Selection and Use of Expert Judgment Panels Supporting Performance Assessments of the Waste Isolation Pilot Plant* (SAND91-0429), which has been available since November 1992. SAND91-0429 states:

> "The PA Department shall seek nominations from a wide range of sources. Possible sources for nominators are the following, as applicable:
>
> - Participants (WIPP Project staff)
> - Customers (DOE)
> - Stakeholders
>   - Intervenor groups
>   - Regulators
> - Other
>   - Literature
>   - Professional organizations
>   - Government agencies
>   - Universities
>   - Consulting firms
>   - Public interest groups
>
> Nominators will be asked to provide

nominations, which can include themselves."

Once nominations have been made, the selection of the expert panel is based on the selection criteria of lack of conflict of interest, expertise, objectiveness, and availability.

SAND91-0429 also states that the ranking of nominees will consider:

> "Diversity of the panel with respect to scientific approaches, backgrounds, and organizational affiliations."

This approach and its implementation ensures that peer reviews are conducted in a consistent manner and that a range of diversity of views is maintained as appropriate for the topic being considered.

(b) SAND91-0429 allows for the broader use of expert judgment beyond providing probability distributions:

> "The products of the expert elicitation process, as described in the issue statement and the contract statement of work, can be both qualitative and quantitative and are task dependent...Qualitative information documented in the panel's written material, Recommendations (e.g., experiments, design criteria)."

The WIPP Project has used and continues to take advantage of the broad expertise and perspective of individuals outside of the Program in concert with the expertise of staff scientists. This external cooperation can provide peer review of data sets and their use, and of analysis techniques and assumptions. Peer review and concurrence may become essential in supporting the case for a reasonable expectation of compliance with the provisions of 40 CFR Part 191.

REFERENCE

Rechard, R. P., K. M. Trauth, and R. V. Guzowski, 1992. *Quality Assurance Procedures for Parameter Selection and Use of Expert Judgment Panels Supporting Performance Assessments of the Waste Isolation Pilot Plant*, SAND91-0429, Sandia National Laboratories, Albuquerque, New Mexico.

CCNS-33 COMMENT

HUMAN INTRUSION

SITE SELECTION

The CSR must be more specific about its justification that the WIPP site's "favorable characteristics compensate for [its] greater likelihood of being disturbed in the future" (9-12, 13). Recent revelations about current drilling practices (EEG-55) have called attention to DOE's past minimization of the interest in oil reserves in the vicinity of WIPP (6-8, 9). The entire area of site selection must be reevaluated in view of this new data. It may even be necessary to reevaluate the current oil reserves. The number of abandoned wells and the inadequate sealing and abandonment practices on Bureau of Land Management properties could affect the site performance. In addition, the use of brine injection for secondary or tertiary recovery could potentially have an adverse effect on the hydrology of the site (10-21), thus affecting its performance.

CCNS-33 RESPONSE

The issue of resources and site selection is multi-faceted. From the stand point of site selection, resources were important for three reasons. First, areas where resources were undeveloped or underdeveloped are considered desirable since DOE sought to have a large volume of intact, undrilled salt for the disposal system. This is the single most important resource related criteria which could not be satisfied at a number of other sites (e.g., Lyons Kansas). Second, DOE needed resource information to predict future risks, once active control of the site ended. This is done in the Performance Assessment. Third, under the rules of the National Environmental Policy Act, the DOE needed to understand and evaluate the impacts of resource denial in its decision making process.

Nothing from the recent study would change the decision that was made based on these factors. The recent study simply provides an up-to-date interpretation of resource information as specified by regulatory application submittal requirements.

The site selection of the WIPP repository has been evaluated in the *Final Environmental Impact Statement, Waste Isolation Pilot Plant*, and the *Geological*

Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico. These documents are available for review to obtain a full understanding of the WIPP site selection process based on the information available at the time.

The impacts of present and past drilling practices, as well as future human intrusion scenarios, are still being evaluated for PA. If evidence is found that drilling practices or human intrusion are the reason for an inability to demonstrate compliance with the containment requirements, DOE will evaluate their options based on uncertainty and sensitivity analyses. The options include modifications/additions to passive and/or active controls concepts, development of engineered alternatives, making additional or modified assumptions in PA, gathering additional data/information, etc. The option chosen will be documented and justified in the CCA.

CCNS-34 COMMENT

HUMAN INTRUSION

PASSIVE INSTITUTIONAL CONTROLS

The CSR should be clear about how the PA intends to incorporate passive institutional controls into its demonstration of compliance (3-23,4; 9-10). CCNS has endorsed the inclusion of passive institutional controls at WIPP as a support for the defense in depth philosophy. However, we have opposed any quantification of the benefits from such use on the basis that these calculations are speculative and cannot be assured to be conservative.

CCNS-34 RESPONSE

The DOE, too, views the 40 CFR 191.14 Assurance Requirements as part of a defense in depth strategy to assure the long term integrity of the WIPP. The 1992 PA presented the calculations and their results for intrusion probabilities estimated for cases with and without passive markers (quantitative). Complete modeling of repository performance must include the effects of the entire disposal system. Determining the effects of passive institutional controls is important in consequence analysis and is not intended to be used as a reliance factor for compliance with release limits in 40 CFR 191.

Work is continuing, through PA efforts, to provide

quantitative estimates for the effectiveness of passive institutional controls for inclusion in disposal system performance calculations.

CCNS-35 COMMENT

HUMAN INTRUSION

ACTIVE INSTITUTIONAL CONTROLS

DOE's draft Land Management Plan (DOE/WIPP 93-004 states: 'It is not the intent of the DOE to manage the surface of the withdrawal area as a WIPP exclusive-use area." Because of this multi-use philosophy, the CSR must be more specific about what conditions would trigger emergency institutional controls and how these controls will interface with the public. For instance, in the event of a release, what procedures will inform the public about the danger? How severe must a scenario be in order to exclude the public or stop drilling? In the event of contamination from these releases, what cleanup guidelines will DOE follow in relation to this public, multi-use policy?

CCNS-35 RESPONSE

During the operational period, institutional control will be conducted in accordance with the Land Management Plan (LMP), or equivalent. In such off-normal instances as those you mention, the Emergency Plan and/or the RCRA Contingency Plans would be implemented, as appropriate. These Plans include guidelines for the grading of events based on severity, structured public information protocols, and remedial actions to be implemented if appropriate.

CCNS-36 COMMENT

HUMAN INTRUSION

ACTIVE INSTITUTIONAL CONTROLS

The CSR states that monitoring of parameters related to disposal system performance will be maintained "for as long as practical after closure" (5-7). The CSR should state what criteria will be used to evaluate the practicality of monitoring. In particular, since as the CSR states, "there will be little opportunity to test the actual [shaft] seals after placement, " (10-12) CCNS believes DOE would be prudent to be more specific about the time period for active monitoring of the performance of these seals after closure.

CCNS-36 RESPONSE

The DOE has developed long-term monitoring plans for the NMVP and the CCA. These plans will focus practicable technologies on sensitive parameters that will provide meaningful information relative to repository performance. There are no plans to focus any monitoring efforts on shaft seal performance. The active control program will be implemented for at least 100 years after closure. The DOE has further committed to continue this program after that period of time for as long as reasonable and practicable.

CCNS-37 COMMENT

WASTE CHARACTERIZATION AND INVENTORY

WASTE DESCRIPTION

The CSR states: "The total volume for all generator/storage sites is less than the design capacity for [CH]TRU waste to be emplaced at the WIPP" (4-1). Yet PA calculations assume full repository capacity (4-2). The CSR must be more specific about what waste will be considered for WIPP. For instance, Pantex is not listed as a potential generator site. Does this mean that DOE is not considering TRU waste from dismantling operations at Pantex as possible WIPP waste? Will WIPP potentially take TRU waste from cleanup of pre-1970 land fills? What prioritization method does DOE intend to use for deciding what waste will fill the remaining WIPP CH TRU capacity?

CCNS-37 RESPONSE

The WIPP TRU Waste Baseline Inventory Report (WTWBIR, or just BIR) Revision 0, was published after the CSR was distributed. The BIR uses information on waste streams from the Mixed Waste Inventory report (MWIR) and overall inventory information from the Integrated Database (IDB) to provide information as input to the Performance Assessment (PA) process. The draft version of the MWIR became available in May of 1994 after the CSR was published. The MWIR is organized to provide waste stream information according to the EPA's guidance on treatability groups. This information when extrapolated to include the entire inventory, as has been reported in the IDB, provides the information on the type and relative amounts of the various waste in the TRU Waste system. The anticipated inventory as reported in the BIR includes the retrievably stored waste and currently projected waste volumes. Much of

the pre-1970 waste is not retrievably stored. The BIR has attempted to improve upon the future waste generation information through additional contacts with the various generator sites. Future BIR estimates will include predictions of waste to be generated as a result of decontamination and decommissioning (D & D) activities. This waste will be generated under strict certification, characterization, and quality assurance programs. This will control and properly identify the hazardous constituents. These programs will provide the opportunity to minimize the generation of hazardous materials by the use of waste minimization and substitution techniques.

CCNS-38 COMMENT

WASTE CHARACTERIZATION AND INVENTORY

RH-TRU WASTE

How have DOE generator sites arrived at the RH TRU inventory quantities in Table 4-2? What is the expected time frame for NRC certification of an RH TRU shielded shipping cask (3-20)? When will PA modeling include subsurface groundwater releases for RH TRU wastes (8-32)? Was RH TRU curie content included in PA cuttings release estimates for use in the erosion conceptual model (10-19)?

CCNS-38 RESPONSE

The DOE TRU waste inventory (CH and RH) is documented in the *Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report* (CAO-94-1005) (WTWBIR). This document defines the inventory in terms of volumes of waste and quantities of radionuclides. Additionally, this document provides the densities of nonradioactive waste material parameters determined to be necessary for SPM and PA modeling to determine the sensitive waste materials. The WTWBIR explains the methodology used to develop the inventories.

Certifying the RH TRU shipping cask will be a two-step process. The documentation for certification will be sent to DOE Headquarters. The DOE certification process will take approximately 6 months. After DOE has certified the container, NRC will begin their certification process. The NRC process is expected to take 12-18 months.

The PA modeling utilizing RH inventories is discussed on pages 8-32 and 10-19 through 10-21 of the CSR.

RH-TRU waste was included in estimates of cuttings and cavings releases in the 1992 preliminary PA.

CCNS-39 COMMENT

WASTE CHARACTERIZATION AND INVENTORY

PROCESS KNOWLEDGE AND SAMPLING

In the past, CCNS has been critical of DOE's assertion that process knowledge (7-4) is a sufficiently accurate method to determine waste characterization. The CSR should include information perhaps from the more thorough waste characterization done in conjunction with the No-Migration Variance about how accurate inventory records have been since 1970? since 1986? Sampling or more intrusive waste analysis may need to be more intensive pre-1986 to assure an upper 90% confidence level (4- 42).

CCNS-39 RESPONSE

The Performance Assessment (PA) will be based upon the best estimates of the total inventory of TRU waste to be emplaced in WIPP. The inventory information used in the PA will be derived from data in the WIPP TRU Waste Baseline Inventory Report (WTWBIR). The PA process will identify the parameters critical to repository performance. In the future additional criteria may be added to the WAC based upon the PA results. Such additions would be performance based (PC)WAC. The current characterization and certification programs have and will continue to provide analytical data to the base of process knowledge. This data will be used in conjunction with PA results to establish the acceptable waste envelope. Waste that falls outside this envelope of acceptability will not be shipped to WIPP.

Waste characteristics can be identified generally or in detail, depending on their relative importance to performance and the amount of associated uncertainty. Waste characterization can be accomplished in a number of ways including process knowledge. Waste characterization is a set of evaluation activities specifically designed to result in determinations relative to the acceptability based on physical, chemical, and other properties of a waste within a particular waste management system.

CCNS-40 COMMENT

WASTE CHARACTERIZATION AND INVENTORY

PERFORMANCE BASED WASTE ACCEPTANCE CRITERIA (PBWAC)

The CSR should state what the context for the PBWAC envelope will be. For instance, RH TRU criteria specify "maximum activity concentration for a RH TRU waste package shall not exceed 23 curies/liter" averaged over the waste container (4-30). Will the envelope context be the waste container for some radionuclides, a panel for others, or the entire WIPP disposal area for others?

CCNS-40 RESPONSE

The Performance Assessment (PA) will provide the limits (an envelope) and a context for the characteristics of the waste that will be acceptable to meet the criteria specified in 40 CFR 191 for emplacement in the WIPP repository. Waste characterization, that is, the process of judging if waste fits within the envelope, will be on a container basis. The PA will use the container based waste characterization information. In some instances the container based information will be scaled to room or panel level to meet the specific needs of PA.

CCNS-41 COMMENT

WASTE CHARACTERIZATION AND INVENTORY

PERFORMANCE BASED WASTE ACCEPTANCE CRITERIA (PBWAC)

The CSR states: "Because a significant portion of the waste to be disposed of at the WIPP facility is not yet generated, specifying waste acceptance criteria that will decrease uncertainties in the PA is a viable option" (9-15). The CSR should indicate what new restrictions are being contemplated and if these new conditions will prevent any of the TRU waste currently destined for WIPP from being accepted.

CCNS-41 RESPONSE

The DOE agrees that as soon as any new restrictions can be identified they should be made available to waste generators for controlling future generated waste. We respectfully disagree that options being contemplated are a matter worthy of discussion in the CSR or any compliance submittal. No new regulatory compliance

related restrictions beyond those already in the WAC have been identified to date. The WAC criteria will be revised in the future if modifications are needed.

CCNS-42 COMMENT

WASTE CHARACTERIZATION AND INVENTORY

PERFORMANCE BASED WASTE ACCEPTANCE CRITERIA (PBWAC)

Will the PBWAC consider the influence of radiolysis in the PBWAC envelope, particularly with respect to Pu238 and RH-TRU? What is the deadline for incorporating experimental data such as chemical prevalence or chemical concentration values (9-16) into the final PBWAC?

CCNS-42 RESPONSE

Important waste parameters, as identified by the PA process will be considered for inclusion in the WAC/PBWAC. The WIPP DDP provides the current timeframe for completion of such activities. The DOE will strive to minimize the wastes precluded through both WAC and PBWAC restrictions. As additional data/information are acquired, some of the initial PBWAC restrictions that are necessary due to a lack of information currently may be relaxed. Specifically the effects of radiolysis are currently treated for in PA. If the sensitivity analysis so indicates, these effects could be managed through PBWAC restrictions.

CCNS-43 COMMENT

WASTE TREATMENT AND ENGINEERED BARRIERS

COMPACTION

The CSR states: "The end state of densification of the waste becomes much clearer if the waste is processed prior to emplacement (2-61)." The CSR also indicates that waste composition and state of compaction is a sensitive issue for erosion and spallation (2-62). The CSR should state whether it is possible to evaluate the "end state of densification" so that data on erosion and spallation can be determined?

CCNS-43 RESPONSE

The discussion in the CSR was intended to indicate that waste segregation prior to compaction will lead to a more predictable end product. The degree of certainty

needed with regard to this end state could potentially drive the decision to segregate, not vice-versa. Post compaction characterization is not practicable. End state densities can be predicted if the need for greater certainty is identified through PA.

CCNS-44 COMMENT

WASTE TREATMENT AND ENGINEERED BARRIERS

WASTE FORM

What analysis has been made to determine the benefits and costs of solidifying the waste into a more stable form (3-10)?

CCNS-44 RESPONSE

This topic is included in the Engineered Alternatives Benefit/Detriment study that is currently underway.

CCNS-45 COMMENT

WASTE TREATMENT AND ENGINEERED BARRIERS

ENGINEERED BARRIERS

The CSR should be more specific about what modifications of the "form of the waste and backfill of drifts, panels, or rooms, or design of the waste emplacement areas" (3-10) DOE would use to comply with regulatory requirements. Have the tests been done and the engineering investigated for these modifications should they be needed?

CCNS-45 RESPONSE

The DOE continues evaluations of such engineered alternatives. The CCA will discuss the specifics that you mention relative to any engineered alternatives that are made a part of the compliance baseline for the disposal system.

CCNS-46 COMMENT

WASTE TREATMENT AND ENGINEERED BARRIERS

ENGINEERED BARRIERS

Will added data be needed before "CCDFs for alternative conceptual models, which include variations in assumptions about the natural and engineered barrier

systems" can be developed (8-35)? If so the CSR should be specific about what tests are needed and how long these tests will take? This information seems particularly important since the CSR admits that so far, the PA has assumed that short-term seal components "perform sufficiently well to assure that water does not enter the repository via shafts and that not enough water enters the shafts to preclude or delay the consolidation of the salt components" (10-22). If this assumption cannot be confirmed, modifications in repository design, form of waste and backfill composition will be essential. The CSR should be more specific about what engineering alternatives identified by the Engineering Alternatives Task Force (EATF) (9-12) it would consider for WIPP. What process will DOE use to evaluate whether : such measures would be necessary" (9-12).

CCNS-46 RESPONSE

If engineered alternatives are needed to improve repository performance (as predicted by PA and characterized in the CCA) to a compliant level they will be identified, included in the compliance baseline, and justified in the CCA. With respect to additional data needs, the DOE will acquire whatever additional data are required to justify the assumptions germane to the compliance demonstration in the CCA and other compliance submittals as appropriate.

CCNS-47 COMMENT

REPOSITORY PERFORMANCE CONCERNS

BRINE WEEPS AND SEEPS

The CSR should be more clear about how the PA will resolve the issue of brine inflow. Brine inflow studies have been conducted for about ten years and yet brine seepage rates are still characterized as " slow and difficult to quantify" (6-4). Will there be a change in approach or does DOE anticipate finally having data which will be useful for PA calculations?

CCNS-47 RESPONSE

The PA calculations will be revised to be consistent with observed data and a refined conceptual model. There are three conceptual models with respect to brine inflow: (1) a far-field model, also known as the Darcy flow model, which proposes that brine flows from the far field in response to potentiometric gradients

through naturally interconnected intergranular pore spaces; (2) a redistribution model, which considers that brine flows only from within deformed rock in the immediate vicinity of WIPP excavations; and (3) a clay-consolidation model, which proposes that the most significant source of brine flow is the layers of clay that were exposed by WIPP excavation. Experimental information along with an ongoing facility-wide brine inflow observation program (called the Brine Sampling and Evaluation Program), are designed to provide data relevant to the flow mechanisms related to the excavation. Results of these activities will be considered in development of the conceptual models for fluid flow in the Salado Formation to be included in the CCA and other relevant compliance submittals.

CCNS-48 COMMENT

REPOSITORY PERFORMANCE CONCERNS

BRINE WEEPS AND SEEPS

Table 12-1, 6.1.1 C mentions experiments on the "hydrological properties of the repository horizon sediments," yet these experiments are not explained elsewhere. The CSR should be more clear about the significance of these experiments for PA.

CCNS-48 RESPONSE

Chapter 10 (page 10-4), Large-Scale Brine Inflow Experiments discusses planned activities, at Room Q, related to brine inflow. Room Q activities, along with an ongoing facility-wide brine inflow observation program (called the Brine Sampling and Evaluation Program), are designed to provide data relevant to the flow mechanisms related to the excavation, which provide fundamental input to the conceptual models for fluid flow in the Salado Formation. This information will be considered in compliance evaluations and will be discussed, as appropriate, in the CCA and other relevant compliance submittals.

CCNS-49 COMMENT

REPOSITORY PERFORMANCE CONCERNS

BRINE RESERVOIRS

The presence of brine reservoirs beneath the WIPP site raises serious concerns about WIPP's suitability as a disposal site because of the human intrusion release

scenarios. The CSR's implication that the effect of release scenarios involving these brine reservoirs can be modified or diminished by the likelihood that a driller would stop drilling before hitting the reservoir is wishful thinking and not good science. The CSR must describe how PA will resolve the brine reservoir problem, without arbitrarily eliminating worst case scenarios.

CCNS-49 RESPONSE

The current PA does include scenarios that involve drilling into a pressurized brine pocket below the repository (Chapter 6, page 6-3, Issue C). The DOE is evaluating standard drilling procedures in the region in an effort to determine if it is reasonable to expect that a driller would soon detect the repository and stop drilling operations prior to encountering a Castile brine reservoir. The question referred to in the table at 12-4 is not whether a driller penetrating and unaffected portion of the Salado would stop drilling before encountering a brine pocket, but rather a driller who penetrates the repository would identify the situation as unusual and stop drilling, and if so, would the driller stop before he had penetrated a Castile brine pocket. The problem with penetration of a possible brine pocket has to do with the potential for creating communication between a brine reservoir and the repository. If encountering an anomaly like the repository would be sufficient to make a driller stop drilling (and ultimately abandon the well) before reaching Castile, then brine pockets below the Salado are less of a concern. If this can be determined, the probabilities associated with human intrusion events can be reevaluated. The results of these evaluations will be discussed in the scenario screening text of the CCA.

CCNS-50 COMMENT

<u>REPOSITORY PERFORMANCE CONCERNS</u>

<u>CULEBRA TRANSPORT</u>

The CSR is clear about the importance of this arena (6-18). Although much of the focus of PA investigation has been in this area, it is clear that resolution of the uncertainties is itself uncertain. Therefore, CCNS believes that the CSR should be more clear about how much certainty can reasonably be expected within the projected compliance time frame. For instance, deficiencies exist even in the conceptual models (2-29

and 6-28). Current models for the most sensitive area, blowout or controlled release during drilling, are inadequate (10-22). Models for horizontal releases may not adequately reflect chemical retardation (2-21 and 10-10). Even "extremely slow vertical flow" is a sensitive parameter, yet has not been integrated into PA (2-30).

CCNS-50 RESPONSE

A number of alternative concepts are being investigated to assess their consequences with respect to Culebra transport. Non-sorbing tracer tests are also planned to provide transport parameters and to test the conceptual models.

Current models for blowout or controlled release during drilling cannot be modeled as Darcy flow, and computations are not planned with BRAGFLO code in the Monte Carlo simulations. However, separate analytical calculations will be performed to identify these potentials for release.

Clay minerals are most abundant in horizontal layers that represent original bedding planes in the evaporite sequences of the Culebra Dolomite. Because the clays are less competent than the dolomite above and below, clay-rich layers are preferentially opened during fracturing, creating clay-lined sub-horizontal fractures. Due to the cation exchange capacity of clay minerals in general, clay-lined sub-horizontal fractures may play an important role in the chemical retardation of radionuclides.

Programs of regional three-dimensional models are in place and progressing. Consideration of the suitability of the performance assessment model of the Culebra as a confined aquifer is not yet concluded. Preliminary conclusions lead us to believe that it is important and necessary to include vertical flux in regional three-dimensional calculations that examine how the natural system might respond to climate change. However, for purposes of calculating transport, preliminary calculations lead us to believe that vertical flux can be justifiably neglected in performance assessment calculations.

CCNS-51 COMMENT

REPOSITORY PERFORMANCE CONCERNS

CULEBRA TRANSPORT

The CSR refers to a process for arriving at "conservative but reasonable values" for retardation coefficients for sorption of radionuclides in the Culebra outlined in the 1988 Modification to the Working Agreement of the Consultation and Cooperation Agreement between New Mexico and DOE (6-14). The CSR is unclear how this consultation will be carried out and which state entity is ultimately responsible for the consultation. Presumably the process would involve EEG with approval by both the New Mexico Attorney General and the Governor's WIPP Task Force. CCNS believes that the public should also have an opportunity to comment on not only these values but also any other values which will be used for modeling compliance but which are not "experimentally justifiable" values.

CCNS-51 RESPONSE

Retardation values for sorption of radionuclides in the Culebra will be justified in the CCA. "Consultation" will be focused through guidance received from EPA ORIA. The process of certification will clearly involve the public.

CCNS-52 COMMENT

CLIMATE/SUBSIDENCE

CLIMATE

The CSR indicates that climate is a sensitive parameter (6-19), but states that "no further studies of climate changes are required" for compliance determination (12-7). PA predictions of future climate variability assume that "future climate variability [is] bounded by past" variability (8-33). However, the effect of even small precipitation levels on the geology of the WIPP site is not yet resolved. The CSR explains that future wetter climates could cause the "water table to rise into the more permeable upper portion of the Dewey Lake thereby generating a possible release pathway" (6-19). According to Dr. Roger Anderson (Dr. Roger Anderson (Anderson to Lovejoy, Comments on CSR, DOE/WIPP 94 019: 14 July, 1994), the effects from climate change are not limited to Dewey Lake, but also affect the Rustler

aquifer and the Culebra. Anderson's contention that climate change within the 10,000 year regulatory period can have dramatic effects on the geology of the WIPP site raises serious issues of compliance. The CSR should explain how PA will deal with these questions about the age of Nash Draw, the potential for dissolution and/or karst development within the Rustler Aquifer during the regulatory period, and the potential for the Nash Draw "finger of conductivity" to penetrate the WIPP site.

CCNS-52 RESPONSE

On page 12-7 of the CSR, within the issue titled Paleoclimate and Climatic Changes pertaining to section 6.1.1, the CSR states that "no further studies of the range of climate changes are required." On page 6-27, the CSR goes on to state that "A study of long-term climate variability at the WIPP was undertaken in 1989, and potential hydrologic changes due to climatic variability have been included in two-dimensional groundwater flow modeling since 1991. Documentation of the study of long-term climate variability is available in Swift (1992). Implementation of the effects of climate variability in two-dimensional groundwater flow modeling is described in Volume 2 of the 1991 PA report and Volume 4 of the 1992 PA report. The effects of climate change are currently being investigated as part of a regional three-dimensional flow modeling study." Additionally, the Compliance Summary Table (Table 12-1) on page 12-24 identifies the status of Climate Change issues associated with section 6.1.4. F to be "open." The results of the 3-D modeling study will be considered in scenario development for the final PA for the CCA and other relevant compliance submittals.

CCNS-53 COMMENT

<u>CLIMATE/SUBSIDENCE</u>

<u>CLIMATE</u>

PA must also integrate recent concerns about climate changes such as the "greenhouse effect" which may be induced by human activities. Such climate changes are global and could significantly affect future conditions at the WIPP site.

CCNS-53 RESPONSE

A study of long-term climate changes at the WIPP was undertaken in 1989, and potential hydrologic changes

due to climate variability have been included in two-dimensional groundwater flow modeling since 1991. Documentation of the study of long-tern climate variability is available in Swift (1992). Implementation of the effects of climate variability in two-dimensional groundwater flow modeling is described in Volume 2 of the 1991 PA report and Volume 4 of the 1992 PA report. The effects of climate change are currently being investigated as part of a regional three-dimensional flow modeling study. The results of the 3-D modeling study will be considered in developing the final PA for the CCA and other relevant compliance submittals.

REFERENCES

Swift, P. N., 1992, *Long-Term Climate Variability at the Waste Isolation Pilot Plant, Southeastern New Mexico, USA*, SAND91-7055, Sandia National Laboratories, Albuquerque, New Mexico.

WIPP Performance Assessment Division, 1991, *Preliminary Comparison with 40 CFR Part 191, Subpart B for the Waste Isolation Pilot Plant, December, 1991—Volume 2: Probability and Consequence Modeling*, SAND91-0983/2, Sandia National Laboratories, Albuquerque, New Mexico.

CCNS-54 COMMENT

CLIMATE/SUBSIDENCE

SUBSIDENCE

The CSR indicates that subsidence is an unresolved issue (8-34 and 10-21). Again this issue seems to be predicated upon questionable climatic predictions (see above). CCNS also believes that the CSR minimizes the impact of current mining as well as future mining practices around the WIPP site (see above, EEG-55). If subsidence monitoring only began in 1990, what is the basis for determining the value of less than .04 inches of regional subsidence at the WIPP site between 1977 and 1981 (9-10)? The CSR should state how DOE intends to use this number in its compliance determination.

CCNS-54 RESPONSE

Natural subsidence from tectonic activity is generally a broad-scale event and is not likely to specifically disrupt the WIPP site. Information about subsidence from potash mining in the district has been assembled and summarized (DOE, 1980) providing some evidence of

"angle of influence" and magnitude of subsidence in the district. The potential for subsidence due to WIPP itself has been addressed by recent modeling studies (see Westinghouse, 1994). While the reasonable expectation is that subsidence will not be a factor affecting the long-term integrity of the WIPP, an appropriate scenario will be considered and will be addressed in scenario screening for the CCA and other relevant compliance submittals.

Natural subsidence due to tectonic activity is broadly monitored by a regional first-order leveling network. The National Geodetic Survey (NGS) completed a first-order, class I leveling survey in the fall of 1977 and again in 1981 for the vicinity of Carlsbad, New Mexico. The survey was requested by Sandia National Laboratories, Albuquerque, New Mexico, to evaluate elevation changes in the area of the WIPP site (Balazs 1978, 1982). This number (0.04 inch) was intended for use in the regional geological information and for use in the long-term monitoring program.

REFERENCES

Balazs, E. I., 1978, *Report on First-Order Leveling Survey for Sandia Laboratories Waste Isolation Pilot Plant (WIPP) Project*, Rockville, Maryland, National Geodetic Survey.

Balazs, E. I., 1982, *Vertical Movement in the Los Medanos and Nash Draw Areas, New Mexico, As Indicated by 1977 and 1981 Leveling Surveys*, NOAAQ Technical Memorandum NOS NGS 37, Rockville, Maryland, National Geodetic Survey.

Westinghouse, August 1994, *Backfill Engineering Analysis Report*, Waste Isolation Pilot Plant

CCN8-55 COMMENT

GAS GENERATION/BRINE/FRACTURES/CLOSURE

The CSR clearly establishes the sensitivity of gas generation and brine flow effects on the potential for release pathways at WIPP: "The gas generation, in conjunction with the creep closure and consolidation of the disposal room contents, is the source of driving pressures that may prevent the complete closure of the disposal room, cause room expansion, cause migration of gases out of the repository, cause crack dilation or fracture initiation or both in the interbeds and marker beds, and drive brine out of the disposal room, thus

limiting radionuclide transport by isolating the waste from the brines" (2-52). Yet this very complex interactive set of issues seems far from resolution. Pore structure of the waste and backfill are uncertain (2-55). Neither gravitational effects from the non-horizontal nature of the repository (2-57) nor a detailed understanding of the stratigraphy (10-5) are available at this time. Current models for release pathways assume porous, not fractured media (10-3 and 10-4). Models do not include the potential for vertical fractures (2-66), radiolysis (10-16), experimentally justifiable figures for actinide solubility (10-17 and 1-18) and other uncertainties. The CSR is clear that salt creep needs to be predictive if gas effects are to be modeled (10-12), yet current PA calculations admit that room closure estimates are uncertain when gas and brine are present (10-14).

CCNS believes that these are extremely important issues. Completing the scientific investigations necessary for their resolution may take longer than the current Disposal Decision Plan allows. However, a compliance application which short circuits science, substituting expert judgment, arbitrary extrapolations, or scenario exclusions would be seriously flawed.

CCNS-55 RESPONSE

Comment noted.

CCNS-56 COMMENT

<u>WASTE RETRIEVABILITY</u>

The CSR fails to anticipate several very important issues when it concludes: "The WIPP facility is a mined repository. No additional actions to meet this assurance requirement are considered necessary, and none are planned" (9-13). Retrieval of waste from WIPP will be extremely difficult, dangerous and expensive. Given DOE's limited ability to test the shaft seals after placement (10-12), some uncertainty will remain about WIPP's ability to isolate waste despite well intentioned modeling and defense in depth precautions. WIPP is no ordinary mined repository. DOE must assure EPA and the public that it has safe, economical plans for retrieval of waste in the event that releases occurs at the WIPP site after closure, a better method of disposal has been found, or for other reasons. Without such reassurances, this assurance requirement cannot be said to be met and the suitability of WIPP a disposal site must remain in question.

CCNS-56 RESPONSE

Retrieval is not required by the applicable regulations. Your comment on the DOE's limited ability to test shaft seals in noted. You are right that the concepts of probabilistic Risk Assessment and "proof of performance" are incompatible.

Only part of the CSR was excerpted in the above comment. The entire section that pertains to this comment is:

> "The EPA has specified that "...[disposal systems shall be selected so that removal of most of the waste is not precluded for a reasonable period of time after disposal" (40 CFR 191.14[f]). The EPA also states in Federal Register 50. p. 38082:
>
> Any current concept for mined geologic repository meets this requirement without any additional procedures or design features. For example, there is no intent to require that a repository shaft be kept open to allow future recovery. To meet this assurance requirement, it only need be technologically feasible (assuming current technology levels) to be able to mine the sealed repository and recover the waste—albeit at substantial cost and occupational risk.
>
> The WIPP facility is a mined repository. No additional actions to meet this assurance requirement are considered necessary, and none are planned."

Because WIPP is a mined facility, it falls within the limits set in the Federal Register 50. p. 38082 which requires that it be "technologically feasible" to remove the waste "albeit it at substantial cost and occupational risk." It is technologically feasible for DOE to mine the waste from WIPP if deemed necessary. This mining process would be at substantial cost and occupational risk, which is specifically allowed in the Federal Register.

CCNS-57 COMMENT

<u>MODELS TO 100,000 YEARS</u>

CCNS believes that DOE would be prudent to model climatic, geologic, and hydrologic effects for 100,000

years. In many cases performance of the repository may not be assured by only looking at data over 10,000 years. Uncertainties may be lessened with longer modeling predictions.

CCNS-57 RESPONSE

The EPA in 40 CFR 191 established 10,000 years as the regulatory time frame. You are proposing the creation of a new regulatory standard for radioactive waste disposal. The DOE does not believe that would be prudent.

CCNS-58 COMMENT

RESOURCE CONSERVATION AND RECOVERY ACT OF 1976 (42 U.S.C 3251 ET SEQ.)

CCNS does not agree that WIPP has interim status nor do we concur with the CSR assumption that the test phase permit application can be modified into a disposal phase permit application (11-9).

CCNS-58 RESPONSE

Your other comment is noted.

ENVIRONMENTAL EVALUATION GROUP
COMMENTS ON THE COMPLIANCE STATUS REPORT FOR THE WIPP
(DOE/WIPP 94-019, Rev.0)

EEG-1 COMMENT

EXECUTIVE SUMMARY

The Purpose of WIPP

The description of the purpose of the WIPP project continues to remain confused in the DOE documents. "Research and development facility to demonstrate the safe disposal of radioactive waste..." has never adequately described the purpose of WIPP, even though it is the language in the 1979 Act authorizing WIPP. The first sentence in the Executive Summary of the CSR, "WIPP...has been sited and constructed to meet the criteria established by the scientific and regulatory community...", is also unnecessarily convoluted. The following straight forward statement is suggested to describe the purpose of the WIPP project for use in all the WIPP project documents: "The Waste Isolation Pilot Plant is planned to be a permanent geologic repository for transuranic waste generated by the defense activities of the United States."

As appropriate, additional statements about the DOE being the manager of the waste and the repository, the EPA being the certifier of compliance with the environmental regulations, etc., can be added.

EEG-1 RESPONSE

Your comment is noted.

EEG-2 COMMENT

CHAPTER 1 - INTRODUCTION

Project Overview

Only through a full description of the checkered history of the WIPP project can the inconsistencies and contradictions in the project be fully explained. For example, the WIPP facility has not been constructed to "determine the efficacy of an underground repository for disposal of TRU waste" (CSR, p. 1-1, second paragraph). Study of the in situ geomechanical and geohydrological behavior of the repository did not require excavation of the full-fledged repository and

waste handling facilities, or the heated room experiments. The WIPP facility was constructed in the 1980s because the DOE had planned to emplace underground all the then existing (200,000 drums) transuranic contact-handled (CH-TRU) waste, and limited quantities of high level waste for experiments, before assessing the WIPP's suitability as a permanent repository. Similarly, for those who may not be familiar with the DOE desire to conduct a "test phase" involving emplacement of waste in the Panel 1 rooms and in the alcoves, the provisions of the Land Withdrawal Act are hard to explain. This section should describe the plans prior to October 1993, the reasons for the DOE decision to abandon the idea of testing with the waste at WIPP, and the effect of that decision on the requirements of the Land Withdrawal Act.

The DOE Energy Systems Acquisition Advisory Board (ESAAB) decision (p. 1-2, last paragraph) was made specifically to start the test phase, so the characterization of this decision to mark "the end of the construction phase" is curious. Since only one-eighth of the planned repository has been excavated, how could the construction phase have ended, anyway? Also, since the CSR and the Experimental Program Plan describe a number of site characterization activities yet to be conducted at WIPP, how could Lappin (1988) have "brought to termination the WIPP site characterization phase" (p. 1-2, third paragraph)? Similarly, it is misleading to state that "The Final Safety Analysis Report (FSAR) was then published." (p. 1-2, last sentence). The 1990 FSAR did not even evaluate the safety of conducting the bin and alcove experiments, that had been planned for WIPP. An Addendum to the FSAR was published in 1991, but it addressed only a small part of the planned tests. A new FSAR is needed to assess the safety of the disposal operations.

Past efforts to represent a very checkered history of the project as a tidy phased development have not succeeded and have only confused successive newcomers on the project. For example, the DOE first announced the end of the Site Characterization phase in 1981, then in 1983, and now it is 1988, but the site characterization is not yet complete because the DOE has not, until now, given a high priority to assessing the facility as a permanent repository. It is not necessary to rewrite history. The project is finally on the right track. Only an awareness of the past mistakes and disassociation with the past short-sighted approaches will keep it there.

The Project Overview should include an assessment of the potential difficulties in carrying out the disposal and decommissioning activities because of the age of the facility. The facility was constructed for a 25 year operation starting in 1988. Since the earliest date to start disposal now is 1998, what is the effect of this 10 year delay on the stability of the excavations and safety of operations?

EEG-2 RESPONSE

This reviewer's perspective on the history of WIPP is appreciated. The comment asks a single question which is answered as follows. The stability of the excavations and safety of operations are continuously monitored by the operations and mine engineering personnel at WIPP. The effects of the duration prior to opening the WIPP site for the disposal phase will be continually updated based on the findings of the operations and mining personnel. Operational safety will not be compromised.

EEG-3 COMMENT

CHAPTER 1 - INTRODUCTION

Site Selection Process

1957 NAS Report: Frequent references to the 1957 National Academy of Sciences (NAS) report (The Disposal of Radioactive Waste on Land, A Report of the Committee on Waste Disposal of the Division of Earth Sciences, NAS-NRC Publication 519, April, 1957) in the WIPP project publications necessitates pointing out some recommendations of that committee which would be useful for the WIPP project to follow:

> The Committee has in no sense done the research so that such expressions of opinion as are contained herein are predicated on the assumption that the research will be done before any final conclusion is reached on any type of waste disposal. (p. 2 of the report).
>
> We stress that the necessary geologic investigation of any proposed site must be completed and the decision as to a safe disposal means established before authorization for construction is given. Unfortunately such an investigation might take several years and cause

embarrassing delays in the issuing of permits for construction. (p. 4 of the report, underlining added).

It should also be pointed out that the report was written for disposal of high level liquid waste in salt cavities and as such has very little relevance to WIPP.

Omissions in the History of WIPP the Site Selection:
Any history of the WIPP site selection process should include the following important milestones.

- The original WIPP site was abandoned after the borehole ERDA-6 was drilled at that location in 1975 and encountered extreme geologic deformation and a pressurized brine reservoir at a depth of 2708 ft. Testing in 1981 indicated that the brine reservoir encountered by ERDA-6 contains 100 million liters of brine.

- The two mile criterion was changed to one mile, since a new suitable site could not be found that would be two miles away from any existing drill holes through salt. The new site was selected so that there were no boreholes through salt within one mile of zone II within the WIPP site. The repository was designed to be in the northern part of zone II (see Fig. 89, p. 8-17, WIPP Final Environmental Impact Statement, Vol. 1).

- Borehole WIPP-12, located in Section 17, T22S, R31E, within the present WIPP site, 1 mile north of the center of the site and just north of the Zone II, was drilled between November 9 and December 7, 1978, to a depth of 2785.8 ft, 48.3 ft in to the Castile Formation. The original purpose was primarily to investigate an anticlinal structure inferred from seismic reflection profiling. Following a suggestion by the EEG, DOE deepened the well in October-November, 1981, to the base of the Castile Formation, to a total depth of 3925 ft, and in the process encountered pressurized brine at a depth of 3016 ft. Brine started flowing out of the well at a rate of 350 gallons per minute and 1.14 million gallons of brine flowed out of the borehole before the well was controlled.

Based on the results of an extensive series of flow tests conducted in 1981-82, the brine reservoir penetrated by WIPP-12 is estimated to contain 17

million barrels (2.7 billion liters) of brine. The different pressure potentials and some differences in geochemistry between ERDA-6 and WIPP-12 encounters were interpreted to suggest a lack of communication between the two. There was no consensus on the origin and age of the reservoirs. Following a suggestion from the EEG, the WIPP repository was relocated in 1982 to be in the southern part of the WIPP site.

- The WIPP site is much richer in natural resources than was assumed at the time of site selection. The site now is surrounded by more than 100 oil and gas wells within 2 miles of the WIPP site boundary (Silva, 1994).

EEG-3 RESPONSE

We respectfully note your comments on the details of the DOE site selection. These and other details, as you note, can be referenced in the WIPP FEIS. The text where you note the omissions was intended to be a summary level discussion of the process used for site selection.

EEG-4 COMMENT

CHAPTER 1 - INTRODUCTION

Regulatory Framework

Section 1.3 should state that the Environmental Protection Agency (EPA) has the authority to approve or disapprove the DOE's determination of compliance with the EPA standards.

Also, add at the top of page 1-9 that the State of New Mexico entered into an agreement with the DOE, soon after the EPA Standards (40 CFR 191) were vacated, to continue the performance assessment work as though the provisions of those Standards remained applicable (C & C Agreement, 2nd Modification, August 4, 1987).

EEG-4 RESPONSE

The text in section 1.3 mirrors the language in the WIPP LWA, as appropriate. The EPA's role with respect to 40 CFR 191 and 40 CFR 194 is clear, as is the DOE's.

EEG-5 COMMENT

CHAPTER 1 - INTRODUCTION

Compliance with RCRA

There may be similarities between the No Migration Variance Petition (NMVP) process for the now-defunct test phase, and the same process for the disposal phase, but there were no procedural precedents set, as the CSR claims (p. 1-8). The NMVP granted by EPA for the test phase incorporated dilution with ventilating air, and that will clearly not happen during the disposal phase. Moreover, the statement about "no migration" on page 1-8 is simplistic. In fact, EPA applies the Draft of Subpart S of 40 CFR 264 (55 FR 30798 et seq, 1990) as "standards" that should not be exceeded. EPA has agreed to apply the soil standards for the relevant chlorinated hydrocarbons to the WIPP.

EEG-5 RESPONSE

The DOE recognizes that a large portion of the information and determinations from the test phase NMD will probably not be appropriate, but it is reasonable to expect that certain aspects will be applicable (e.g., the interpretation of "no migration").

The DOE disagrees with the statement concerning a lack of "procedural precedents." The EPA has a written guidance manual for preparing and processing petitions and has issued a determination (under RCRA) for at least one other comparable facility. There have been numerous petitions reviewed and determinations granted under a similar regulation covering no-migration from underground injection wells.

The statement about "no-migration" is correct and the DOE will comply with the EPA requirements relative to measures for performance.

EEG-6 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Drilling for Oil and Gas Around WIPP

Oil is being produced from the Delaware Mountain Group Sandstones just outside the WIPP site on all sides, and gas is produced from a well drilled directionally beneath the WIPP site. It is misleading to suggest that these sandstones have been "targets for

hydrocarbon exploration elsewhere in the Delaware Basin." (p. 2-9). Furthermore, there is no mention of the deeper stratigraphic units like the Atoka Formation, from which gas is being produced through a directionally drilled gas well located beneath the WIPP site.

EEG-6 RESPONSE

This section, as stated on page 2-1, is part of an overview of site characteristics relevant to waste isolation. It was not intended to provide a detailed description of all stratigraphic features of the Precambrian rock. Rather, this dialogue is presented to give a cursory overview of the stratigraphy that would play any part in waste isolation. In that sense, there is no need to go deeper than the Bell Canyon in describing waste isolation stratigraphy in this portion of the document since hydrocarbon bearing formations are discussed elsewhere, as appropriate. This would serve the intent of the chapter since it is generally accepted that the path of possible waste migration would only be feasible within the mentioned formations and nothing deeper.

The DOE is currently evaluating drilling activities, both past and present, in the Delaware Basin. These activities are being done in light of the more recent evaluation of resources in the WIPP area as reported by NMBMMR. These Delaware Basin drilling studies will be used in compliance evaluations during the development of the CCA. Justifications for the positions taken in the CCA will be provided, in same, as appropriate.

EEG-7 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Breccia Pipes

Any discussion of Breccia Pipes in the Delaware Basin (e.g. Sec. 2.1.2.2) should address Roger Anderson's hypothesis of formation of the Castile in the Delaware Basin and other suspected Breccia Pipes in the Basin cited by Anderson and Kirkland (1980) and Anderson (1980). The WIPP project has also not addressed Davies (1984) criticism of the Snyder and Gard (1982) conceptual model of the formation of breccia pipes. Without addressing these alternate conceptual models, the project should not claim that the breccia pipes are confined to the Capitan Reef.

EEG-7 RESPONSE

Exposures of the McNutt potash zone of the Salado within a mine in Nash Draw have shown a solution pipe containing cemented brecciate fragments of formations higher in the stratigraphic sequence. At the surface, this feature is marked by a dome, and similar domes have been interpreted as dissolution features. The depth of dissolution has not been confirmed, but the collapse structures led Anderson (1978) and Snyder and Gard (1982) to postulate dissolution of the Capitan Limestone at depth, collapse of the Salado, Rustler, and younger formations, and subsequent dissolution and hydration by downward percolating waters. San Simon Sink, some 35 km east-southeast of the WIPP site, has also been interpreted as a solution chimney. Subsidence has occurred here in historical times (Nicholson and Clebsch, 1961), suggesting that dissolution at depth is still taking place. Whether this is the result of downwards-percolating surface water, or of deep groundwater, has not been confirmed. The association of these dissolution features with the inner margin of the Capitan Reef suggest that they owe their origins, if not their continued development, to groundwaters derived from the Capitan Limestone (Anderson and Kirkland, 1980). Dissolution features west of WIPP, in the region where the Salado and Rustler Formations are absent, are inferred to have developed through a similar mechanism. In these instances, however, it is dissolution of the Castile by low salinity water from the Delaware Mountain Group that has caused the breccia pipes (Anderson and Kirkland, 1980).

Davies (1984, PhD Dissertation) proposed that direct, deep dissolution of evaporites below breccia pipes, caused the breccia pipes to form, rather than dissolution and collapse of the underlying limestone of Capitan Reef as suggested by Snyder and Gard (1982) and Anderson (1978). Davies preferred deep dissolution of evaporites rather than limestone because limestone dissolution is normally associated with water-table conditions rather than deep, saturated conditions, and that under deep confined conditions evaporite dissolution is much more likely to occur. The deep dissolution of evaporites is linked to the ability of relatively fresh water to attain these depths, which requires relatively vigorous flow in formations adjacent to or below the deep evaporites; this explains the correlation between some known breccia pipes and the Capitan Reef. As stated in section 6.1, the DOE has closed the issue of Breccia pipes.

EEG-8 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Alternative Conceptual Models for the Culebra

Geological descriptions and interpretations of the observations of the Culebra Member (Sec. 2.1.2.6.2) present only one set of ideas. In many instances, alternative conceptual models exist which should be included. For example, only by ignoring a lot of existing data can it be stated that "density of open fractures in the Culebra decreases to the east". The pattern of fracture distribution and corresponding transmissivity values distribution is too complex to be explained away in a simple statement like that and as expected, has become more complex with additional data acquisition.

Lowenstein (1987) presented an alternative explanation to the Holt and Powers (1988) and Powers and Holt (1990) interpretation of the distribution of halite in the Rustler Formation. Based on a detailed sedimentological study of the Culebra cores from a number of wells at the WIPP site, Lowenstein (1987) interpreted four distinct dissolution zones in the Rustler Formation.

The respective thicknesses of the Rustler and the upper Salado (Chaturvedi and Channell, 1985, Fig. 8, p. 23) call into question the Beauheim and Holt (1990) proposition that dissolution of the upper portion of the Salado Formation may have caused subsidence and fracturing in the Culebra (p. 2-17). The Rustler Formation is 450 ft thick four miles east of the center of the WIPP site and only 300 ft thick from the center of the site westward. The upper Salado (from the top of the Salado to Marker Bed 103), on the other hand, maintains a uniform thickness of about 190 ft over the WIPP site and only decreases in thickness west of the Salado dissolution front that coincides with the western margin of the WIPP site. It would be more logical to postulate the gradational removal of salt from the Rustler Formation itself to have caused fracturing in the Culebra over the WIPP site. West of the Salado dissolution front (west of the WIPP site), both the Salado and the Rustler have been affected grading into total collapse in the Nash Draw.

If the high transmissivity zone in the southeastern part of the WIPP site is related to the dissolution of gypsum fillings in the Culebra fractures, then the high

T zone may extend to the south-central part of the WIPP site (p. 2-21 and Pg. 2-12).

EEG-8 RESPONSE

The inference that the density of open fractures decreases to the east is not based solely on a comparison of fractures in a weathered outcrop of Culebra in Nash Draw with subcrop exposure of the Culebra in the AIS. Rather, as is discussed several paragraphs after the statement in question, enough data have been compiled on open fracture density from core that contour maps of open fractures have been prepared (Figure 2-12 of the CSR). "Open" fractures are those that have not been filled with gypsum crystals.

The CSR, page 2-17, describes several processes which, regionally around the WIPP, may have occurred and caused fracturing in the Culebra. None of the processes are stated to have happened; however, the upper Salado dissolution described likely did happen in Nash Draw. For Performance Assessment, determining the cause of fracturing is important only insofar as it yields insight into the fluid flow properties of the Culebra and other supra-Salado lithologies. As characterizing the fluid flow properties in this region has been and continues to be the subject of direct tests, the cause of fracturing is relatively unimportant.

With respect to the supposition that there is high transmissivity in the Culebra in the south-central portion of the site, *in situ* well tests at WQSP-5 will directly determine this zone's transmissivity. The results of these tests will be considered in development of the CCA and other relevant compliance submittals.

EEG-9 COMMENT

<u>CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION</u>

<u>Retardation Through Clays in the Culebra</u>

This section (page 2-21) asserts:

> "___ clay fracture-linings may play an important role in the chemical retardation of radionuclides transport through the Culebra---."

This conclusion is based on the X-Ray Diffraction and

Analytical Electron Microscopy analysis of samples collected primarily from clay rich layers of the Rustler Formation from cores of wells drilled primarily in the Nash Draw. Four reports are cited to support this conclusion. These reports are based on the work of Terry Sewards and others at the University of New Mexico under contract to the Sandia National Laboratories.

Sewards, et al, 1991 (a) contains mineralogical analysis of core samples from a single well, WIPP-19, and presents no claim for clay filled fracture linings in the Culebra.

Sewards (1991) presents data on the "whole rock" as well as the "fracture surface" compositions of samples of cores collected from 6 wells (WIPP-26, 27, 28, 29, 30, 32) in the Nash Draw, one borehole (WIPP-33) between the Nash Draw and the WIPP site, and three boreholes (WIPP-12, 13, and 34) in the northern part of the WIPP site. Clays are expected to be present in the Nash Draw cores because of extensive dissolution, weathering, and erosion in that area. WIPP-33 is located in a sink hole and processes similar to Nash Draw have operated there as well. Boreholes 12, 13 and 34 are located north of the WIPP repository and upstream from the direction of flow of water in the Culebra Furthermore, the cores from these wells were selected from known clay seams. For example, the only sample from WIPP-12 (CS-1) came from the zone 838.5 to 838.7 ft below the surface. The Basic Data Report for WIPP-12 (Sandia National Laboratories, 1982) identifies mud seams at 837.7 and 840.7 ft depths.

Three Sandia National Laboratory scientists (WIPP Performance Assessment Department, 1992, pp. A-127 to A- 131) correctly evaluated the Sewards (1991) report and stated the following:

> Sewards (1991) measured and reported clay abundance for eighteen Culebra samples; thirteen from locations to the north and/or west of the WIPP site, and five from the north end of the WIPP site. None of these samples was from wells along fast transport paths. Because Sewards (1991) was focusing on clay abundance and compositional analyses, it is likely that samples were selected for analysis based on visual appearance of clays. Thus, these data may not be representative of clay abundance on fracture surfaces in the area of interest for transport modeling. (WIPP Performance Assessment Department, 1992, Memo from

> Craig F. Novak, et al to Martin S. Tierney, p. A-127 to A-131).

Having made this statement, it is surprising that the authors of the memo, Messrs. Craig F. Novak, Fred Gelbard and Hans Papenguth, nevertheless recommended assuming the probability of the existence of relative thickness of clay linings in the Culebra fractures to be as high as 0.5.

Sewards et al., 1991 (b) presents mineralogy of 107 samples collected from the cores of 8 wells, 3 of which are located within the WIPP site. However, clay fraction separates (<2 microns) were obtained for only three samples: "WlPP-12 #3, a clay-poor dolomite; WIPP-12 #16, a clay-rich dolomite; and H6B #3, a shale." X-Ray Diffraction analysis was performed on the clay fractions from these three samples, and one sample (H6B #3) was analyzed under the electron microscope. The electron microscope on this one sample casts doubt on the accuracy of the X-Ray Diffraction technique used:

> There is, however, a discrepancy between the results of the quantitative XRD analysis and the results of the AEM investigation of sample H6B #3. In that sample, the XRD results show that the sample contains approximately 50% corrensite. When imaging was attempted on the AEM, it was extremely difficult to find any corrensite at all; the dominant phases appeared to be serpentine, illite, and chlorite. (Sewards et al 1991 b, p. VII-19).

The conclusion of this report, quoted below, clearly demonstrates how very limited information has been used to make important interpretations:

> The fact that corrensite is the dominant phase in the Culebra samples is important. Corrensite has a high CEC and high surface area, thus it is able to sorb radionuclides very efficiently in the event of a low pressure breach in the WIPP facility. Although the clay minerals of only three samples were investigated, the results of Sewards et al., 1991 show that mixed-layer chlorite/smectite is the dominant clay phase throughout the Rustler Formation, so it is reasonable to suggest that the same is true in the Culebra unit. (Sewards et al, 1991 b, p. VII-19).

Sewards et al., 1991, mentioned in the above quotation, is Sewards et al., 1991 a of this review (Sewards et

al, 1991 b of CSR), i.e., "Mineralogy of the Rustler Formation in the WIPP-19 core". As stated earlier, that report makes no claim for clays lining the Culebra fractures. Corrensite is only interpreted to be present in some of the samples, as one mineral among many, when powdered bulk samples were analyzed through X-Ray Diffraction. How can this observation lead to the statement cited above?

The final report by Sewards (Sewards et al, 1992), cited in the CSR, presents mineralogical analysis from 47 samples. Of these, 17 samples were taken from the Culebra, and of these only 9 are from the WIPP site - 6 from the Air Intake Shaft and 3 from WIPP-12. The report states the following with respect to the existence of clay in the fractures of the Culebra Samples:

> Only small amounts of clay can be sampled from the Culebra fracture coatings; therefore, initial technique and model development for adsorption studies on WIPP clays (Park et al., in review) were carried out with material from a black shale layer in the unnamed member. This material, so-called CorWIPP, is 94% corrensite and is described as Sample AIS-15 in this report. Corrensite has a high cation exchange capacity and affinity for the uranyl ion in dilute solution (Park et al., in review) and could provide significant radionuclide retardation in fractures in the Culebra (SAND90-2569, p. 28).

The above quotation clearly identifies the problem with using Terry Sewards' work to conclude that corrensite clay lined fractures in the Culebra may provide retardation for radionuclide migration through the Culebra. The argument is based on a sample from a "black shale layer" obtained from the lower part of the Rustler Formation, below the Culebra, because not much clay could be sampled from the Culebra fracture coatings! And yet, this information is used to argue that "significant radionuclide retardation in fractures in the Culebra" could be present. It is also the basis for continuing research on the adsorption properties of Corrensite, model development for retardation properties of the Culebra, and the credit for radionuclide retardation taken in the performance assessment work to date.

Any reference to the existence of corrensite or other clay minerals lining the fractures in the Culebra Dolomite member of the Rustler Formation at the WIPP

site should be deleted from the project documents because there is no basis for this assumption.

EEG-9 RESPONSE

Your technical comments on corrensite and other clay distributions in the Culebra are respectfully noted. The PA methodology is designed to characterize and treat for such uncertainty through sampling among a range for imprecisely known variables such as this one. Your comment on the lack of a basis for the upper limit of the sampling range is also noted.

EEG-10 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Supra-Rustler Hydrology

The hydrology of the strata overlying the Rustler Formation is poorly understood and serious effort to understand it has not been made (Sec. 2.1.2.7). Basic hydrological parameters such as the location of the water-table and the recharge and discharge areas must be known as clearly as possible, if only to establish the credibility of site characterization. EEG has made specific suggestions for field work in this area since 1985. As long as the position of the water table is not known, it is not possible to say that "Most of the Dewey Lake Red Beds Formation is unsaturated." (p. 2-26, first sentence).

EEG-10 RESPONSE

The PA methodology is designed and implemented so as to characterize and treat uncertainty such as this. This is accomplished through conservatism in modeling assumptions and sampling among ranges for imprecisely known variables. Your comment regarding the basis for assuming that most of the Dewey Lake Red Beds formation is unsaturated, is noted.

EEG-11 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Conceptual Model of Contaminant Transport in the Culebra

The discussion of this topic on page 2-30 is incomplete and presents a single conceptual model while the DOE has decided to perform an important series of field

tests to resolve the issue. At this stage, a full discussion of the status of understanding of the mechanism of contaminant transport would include single versus double porosity flow, the role of matrix diffusion and the channeling model.

The estimated flow velocities in the Culebra, when integrated over the general flow path from the storage panel area to the compliance boundary, range from 100 to 1000 years. The performance assessment has assumed matrix diffusion to retard the radionuclide transport, but the degree of matrix diffusion affecting the transport is not clear. The INTRAVAL participants have pointed out that a conceptual flow-model based entirely on channeling also fits the current hydrological field data, but the current modeling utilizes a dual porosity concept instead. With the channeling model, there would be no matrix diffusion. Sandia National Laboratory plans to start a 7-well tracer test to address these questions. Unless and until these issues are resolved, there is no basis to favor a particular conceptual model.

EEG-11 RESPONSE

Conservative assumptions regarding Culebra flow and transport have been made for PA. Pending results of the tracer tests you mention, different numerical models may be substituted for the current assumption, if appropriate. Your comment on the absence of a basis for the conservative assumption is noted.

EEG-12 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Culebra Hydrochemical Facies

Section 2.2.2.1 should be revised to assign proper credit for the issues discussed in this section. The EEG has raised the issue of the inconsistency between the inferred direction of flow in the Culebra aquifer and the chemistry of water since the early 1980s and has published three reports on the subject. The issue was first raised by the EEG in 1983 as follows:

> The unexplained decrease in TDS and a change in the general chemical nature of the Culebra water from sodium and chloride at the site to magnesium, calcium, and sulfate south of the site indicates that insufficient data are presently available to adequately characterize the flow system south of

the site. (Neill, et al, 1983, p. 79).

Ramey (1985, Fig.7) elaborated on this issue and presented the concept of geochemical zonation of the Culebra water. Chapman (1988) further explored the problem and provided a hypothesis to account for the decreasing total dissolved solids in the direction of flow, as follows:

> As groundwater moves from north to south across the area, the Total Dissolved Solids (TDS) decrease by an order of magnitude and the major hydrochemical facies change from Na-Cl to Ca-SO4. The only plausible mechanism to effect this change is the influx of a large quantity of low TDS water. The possibility of recharge in the southern area is enhanced by the presence of solution and fill features such as the gypsum caves in the Forty-Niner Member of the Rustler near the Gnome site. These features could behave as conduits supplying fresher water to deeper Rustler units. (Chapman, 1988, p. iv).

The Siegal et al. (1991) report was prepared following a suggestion by the EEG which was incorporated as a requirement of the DOE/State of New Mexico Agreement for Consultation and Cooperation. The EEG considers this issue to remain unresolved, and unless it is resolved, an adequate understanding of the hydrology of the Rustler Formation cannot be claimed.

EEG-12 RESPONSE

The major solute composition of groundwater in the Culebra Dolomite Member varies spatially in the vicinity of the WIPP site and can be described in terms of hydrochemical facies. Siegel et al. (1991a) present the most recent delineation of these facies. Potentiometric data indicate that current-day flow lines cross facies boundaries and that, in places, flow occurs from saline (about 3 molal) NaCl waters to more dilute (less than 0.1 molal) $CaSO_4$ type waters. The EEG pointed out that a satisfactory explanation for this change in water chemistry along proposed flow lines had not been presented as of 1985 (Neill et al., 1983; Ramey, 1985). In response to this observation, several studies have been performed to address this issue. A detailed review of that work would not add to existing published reviews (refer to Lappin, 1988; Lappin et al., 1989, sections 3.3.2 and 3.3.3; WIPP Performance Assessment Division, 1992, volume 2, section 2.2.3.6; U.S. Department of Energy, 1994,

section 2.2.2). The most recently completed and published body of work on this topic used results from interpretations based on an extensive compilation of lateral changes in isotopic (stable and radiogenic) ratios of Culebra rock, mineral, and groundwater; solute (major and minor ions) concentrations in Culebra groundwater; and the mineralogy of the Culebra (Lambert, 1987; Lambert and Carter, 1987; Lambert and Harvey, 1987; Bodine et al., 1991; Siegel and Lambert, 1991; Siegel et al., 1991b; Lambert, 1991, 1992; Siegel and Anderholm, 1994). A concise summary of that work can be found in Siegel et al. (1991a, pages ES-1 to ES-5). The objective of the following discussion is only to provide a brief review of the results of some of the more extensive regional geochemistry investigations, and the interpretations that those authors made.

One conceptual model for the relationship between the facies distribution and the flow paths has been proposed by Chapman (1986, 1988). She coupled an extensive compilation of stable and radiogenic isotope ratios of Rustler Formation groundwaters with isotopic data from regional groundwaters and surficial waters. Chapman cited evidence for short residence times of Culebra groundwaters and postulated that recharge from the surface could account for the less concentrated groundwaters south of the WIPP Site. That explanation, however, is not supported by interpretations of isotopic and solute data presented by Lambert, Siegel, and others. Specifically, radiogenic isotopic signatures suggest that the age of the groundwater in the Culebra is on the order of tens of thousands of years (Lambert, 1987; Lambert and Carter, 1987; Lambert and Harvey, 1987). An alternative conceptual model was put forth by Siegel et al. (1991a, and references therein). Those authors contend that there has been a change in the location and amount of recharge since the last glacial maximum and that the present distribution of solutes and isotopes in the Culebra is a relict of a flow regime of a wetter climate, in which the recharge area was in the vicinity of Nash Draw resulting in an eastward paleo-flow direction. The current distribution of hydrogeochemical facies according to this interpretation, therefore, represents a rock-water system that is still slowly reaching a new chemical and physical equilibrium.

Currently, the issue of the relationship between water chemistry and groundwater flow in the Culebra remains unresolved. It is possible that the lack of resolution reflects the way the problem has been posed. Previous discussions, for example, have focused on flow

directions but not flow rates. Computer models of flow in the Culebra suggest that flow rates are orders of magnitude slower in the region of the NaCl facies than in the region of the $CaSO_4$ facies (see for example, Lavenue et al., 1990). It is possible that the geochemical signature of flow from the NaCl facies to the CaSO4 facies is not observed because only minute amounts of water flow along this path. In addition, some of the previous studies have not considered, or have ruled out, transport of solutes from units above and below the Culebra. For example, the region of the NaCl facies correlates well with the extent of halite in strata above and below the Culebra. The possibility that the NaCl facies results from vertical advective or diffusive transport into a region of extremely slow flow in the Culebra has not been investigated in depth. Preliminary results of three-dimensional calculations using the groundwater basin approach suggest that it will be helpful in addressing these issues to treat the hydrology as three-dimensional, transient system. The DOE will address this issue, as appropriate, in the process of developing final PA for the CCA. An adequate understanding of the Rustler, for the purpose of demonstrating adequate repository performance, will be described and justified in the CCA and other compliance submittals, as appropriate.

EEG-13 **COMMENT**

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Hydrogen and Oxygen Isotopes in Groundwater

The EEG (Chapman, 1986) compiled stable isotope data from throughout southeastern New Mexico and compared them to data from the WIPP area. The stable isotopic compositions of most samples of groundwater from the Rustler Formation were found to be similar to the composition of other, verifiably young, groundwater in the area. Though the stable isotope data cannot indicate ages for water in the various aquifers, neither did the data show any distinction between most Rustler groundwater and verifiably young groundwater. A small number of samples, primarily from the Rustler/Salado contact east of Nash Draw, had isotopic compositions that are not characteristic of recently recharged meteoric water. These waters' enrichment in heavy isotopes may be due to mixing with deeper groundwater (supported by the stable isotopic composition of Salado fluid inclusions and Castile brine) or to exchange between the groundwater and hydrous minerals.

A comparison of the heavy isotope enrichment observed in evaporating waters and the composition of the water at WIPP-29 and Surprise Spring showed that the isotopic composition of these Nash Draw waters could be derived by evaporating Rustler groundwater. Based on stable isotopes, both WIPP-29 and Surprise Spring could be discharge areas for Rustler groundwater moving from elsewhere in Nash Draw and the east.

The enrichment in heavy isotopes found in the water from pools in the Carlsbad Caverns was used by Lambert (1986) as evidence that the relatively depleted Rustler water was recharged during a past, more pluvial, time. However, the uniqueness of the isotopic composition of water in the Caverns' pools suggests that rather than representing the composition of recent recharge, the heavy isotopes are enriched by evaporation and equilibrium isotope exchange in the humid cave environment. Recharge in the extreme karst environment near the cavern may also favor isotopically heavy precipitation.

EEG-13 RESPONSE

Similarity or dissimilarity of the isotopic composition of waters from different hydrogeological systems can be ambiguous, if used to draw conclusions regarding the similarity or dissimilarity of residence time. This is so because different groundwater systems contain not only different initial isotopic composition of incident rainfall, but also because of differences in the mineralogies with which the groundwaters react. For isotopic composition to be the basis for such a conclusion as to the relative ages, the similarity of the complete groundwater system needs to be established, which would include a description of constituent mineralogies.

Nash Draw waters sampled at Surprise Spring and WIPP-29 certainly could have a component of Rustler water from easterly areas in them, in addition to waters imported for potash mining activities and dumped into Nash Draw (Hunter, 1985), and recent recharge, as hypothesized by Lambert (summarized in Siegel et al., 1991, SAND88-0196).

The isotopic composition of Carlsbad Cavern water likely has been affected by interactions occurring in the humid cavern environment; these isotopic compositions may not unequivocally support Lambert's (1986) contention that the Rustler in this region was

recharged in a past, more pluvial time.

EEG-14 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Radiocarbon Ages of Groundwater

The discussion in section 2.2.2.3 is based on Lambert (1986), although the report is not identified. This report was reviewed for EEG by Dr. Fred Phillips of the New Mexico Institute of Mining and Technology in 1987 who found the conclusions of the report, now presented in the CSR, to be unacceptable. Reasons for our position, based on the review by Dr. Phillips, are discussed below.

While it is true that all of the samples (excluding H-5C, which may possibly be contaminated) are probably in the age range 10,000 to 16,500 years B.P., the ages of the water samples vary in a systematic fashion from youngest (10,000 years) in the north to oldest (16,500 years) in the south (with the exception of H-5, which is clearly on a different flow path than the other ^{14}C sampling wells). This corresponds to the pattern expected from the north-to-south flow direction inferred from the physical hydrology. Thus a more reasonable interpretation of the ^{14}C age distribution is that only a segment has been sampled in the middle of a large-scale flow system. Additional ^{14}C samples to the north and/or east might well yield Holocene ^{14}C ages. Also, well H-5, although it may be contaminated, may also indicate active recharge.

The major conclusion of the report (Lambert, 1986, p. 5-10 and 81) was, "Because of the questionable validity of the assumptions necessary in applying radiocarbon and radiochlorine dating method is in the evaporite environment of southeastern New Mexico, and because of the previously demonstrated susceptibility of these components to contamination in this groundwater system, these methods will not be pursued beyond this feasibility study." The EEG finds this conclusion to be unnecessary because good results have been obtained from uncontaminated wells. Ground-water systems are fundamentally not amenable to intensive sampling and thus in all ground-water investigations (whether physical or geochemical) assumptions regarding the system are necessary. Useful results can be obtained, even given a wide range in parameters assumed for the ^{14}C dating model. With a properly conducted field study of the system, the parameters could undoubtedly

be constrained much more closely and much better refined dates obtained. Because interpreting WIPP site flow patterns by physical hydrology alone is very difficult and uncertain, and because ^{14}C tracing may hold the best hope of elucidating the flow system, the very negative viewpoint expressed by Lambert (1986) is considered by the EEG to be totally unwarranted.

The contamination issue is even more clear-cut. Certainly, it is true that a majority of the wells sampled during this study did not yield useful results due to contamination. One does not need to be an expert in ^{14}C to predict that wells crammed with "shredded paper, cottonseed hulls, peanut shells, and various proprietary organic additives" (Lambert, 1986, Section 4.2.6) will not yield meaningful ^{14}C dates! There is very little logic in arguing that because wells deliberately injected with organic material were contaminated, all other wells must also be. Contrary to the statement by Lambert (1986, p.23), contamination during drilling is not "inescapable". The best evidence of this is that four of the wells drilled without organic circulation-loss additives did not show any sign of contamination. There is no evidence that this groundwater system is unusually "susceptible" to contamination. Any system is susceptible to inappropriate drilling practices, and appropriate practices should yield acceptable results at the WIPP site.

Based on the data contained in the report, the EEG came to a different conclusion. In all cases, where ^{14}C could reasonably be expected to give useful results, it did so. Although there were only a limited number of uncontaminated samples, the geographic distribution of the resultant ages is hydrogeologically reasonable. A carefully designed program should be undertaken to expand the number of useful ^{14}C samples and to constrain their interpretation. The EEG advised the DOE not to abandon this potentially very informative avenue of investigation in 1987 and the EEG recommendation was incorporated in the 1988 modification to the DOE/State of New Mexico Consultation and Cooperation Agreement, as follows:

> Conduct additional radiocarbon studies on Rustler groundwater. The study will consist of two parts. At least 6 wells will be samples to investigate further questions of contamination and system stability raised in SAND86-1054; completion of this study may require resampling of one or two wells known to be contaminated at the time of

earlier sampling. In addition, several (approximately 10) new radiocarbon samples will be collected during sampling as part of the Water-Quality Sampling Program (WQSP), in the hope of obtaining direct evidence of groundwater residence times. Samples from the WQSP will be restricted to the near-WIPP environment (not including Nash Draw), and will include reasonable numbers of samples from both high- and low-transmissivity holes. Serious consideration will be given to conducting limited investigations of the metabolic pathways of modern vegetation at the WIPP, and to carbon analysis of both soil gas and soil carbonate, if evaluation indicates these studies would improve the confidence in modeling of WlPP release scenarios.

The target date for completion of this study was September, 1989.

The EEG recommends initiating this study without further delay using the following guidelines:

(1) avoid sampling all wells known to have organic circulation-loss prevention agents added; (2) sample existing wells at larger distances from the WIPP site that may yield information on recharge areas, in addition to unsampled wells near the site; (3) collect data on the metabolic pathway characteristics (and thus $\delta^{13}C$) of present vegetation and the $\delta^{13}C$ of modern soil gas and soil carbonates, and (4) use quantitative geochemical modeling to investigate the chemical and isotopic evolution of carbonate species in Rustler groundwater.

Given this approach to a ^{14}C groundwater investigation, there is a high probability of greatly enhancing our understanding of the groundwater flow system at the WIPP site.

EEG-14 RESPONSE

The reinterpretation and reevaluation of Lambert and others' conclusions regarding three radiocarbon ages in the Rustler and one in the Dewey Lake is welcomed, as an interpretation of such a limited data set is not likely to be unique; there undoubtedly would be knowledge gained in pursuing study of radiocarbon ages in the Rustler such as suggested in the comment. The value of completing such a study, however, must be

evaluated with respect to its impact on Performance Assessment and demonstrating repository safety, and in comparison to studies which will better characterize other aspects of system performance. The result of such DOE decision making, relative to the experimental program likely to be most valuable to the DOE in evaluating and demonstrating compliance, has been provided and the course for the experimental program has been set. Unfortunately, such a study did not make the list of DOE priorities.

EEG-15 **COMMENT**

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Uranium-isotope Disequilibrium Data

The Lambert and Carter (1987) report was reviewed for the EEG by Dr. John Osmond in 1987. Dr. Osmond is the co-inventor of the Uranium-isotope Disequilibrium technique applied to the study of groundwater flow, as acknowledged in the first sentence of Section 2.2.2.6 of CSR. Based on Dr. Osmond's review, the EEG provided comments on the Lambert and Carter (1987) report to the DOE through a letter dated 12/2/1987. The following is a summary of those comments.

The limitations of the application of uranium systematics to groundwater interpretations should be kept in mind:

1. One usually cannot deduce from the uranium data alone the direction of groundwater flow,

2. One usually cannot determine the flow rate of groundwater itself by the use of U-234 decay rates.

The same isotopic data can be used to model water flow in more than one direction. This is because changes in isotopic ratio can be caused either by true ageing (decay or growth of U234) or by water-rock or water-water interactions. Researchers in this field usually have independently derived information as to flow directions, which they can use to deduce the possibility of uranium leaching or the mixing of two or more groundwater sources.

Investigators can sometimes determine, in deep confined aquifers, the rate of movement of uranium in the

system. The rate of flow of the water itself, however, must be inferred from one's estimate of the retardation factor for uranium in that particular aquifer.

That an aquifer is "confined" is usually an assumption of the modeling of slow-moving systems. Mixing with undefined waters, whether from recharge or other aquifers, negates any evolutionary conclusions. The authors of this report recognize the potential problem, but argue against leakage, perhaps too readily.

Finally, when uranium leaching or adsorption is inferred, it should be remembered that only the grain or fracture surfaces of the host rock are involved. The concentration of uranium on these surfaces can be much different than the concentration values of the whole rock.

Therefore, the principal conclusions of the report must be regarded as possibly overstated: 1) it is possible, but not proven, that the Rustler system can be modelled as a confined aquifer, 2) it is plausible that the flow regime has changed direction, but alternative interpretations based on a more steady-state model are readily visualized, and 3) although the inferred rate of movement of uranium through the aquifer near the site is probably about right, the flow rate of the water itself could be appreciably faster.

The basic pattern of occurrence of uranium isotopes in the Rustler ground water in the western half of the study area, as pointed out by the authors, is consistent with a two-source mixing model. These two end members could be water masses represented by H4 and W29 (Fig. 10), or by a water with very little U-238, but considerable excess U-234, that has leached to varying degrees uranium from the aquifer rock. The regression line on Fig. 15 implies that these two end members are leached uranium (infinite concentration) with an atomic ratio (A.R.) of 1.55 and water of zero concentration of U-238 but carrying 13.4 ppb (U-238 equivalent) of U-234.

The authors make use of this pattern to make three different interpretations. Each interpretation is plausible to some degree, but taken together they are somewhat inconsistent.

The most logical has to do with a possible westward flow direction of water from the site toward Nash Draw. Low concentration water (with respect to U) gradually dissolves uranium with lower A.R. values. No

information regarding flow rate derives from this model.

The least plausible interpretation assumes that the decrease in A.R. westward is the result of U-234 decay, which leads to deductions regarding low U movement rates (not necessarily low water flow rates). It is recognized by the investigators that such a model is suspect where uranium concentration values are increasing; leaching, if ignored, produces inferred flow rates which are too low.

The third interpretation is inconsistent with the first, so the authors postulate an earlier flow regime and ask as to why the A.R.'s are so high to the East. Such values depend on fractionation processes that often require time periods commensurate with the half-life of U234, and therefore are nearly always down-flow. In this case, argue the investigators, the estimates of time are apt to be conservative because leaching would hold the A.R values down.

In all of their modeling, the authors of this report display considerable knowledge and insight; they do not flagrantly misinterpret the data. Their assumptions are made clear. Nevertheless, one aspect of uranium isotope systematic in groundwater is neglected, and could affect their models. In any ancient system, uranium has been moving for much longer than the period of time being modeled. The distribution factor between dissolved and adsorbed uranium (related to retardation) means that any interactions between water and rock are probably independent of whole-rock uranium concentration values. It is the concentration of uranium on adsorption surfaces, rather than that inside the rock particles, which determines how much fractionation occurs, and how fast relative to water movement. The concept of "reducing barrier" is often cited to explain concomitant decreases in U concentration and increases in A.R. over short distances.

The potentiometric contours of the Culebra suggest two flow lines in the study area: to the west, flow is more or less directly south; in the general area of the site, however, there appears to be an easterly flow in the north, a southeasterly flow at the site, and a southerly and westerly flow to the South.

If we postulate a general source area anywhere to the North, with the usual reducing barrier not far from the point of recharge, then all of the water would enter

the area with a high A.R and a low concentration. Water flowing southward in the west would dissolve uranium and take on the higher U and lower A.R. fingerprint. Water flowing in the east would move slower, dissolve less uranium, and have its A.R. altered only gradually with time. When the flow looped west, dissolving and "mixing" with rock-derived uranium would occur.

This scenario combines the three models proposed by Lambert and Carter: mixing in the west and southwest, increasing A.R. due to recoil-type fractionation in the north, and decay of excess U-234 in the general area of the site. If this model has merit, we can deduce uranium movement rates in the aquifer near the site which are consistent with those values proposed by the investigators. Because of the retardation factor, the water flow rate could be higher.

All of these remarks concern the Culebra unit of the Rustler. There are not enough data from the other units to do any regional modelling. However, the fact that none of the A.R. values from above and below are as high as some from the Culebra suggests that the latter is the "tightest" with respect to uranium mobility.

Apparently the data regarding oxidation potential of the Culebra waters is inconclusive; and the same might be said about the other hydrologic and geochemical information that might be used to demonstrate that the Culebra is truly confined. Uranium isotopic data has often been used as evidence in such interpretations. Most deep confined aquifer waters carry uranium at very low concentration levels, on the order of .1 to .001 ppb., and with quite high A.R values, anywhere from 2 to 20 or more. The Culebra waters have higher uranium concentration than do truly reducing aquifers suggesting the possibility of leakage from shallower horizons. However, the fact that the isotopic data can be used to model flow in systematic ways suggests that such invasions are not the predominant process. Any such oxidative tendencies would favor interactive models (uranium leaching) over the fractionation and time-related models emphasized by Lambert and Carter (1987).

Regarding flow rates and groundwater residence time, Lambert and Carter (1987) consistently confuse <u>uranium</u> residence time with <u>groundwater</u> residence time. The data presented in the report do not allow for the calculation of groundwater ages. Even when the appropriate retardation factors and grain and fracture

surface characteristics are known, there are still serious questions about applying uranium isotopic data to determine basic groundwater flow characteristics. Davis and Murphy (1987), Simpson et al (1985), and Hussain and Krishnaswami (1980) all express serious reservations about the reliability of uranium - disequilibrium dating because of the many difficult-to-substantiate assumptions involved.

The amount and reliability of the data are also questionable. Outside of Nash Draw, the authors have only four wells on which to base conclusions of changes in flow direction. It is important to consider the dual-porosity nature of the Culebra, indicated by the recent hydrologic testing. The very high activity ratios at H-4 and H-5 may be related to the low - transmissivity, matrix flow found at those wells. Conversely, the lower activity ratios at H-6 may be the result of rapid groundwater flow through fractures. More data east of Livingston Ridge, and from fracture-flow areas such as near H-11 and DOE-1 must be collected before any confidence can be placed in conclusions about flow paths.

Considering the serious questions of groundwater contamination in Nash Draw raised by Lambert (1987), there should be an in-depth discussion of the reliability of the presented analyses of a trace constituent like uranium. If contamination with organics is as pervasive in the Nash Draw wells as reported in SAND86-1054, this would very likely alter redox conditions near the wells. Oxidation-reduction potential is an important control on uranium content. Though the authors state on page 6 that the uranium values and isotope ratios have been perturbed at W-29 by wastewater dumping, they then proceed to use this value throughout the report, for instance as an important part of their argument for recharge in southwest Nash Draw.

As previously mentioned, redox conditions are an important factor in modeling uranium behavior. Field evidence (Eh values as reported in Uhland and Randall, 1986 and Uhland et al, 1987) and the relatively high uranium values both argue against reducing conditions in the Culebra. There is no evidence for the "reducing barrier" required by Lambert and Carter's model. The authors should provide some discussion of the physical requirements of the model relative to known aquifer characteristics.

The section on "Implications" for recharge, karst flow, and climate change presents insufficient discussion for reaching the presented conclusions on this broad topic. For instance, if no recharge is supposed to be occurring, there should be some discussion of what happens to rainfall. There is no integrated surface drainage, there are numerous gaps in the Mescalero caliche, and 20 inches of annual rainfall has been common the last few years. The role of southwestern Nash Draw (SWND) is another point requiring additional discussion.

The authors present contradictory hypotheses in this section. Lambert and Carter's item number 2 on page 45 says SWND is a recharge area, while item number 4 on page 46 calls for discharge in that area.

Contradictory statements are also made regarding the degree of vertical interconnection in Nash Draw. Item 5 on pages 46 and 47 (Lambert and Carter, 1987) argues that the Magenta and Culebra are freely connected at W-25 and W-27 (as previously discussed in Chaturvedi and Channell, 1985, though overlooked in Lambert and Carter's references). However, item 4 on page 46 argues that recharge to sinkholes in the Tamarisk member cannot be interpreted as providing recharge to the Magenta or Culebra. Are the authors proposing that the Magenta and Culebra are well-interconnected, but not the intervening Tamarisk? Some discussion of this extraordinary hypothesis is warranted. Likewise, more discussion must also be provided of the author's assertion that the dominant process at W-33 is alluvial infilling. The continued presence of this large depression, even after the springs have ceased to flow, argues against infilling at the surface. We are not aware of any evidence or studies that support the author's statement.

In light of the above comments on the Lambert and Carter (1987) report, all the assumptions arising from the conclusions of that report should be reexamined.

EEG-15 RESPONSE

The DOE agrees that conclusions of Lambert and Carter, in and of themselves, do not provide a sufficient basis for development of a conceptual model for groundwater flow in the WIPP region. Uncertainties such as those you mention will be accounted for in PA system modeling through conservative modeling assumptions and/or through sampling within ranges for parametric input where variables are imprecisely known. Detailed

discussions relative to these topics will be included in the CCA and other relevant compliance submittals, as appropriate.

EEG-16 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Physical Hydrogeology of the Bell Canyon/Capitan Flow Regime

This section (2.2.5) presents contradictory interpretations of the postulated flow between the Culebra and the Bell Canyon aquifers if a connection was made between the two. Mercer (1983) concluded that the flow would be downward, and Beauheim (1986) concluded it would be upward. What is the project's latest position on this issue?

EEG-16 RESPONSE

The Mercer conclusion regarding flow was based on AEC-7, AEC-8, and ERDA-10 borehole data; the Beauheim conclusion was based on Cabin Baby and DOE-2 data. The data for all five wells was reevaluated in response to the comment, with the finding that only in AEC-7, northeast of the site, is the hydrostatic head in the Bell Canyon lower than in the Culebra; which in a cased borehole open only to the Bell Canyon and Culebra would result in downward flow. The other four boreholes, which are on or close to the site, have hydrostatic heads higher in the Bell Canyon than the Culebra, which would result in upward flow in a cased borehole open only to the Bell Canyon and Culebra. If the density effects of dissolution of evaporites between the Bell Canyon and Culebra are incorporated, as would occur in an uncased borehole or a borehole with damaged or deteriorated casing, flow in all five boreholes would be downward. There is therefore no discrepancy indicated by these data, when all the data are considered.

EEG-17 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Resources

The estimates of resources reported in the 1980 Final Environmental Impact Statement (FEIS) and all other DOE reports have been shown to be wrong by current exploitation in the field (Silva, 1994). We understand

that the DOE has recently contracted with the New Mexico Bureau of Mines and Mineral Resources to prepare new estimates based on current data and look forward to the results of that study.

EEG-17 RESPONSE

The estimates in the FEIS were based upon the best petroleum information and reservoir technology information available at the time. The New Mexico Bureau of Mines and Mineral Resources (NMBMMR) has conducted an evaluation of current mineral resources in the WIPP area. The NMBMMR will issue this report in the near term. The revised resource estimates will be used in future compliance evaluations as appropriate.

Since the FEIS information indicated no recovery from the Delaware Mountain Group formations was expected due to the high water volumes (the formations were considered "wet"), this potential hydrocarbon source was not a viable economic consideration in 1980. The value of the leases at that point in time clearly demonstrates that no knowledge of such potential existed until much later. It was only recently (about 1989) that improved interpretation techniques motivated companies to test these formations. Standard treatments such as acidizing and massive hydraulic fracturing inevitably caused irreparable formation damage. Only through careful treatment were these formations coaxed to profitably produce hydrocarbons. Presently, the Delaware Mountain Group's Cherry Canyon and Brushy Canyon formations are being explored and exploited in the areas adjacent to the WIPP site as well as elsewhere in the Delaware Basin.

EEG-18 COMMENT

<u>CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION</u>

<u>Background Environmental Conditions</u>

The statement (Section 2.4, p. 2-44), "The effort to establish environmental baseline conditions at the WIPP facility was initiated in 1975.", is wrong.

The earliest environmental data reported by WIPP was collected in 1985. The first report which contained the 1985 data was the <u>Annual Site Environmental Monitoring Report for the Waste Isolation Pilot Plant CY 1985.</u> (DOE-WIPP 86-002).

The WIPP facility is designed to handle and dispose of several million curries of transuranic elements. The environmental baseline has not established a range of specific transuranic elements. The Compliance Status Report only reports gross alpha and gross beta ranges which are several orders of magnitude greater than the fall-out levels of transuranic elements reported for New Mexico by EPA and LANL. This very important portion of the baseline has not been adequately determined by WIPP's Environmental Radiological Surveillance Program.

EEG-18 RESPONSE

The 1975 date was a typographical error, the actual date is 1985. This will be reflected in future DOE compliance submittals, as appropriate. Your comment on the relative adequacy of the WIPP RES program is respectfully noted.

EEG-19 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Climatology and Meteorology

Geological effects of climate change, i.e., dissolution, subsidence, change in hydrological properties of the subsurface strata, etc., should also be considered in scenario screening, in addition to varying the hydraulic head.

EEG-19 RESPONSE

Climatic change has been retained in PA for future scenario development work. The specific effects that could result from such climate change will be evaluated and managed per the same PA and scenario development methodology. The results of these evaluations will be described in the CCA and other relevant compliance submittals.

EEG-20 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Gas Generation

There is considerable discussion (Sec. 2.7;1) of the gas generation model and its development. However, here is a system that can be validated in the laboratory to some extent. What is needed now is not

refinement or simplification of the gas generation model, but some laboratory experimentation to see if the right chemical reactions are being modeled. If the model persists in including hydrogen as a product, while actually methane is produced (as is commonly produced in the anaerobic parts of landfills), the model will lead to erroneous conclusions. Testing the gas generation model assumptions in the laboratory is most important.

EEG-20 RESPONSE

Methane production was not included in the 92 PA calculations. However, microbial methane production (methanogenesis) is included in the reaction-path gas generation model currently being developed. It should be noted that current experimental information has not resolved whether methanogenesis will occur, and, if so, whether it will result in a net increase or decrease in the total amount of gas in the repository. Current and planned experiments investigate microbial gas production under a range of conditions. The effect of the availability of microbes is being investigated (implicitly) by varying parameters such as the amount of nutrients in the various experiments, inoculation, humid vs. inundated conditions, etc. The possible long-term existence of microbes is simulated by non-inoculated experiments. The gas generation rates were based on experimental data and expert estimates. Additional relevant experimental data continue to be collected. The results of these evaluations will be described in the CCA and other relevant compliance submittals.

EEG-21 COMMENT

CHAPTER 2 - SITE DESCRIPTION/SITE CHARACTERIZATION

Salado Formation

The project position on the preferred conceptual model for brine flow from the Salado Formation into the repository should be developed and justified. If it cannot be done without additional analytical or experimental work, then that work should be identified. The EEG does not agree with the strategy of treating various conceptual models to be of equal importance when overwhelming evidence exists that a particular model is far superior than others in explaining the observed phenomena. The EEG recommends that the brine inflow into the repository from the Salado Formation be modeled by assuming Darcy flow in salt, impure salt and

fractured anhydrite of the marker beds, and using the in situ measured permeability values for these layers.

EEG-21 RESPONSE

BRAGFLO doesn't assume a rigid rock body in the sense that rock compressibility effects are rigorously modeled in all materials. The effect of creep consolidation on repository porosity is accounted for in the model. BRAGFLO does assume isothermal Darcy-flow. Data collected at WIPP are analyzed and have been found to fit Darcy-flow models.

The redistribution model and clay consolidation model are also supported by data collected at WIPP. The DOE currently intends to pursue compliance evaluations for the CCA and other relevant compliance submittals with the redistribution and clay consolidation models. The requisite level of justification will be included, as well

EEG-22 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

EEG has commented on inadequacies in the following areas:

* Confinement in the event of a radioactive materials spill

* Probabilistic risk assessment (PRAs) in the Final Safety Analysis Report (FSAR)

* Modeling of onsite air dispersion of releases

Comments on these inadequacies, or at least a recognition that they exist, should be included in the CSR.

EEG-22 RESPONSE

Comment acknowledged.

EEG-23 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

The DOE Facility Acquisition Process (Section 3.1.1, Page 3-2) contains the following sentence: "WIPP structures were designed to meet DOE design and quality (QA) requirements specified in DOE Order 6430.1,

General Design Criteria for Department of Energy Facilities.' The EEG believes that the facility should conform to the up-to-date design criteria (DOE Order 6430. 1A) or that there should be an explanation as to why the facility fails to meet the current design criteria (DOE Order 5481.1B, Ch 1, May 19, 1987). The use of 6430.1 is not consistent with previous DOE positions (W. John Arthur, III, WPIO Project Manager to R.H. Neill, EEG director, dated August 12, 1993) claiming " ...the draft DOE 6430 as the appropriate design criteria for WIPP." We do not agree with either of the DOE positions.

EEG-23 RESPONSE

The WIPP facility was completed prior to the release of 6430.1A in 1989. All new facility and system designs completed since 1989 are to 6430.1A criteria. The current design description, SDD WH00 rev 2, states that 6430.1A is applied to the system design, construction and operation of the waste handling system. All waste handling systems meet 6430.1A requirements.

EEG-24 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

This chapter is intended to present a description of the wastes to be disposed of in the WIPP, but it does not refer to the WIPP Baseline Inventory Report (U.S. DOE/CAO, 1994). Instead, the information was derived from two documents intended to support the now abandoned underground tests with TRU waste (the Waste Characterization Program Plan and the WIPP No-Migration Variance Petition) and the 1992 Performance Assessment reports which cite other DOE documents for waste characterization estimates. As has been pointed out earlier in this review, the 6.2 million cubic feet of TRU (or 175,600 m3) accurately cited here is not consistent, with the citation of 53,000 m3 on page 1-1. The latter number is wrong. Moreover, the 1993 Integrated Data Base (IDB) (U.S. DOE, 1994, pp. 89 and 98) cites the following volumes:

Retrievably stored CH-TRU (1992): 103,942 m3
Retrievably stored CH-TRU (1990): 93,458 m3
Retrievably stored RH-TRU (1992): 2,005 m3
Retrievably stored RH-TRU (1990): 1,900 m3
Buried CH-TRU (1992 and 1990): 204,438 m3
Buried RH-TRU (1992 and 1990): 6,163 m3

The first number, 103,942 m3, is close to the cited sum of stored waste and waste to be generated (63,100 + 40,900 = 104,000). However, the IDB states very clearly that 103,492 m3 is the total of the generator sites' estimates of currently stored CH-TRU waste. In Table 3-17 (p. 110), the IDB lists projected future TRU wastes through the year 2020. If the volume of these wastes is calculated through the year 2018, the resulting total projected volume is about 36,000 m3 and not 40,900 m3, as cited on p. 4-3 of the CSR. If the IDB is the source of the inventory information, the most current IDB should be cited and cited correctly.

Table 4-1 of the CSR (p. 4-4) also does not correspond with the inventory estimates given in the 1991 (U.S. DOE, 1992) or 1993 IDB (U.S. DOE, 1994). Table 4-1 cites Sandia WIPP Project (1992) as an additional source, and the number given in Table 4-1 for total CH-TRU, 176,000 m3 -- equivalent to the 6.2 million cubic feet destined for the WIPP -- is indeed the same total volume as is cited on page A-137 of SAND92-0700/3 (Sandia WIPP Project, 1992). However, except for this one instance, the inventory discussed in Sandia WIPP project (1992) is given as curies of specific radionuclides, and thus probably did not contribute to Table 4-1. The CSR has apparently understated the inventory of DOE transuranic waste. The numbers given are neither consistent with the Integrated Data Base, nor with the numbers used in the most recent performance assessment. Furthermore, under the Land Withdrawal Act, DOE has a responsibility for management of all its TRU waste, not just what is destined for the WIPP. The CSR has not addressed this responsibility at all.

In the case of RH TRU waste (Section 4.1.5) there are notable differences between the 1994 DOE Baseline Inventory Report (U.S. DOE/CAO, 1994) and the CSR. Table 1 of this review compares the RH TRU radionuclide inventory provided by the 1994 DOE Baseline Inventory Report (U.S. DOE/CAO, 1994, section 5.4 and Table 5-3) and the 1994 DOE Compliance Status Report (Section 4.1.5 and Table 4-4).

Table 44 of CSR does reflect Table 3.3-1 of Sandia WIPP Project, (1992) accurately. However, EEG still has some questions about the reliability of the Sandia WIPP Project (1992) radionuclide inventory.

EEG-24 RESPONSE

It is correct that the BIR contains the up to date information on the DOE's TRU waste inventory. The BIR uses the MWIR data that is waste stream specific for existing TRU waste. The BIR has attempted to resolve the previous inventory differences as reported in various documents. The BIR acknowledges that the retrievably stored waste and the currently predicted waste inventory totals do not equal the volume allowed by the LWA. The BIR applies a scaling factor to the existing inventory mix to arrive at a total volume of waste for input to the PA process.

You are also correct that the DOE's responsibility with regard to defense TRU waste does not stop at WIPP. The CSR on the other hand is a WIPP specific document and was focused on WIPP TRU waste.

EEG-25 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Waste Acceptance Criteria

While the Waste Acceptance Criteria (Section 4.2.3) should be referenced, a detailed discussion is not necessary for the Compliance Status Report. It is true that Section 3.3 for WAC Revision 4.0 contains PA criteria for the test phase that may also be applicable to the disposal phase wastes pending final PA and certification conditions. However, Table 4.6 and Table 4.7 are not limited to the needs of PA. Table 4.7 lists only the most restrictive requirements, which might reflect the Waste Acceptance Criteria, the TRAMPAC, or the No Migration Variance Determination. Given that this is a Compliance Status Report, the tables should focus on the requirements imposed by the performance assessment or at least reflect those requirements. We note that the document tabulates only the CH TRU requirements and does not include the RH TRU requirements, although RH TRU waste represents approximately one-third of the inventory in terms of radioactivity.

The Waste Acceptance Criteria should provide an adequate description of an acceptable waste envelope. The remaining descriptions should either be more precise and detailed, or should be deleted. The document would have been much improved by including some actual results of both intrusive and non-intrusive assay. Future Compliance Status Reports should include

measured results and determinations instead of qualitative overviews.

Table 1.

Comparison of RH TRU Inventories (Curies) for PA reported in 1994 DOE Compliance Status Report (CSR) and 1994 DOE Baseline Inventory Report (U.S. DOE/CAO, 1994.

Radionuclide	US DOE/CAO, 1994	CSR
Sr 90	522,000	57,500
Cs 137	569,000	29,400
Pm 147	536,000	1,110
Th 232	5.66	0.33
U 233	199	1,040
U 235	0.613	367
U 236	0.00559	****
U 238	1.8	2.3
Np 237	0.92	0.766
Pu 238	27,300	61,700
Pu 239	8,500	40,800
Pu 240	2,280	9,980
Pu 241	120,000	178,000
Pu 242	2.94	0.948
Am 241	1,060	89,800
Cm 244	4,260	****
Cf 252	86.3	11.0

EEG-25 RESPONSE

The EEG's comments are respectfully noted. The data in the BIR will be used for all future input to the PA process, and will be the reference for the detailed information of waste quantities and descriptions.

EEG-26 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Waste Characterization

The title of Section 4.3 is Waste Characterization, but it only contains general statements about some programs that the agency has not yet undertaken. Worse, there is no mention either of past and ongoing waste characterization activities or of the central dilemma of waste characterization, and how DOE plans to address it. That dilemma may best be stated as follows:

Absolute and complete knowledge of what goes into the WIPP would require intrusive characterization of every drum and waste box, a process much too resource consumptive and potentially unsafe. Therefore, an envelope must be defined (as is recognized in the preceding section) and decisions made about how much and what kind of characterization adequately define the envelope and assure that most of the waste fits within it. The degree or frequency or probability of excursion from that envelope also requires definition.

Some of the questions that DOE should have addressed in this section are:

1. Given the characterization that has already been done, what fraction of each type of waste container must be sampled intrusively?

2. What information can be obtained from non-intrusive sampling, and when does this information suggest further intrusive sampling?

3. What are the characteristics of the waste envelope for each type of waste?

4. What fraction of containers can exceed the waste envelope?

5. What can process knowledge be depended upon to provide?

EEG-26 RESPONSE

The items described in the comment will be addressed in future documentation and/or permit applications. For example, waste characterization will be waste stream oriented and the sampling will be structured to fit this approach. For example, where non-intrusive

examinations are non-conclusive, or inappropriate, intrusive sampling such as headspace gas or coring of solidified waste will be considered. The BIR will become the source of detailed information about the waste quantities and composition. Details of various analyses will be incorporated into the future compliance applications to the extent appropriate. The waste envelope will be defined by the PA process and no waste that falls outside the envelope will be shipped to WIPP. Process knowledge documentation will be referenced in future compliance applications, as appropriate, as well.

EEG-27 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Mixed Waste

Sections 4.1.3 and 4.1.4 of the CSR deal with mixed waste and, essentially, with Resource Conservation and Recovery Act (RCRA) compliance, although EEG has repeatedly urged DOE to deal with RCRA compliance separately, or at least in separate sections of any compliance document. The CSR cites the RCRA Part B Permit Application (U.S.DOE, 1993), with no specific page or chapter citation, as the source for the inventory figures for mixed waste in section 4.1.3 and Table 4-2. In the twelve volumes of U.S. DOE (1993), EEG was not able to find figures corresponding precisely to those in Table 4-2. Calculations made from Part A of the permit application suggest a rate of mixed waste acceptance at the WIPP of about 4,700 m3/year of CH-TRU; twelve years' worth of mixed waste would yield the 57,257 m3 of mixed CH-TRU cited on p. 4-5. The CSR gives no indication that the cited amount was arrived at in this way.

EEG-27 RESPONSE

The reference in the CSR is incorrect. The reference should have indicated the source of the inventory was the IMWIR (DOE 1993b), which only included 5 years of projected data, and would explain the apparent mismatch in the various inventory numbers. The BIR will be the reference for any future waste inventory numbers for input to the PA and will be reported to the appropriate regulatory agencies.

EEG-28 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Mixed Waste

A more fundamental discrepancy exists between the claims of the CSR and the RCRA Part B permit application. The RCRA Part B Permit was for the now abandoned Test Phase of the WIPP, and initially proposed a maximum of 1% of the final inventory (or 1,756 m3, according to the CSR). The actual volume proposed for the Test Phase in the RCRA Part B Permit Application is 84,260 gallons, or 320 m3, of CH-TRU (U.S. DOE, 1993, Volume I, page I-4), instead of the 57,247 m3 of CH-TRU cited on page 4-5 of the CSR.

All currently existing TRU waste may be assumed to be mixed waste. The estimate of 57,247 m3 of CH-TRU is thus puzzling. Does this estimate include the 53,000 m3 cited in Chapter 1? In what way is it consistent with the approximately 103,000 m3 of CH-TRU cited in the IDB, or with the 175,600 m3 cited earlier in the Chapter 4 as the capacity for the WIPP? Does this last imply that DOE has determined that only 1/3 of the CH-TRU destined for the WIPP will be mixed waste? Why then does that include any waste yet to be generated? Moreover, how can DOE make such a determination when less than 0.2% of the waste has been characterized?

Section 4.1.4 states that some mixed waste will contain "a few parts per million" of halogenated solvents. Measurements made on headspace gases and reported in the Bin Case Data reports indicate measured headspace gas as high as 10 ppm for carbon tetrachloride and up to 540 ppm for trichloroethane. The No-Migration variance issued for the WIPP Test Phase by the EPA allows as much as 69,000 ppm carbon tetrachloride in organic sludges. The statement in Section 4.1.4 is gratuitous and uninformative, as well as incorrect. The halogenated solvent content of the TRU waste destined for the WIPP should be described accurately.

EEG-28 RESPONSE

The 1993 IDB states that: "It is estimated that as much as 50 to 60% of the TRU waste is mixed Waste,...". The estimate of mixed waste in the CSR was calculated in this manner (57.2K m3 is just 55% of the 1993 IDB total for all TRU).

Process knowledge provides a good basis for the qualitative assessment of the potential for the co-contamination of the waste with identified hazardous components. It becomes an easy task to estimate the amount of the mixed waste to be generated by extrapolation from the ratio of mixed wastes in the current waste streams. The addition of special controls to minimize the amount of hazardous co-contaminants that enter the waste during the D & D and Environmental Restoration (ER) operations will tend to reduce the actual percentages from the current estimates. It is reasonable to predict that these projections will become conservative estimates in the future.

EEG-29 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Program Summary

Section 4.3.1 mentions the Baseline Inventory Report as being developed by DOE. We note that a final report is already available (U.S. DOE/CAO, 1994). There is discussion of determining the radionuclide inventory by radioassay on a drum by drum basis. Is it also the intention of the project to determine the radionuclide inventory of the RH TRU waste on a canister by canister basis using radioassay?

EEG-29 RESPONSE

It is the intention of the project to determine the radionuclide inventory of the RH-TRU waste on a container by container basis. Various radioassay technology development projects are being pursued by the DOE in order to address some of the issues associated with the assay of RH waste. For example, the Combined Thermal/Epithermal Neutron (CTEN) technique being developed by LANL is addressing the self shielding difficulty and the ability to make accurate fissile material measurements in the presence of higher radiation fields. These are issues common to most RH waste.

EEG-30 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Program Summary

There is a very vague discussion of possible load management alternatives to be considered to ensure the proper mix of waste forms on both panel and room scales. Yet there doesn't appear to be any supporting engineering design or documentation of that effort. Is this approach to compliance demonstration still in the conceptual stage?

EEG-30 RESPONSE

Load management is not currently considered as an active alternative methodology for inventory control. The concept of load management is an additional assurance measure that can be applied to the repository inventory if it becomes necessary to do so. PA will indicate whether such control is important or not.

Inventory control is a separate issue and will be provided primarily through the strict enforcement of the WAC. Load management will become a tool that can be employed to avoid problematic spatial distributions of certain waste types within the repository if the PA process indicates that such control is important.

EEG-31 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Waste Transformation Processes in the Repository Environment

Section 4.4 discusses various efforts aimed at exploring potential long term processes that would impact the performance of the repository. The Section is an adequate initial review of gas generation processes, but does not identify the most currently published information that is available from those studies. Furthermore, there is no timetable to show that the information will be available for input into the performance assessment demonstration and final compliance package to be submitted to the EPA. The results of gas generation modeling are not cited. The vagueness of this section underscores the need for more experimental data.

EEG-31 RESPONSE

Information obtained from the various studies and testing you mention will be considered in future compliance evaluations, as appropriate. The results of these evaluations will be included and justified in the CCA and other relevant compliance submittals.

EEG-32 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Waste Inventory Scaling Factors

Section 4.1 describes scaling factors for extrapolating waste volume parameters to WIPP-specific TRU waste values and refers to the 1992 PA. The most current scaling factors are described in the WIPP Baseline Inventory Report (U.S. DOE, 1994b, Section 5.3). In fact, this section of the document fails to mention the WIPP Baseline Inventory Report and leaves the reader with the impression that the 1992 PA inventory has not been superseded.

EEG-32 RESPONSE

The BIR was issued 3 months after the CSR, therefore the data in the BIR could not be included in the CSR. The most current BIR data will be used in compliance evaluations for the CCA and other relevant compliance submittals.

EEG-33 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Chemical Compatibility

Section 4.1.7 starts out briefly mentioning restriction on the waste that can be emplaced at WIPP but fails to reference the sources of these restrictions and to give the project immediate credit for the development of these restrictions. These restrictions would include the Waste Acceptance Criteria, the TRAMPAC, and the No-Migration Variance Determination.

EEG-33 RESPONSE

Comment noted.

EEG-34 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Chemical Compatibility

This section also mentions analyses of the interaction of compounds with other compounds but does not reference the actual study. Again, the document should recognize the performance of such an effort with a formal citation. Furthermore, complete citations would assist the individual sites in the preparations of their Quality Assurance Project Plans (QAPjP) and would assist the regulators in a compliance decision.

EEG-34 RESPONSE

Chemical incompatibilities are avoided because of the WAC restrictions excluding reactive, corrosive, and explosive substances. Extensive chemical compatibility studies were performed and included as part of the TRUPACT-II Safety Analysis Report for Packaging (SARP), Rev. 4 as Appendix 2.10.12. This information is also documented and included as Appendix D13 of the WIPP RCRA Part B Permit Application, DOE/WIPP 91-005, Rev. 3.

EEG-35 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Performance-Based Waste Envelope

Section 4.2.1 attempts to present a concept that has yet to be studied and developed. We look forward to a report describing this concept and progress in its implementation.

EEG-35 RESPONSE

The DOE does not plan to issue such a report. Any performance based restrictions (PBWAC) derived from PA analyses will be considered for addition to the existing WAC to provide any additional WIPP inventory control that would be needed. Any such PBWAC criteria will be reviewed and approved by the regulator, as appropriate.

EEG-36 COMMENT

CHAPTER 5 - MONITORING

The introductory paragraph (page 5-1) of this chapter contains the following statement:

> Monitoring to ensure protection of site workers, the public, and the environment are required at the Waste Isolation Pilot Plant (WIPP) facility before waste-disposal operations, during waste handling and disposal operations, and during closure/postclosure operations.

There is no explanation in this document of how site workers will be monitored. The above statement is therefore unsubstantiated.

EEG-36 RESPONSE

The specific objectives and requirements for such a monitoring program are not firm at this point in time. These issues will be dealt with in the development of the CCA and other relevant regulatory compliance submittals. We intended for the statement to clarify that the DOE's overall objective for monitoring is to meet the regulatory requirements.

EEG-37 COMMENT

CHAPTER 8 - COMPLIANCE ANALYSIS

This chapter unnecessarily repeats introductory and explanatory material in the 1992 Performance Assessment reports (SAND92-0700/1-5). Compliance with 40 CFR 191 will indeed be demonstrated by performance assessment, so that the appropriate inclusions from SAND92-0700 in the CSR are some of the results in Volume 4 of SAND92-0700. To this end, the inclusion of Figure 8-5 (Figure 9-1 of Volume 4 of SAND92-0700) is pertinent. Other material from Volume 4 that should have been included are Figures 8.5-1 through 8.58, along with a synopsis of the discussion in Sections 8.3 and 8.4 of Volume 4. EEG has separately provided comments on the performance assessment reports (Lee, et al, 1994).

EEG-37 RESPONSE

Determining how much material to reproduce from previous reports in a document such as the CSR was debated internally. The decision we made was to include enough background information to put the issues

discussed in the CSR in a meaningful context, while still achieving the goal of providing a reasonably concise status report. Less emphasis was assigned to reproducing results from earlier reports, particularly results that might be subject to re-calculation as new data are obtained. Your comment is respectfully noted.

EEG-38 COMMENT

CHAPTER 8 - COMPLIANCE ANALYSIS

Section 8.3.2 of the CSR deals with RCRA compliance. Once again, it is evident that forcing consideration of RCRA compliance into the same performance assessment mold as 40 CFR 191 compliance distorts the relative importance of the parameters that affect RCRA compliance and may result in an incomplete compliance application. Compliance with 40 CFR 268.6 means obtaining a No-Migration Variance, and the compliance determination is made on the basis of the No-Migration Variance Petition (NMVP). The existing NMVP was for the now-abandoned Test Phase. The NMVP for disposal will include more waste, all four types of TRU waste, and a system without the large amounts of ventilation air present during the Test Phase. Therefore, gas-phase VOC migration through the Salado and Rustler must be considered in the NMVP, but not apart from, or in isolation of, the equilibration of gaseous VOCs in the WIPP underground.

Inclusion of gas generation and the variables related to it in Table 8-6 implies a misunderstanding of the role of the gas generation phenomenon in compliance. VOC generation by chemical reaction will yield quantities of VOCs that are negligible when compared to the emplaced quantities. Essentially, the VOC vapors in the WIPP result from the vapor in equilibrium with the liquid VOC solvents that contaminated the emplaced waste. The gas generation model that has been developed for the WIPP, models generation of hydrogen, CO2, and possibly methane, that are the products of corrosion, radiolysis, and microbial action. Hydrogen, carbon dioxide, and methane are not RCRA-controlled VOCs. They are not halogenated organic compounds. Conversely, the RCRA-controlled compounds present in the TRU waste: carbon tetrachloride, methylene chloride, trichloroethylene, the trichloroethanes, phenol, chlorophenol, chlorobenzene, toluene, methyl bromide, etc., are not produced by either corrosion or microbial action, and their ultimate production as a result of radiolysis is much less likely than the production of lower molecular weight gases. Moreover,

any halogenated VOC produced as a result of radiolysis of plastic is likely to be chemisorbed in the plastic. Finally, none of these compounds are addressed in the existing gas generation model. The generated gas will serve only as a diluent of VOCs. By including gas generation parameters, Table 8-6 is not only confusing, but wrong. Once again. EEG encourages DOE to treat RCRA compliance separately from compliance with 40 CFR 191, and thereby treat it appropriately.

EEG-38 RESPONSE

It was not intended that Table 8-6 indicate to the reader that gases such as hydrogen and carbon-dioxide should be considered contaminants. These gases are predicted to be generated in substantial volumes within the repository. The hazardous VOCs will be mixed with these gases. The resultant repository headspace will be available for transport should a driving mechanism occur in room closure modeling. The mass of VOCs available for transport, and the rates and migration pathways available will depend in large part on the pressure increase that develops in the repository. This pressure increase will be driven by mechanisms like creep closure and/or gas generation in early repository histories. This is the reason why generation of non-toxic constituents was included in Table 8-6.

The DOE has always intended to handle compliance documentation for RCRA and 40 CFR 191 separately, this plan has not changed. We are handling the CCA and NMVP development processes on parallel, well integrated, but separate paths.

EEG-39 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Chapter 9 is largely redundant, in that it repeats material found in other chapters, and includes some material that ought to be in other chapters. If the purpose of the chapter is assessment of the degree of compliance with various regulations, it could be better achieved by tabulating the information, as is in fact done in Chapter 12. That is, to demonstrate compliance with each regulation, list what has been submitted and what remains to be submitted. The narratives in Chapter 9 do not clearly reflect the assessment of compliance. The summary table of Chapter 12 performs this function much better.

EEG-39 RESPONSE

Chapter 9 was intended as a summary of the regulatory requirements and a summary of our programs as it is intended to fulfill the requirements. More specific information may be found in the DCCA and the draft NMVP. Your comments on the redundancy of Chapter 9 and the utility of the tabular format of Chapter 12 are respectfully noted.

EEG-40 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Sections 9.2.2, 9.5.1, and 9.5.3 discuss the possibility of human intrusion and the potential efficacy of measures to deter human intrusion. In this discussion, DOE has ignored EEG's critiques of both the use of expert judgment in assessing the efficacy of passive institutional controls and the lack of existing institutional control in the vicinity of the WIPP. While this discussion would be adequate if it were the first time the topic were discussed, it is inadequate in the light of these existing and published critiques. The CSR should recognize the existence of differing opinions and assessments.

EEG-40 RESPONSE

The relevant text in CSR sections 9.2.2, 9.5.1, and 9.5.3 discuss briefly the DOE position at the time the CSR was prepared. The DOE recognizes that opinions can, and often do differ with respect to what measures are appropriate for deterring future inadvertent intrusions. Our program is designed and has been implemented so as to allow for such differences to be identified. Directly related to this, but a separate issue, is the relative effectiveness of such a system of passive institutional controls. The issues of passive institutional control and the relative effectiveness of such control will be addressed in the CCA. PA related uncertainty in these areas will be treated through conservatism in modeling assumptions and sampling among ranges for imprecisely known input variables. The assurance requirements programs will be structured in such a way as to add any additional assurance that may be needed to complement the compliance baseline. Treatment of the calculated PA result in a qualitative way will be the design goal in these areas.

Specific to the issue of inadvertent intrusion and permanent marker system effectiveness, the DOE has initiated research of drilling activities in the Delaware Basin. One of the objectives of this study is to identify a future inadvertent intrusion rate for use in PA. The expected drilling rate that results from these studies will be defensible from both a technical and statistical basis.

Our intent is to design the permanent marker system to be effective in rendering future inadvertent intrusion events unlikely for the 10,000 year period of performance. The DOE will consider the affects of future inadvertent intrusions on repository performance as determined in PA. When the PA calculations are completed and appropriate consequence analyses are performed we will be in a position to conclude one of two things. Either the markers system must be effective to some degree to demonstrate compliance with the containment requirements, or that compliance with the containment requirements can be demonstrated with a zero level of effectiveness from the marker system. If the markers are not required to be effective for compliance with the containment requirements, they will be designed and implemented as a component of the assurance requirements program only. If PA indicates that additional measures are needed to demonstrate compliance with the containment requirements, the permanent marker system will be considered as a candidate source for improving performance.

The DOE is well aware that it will be impossible to quantify with statistical certainty exactly how effective such a marker system will be for 10,000 years. The applicable regulations, in recognition of this same issue, simply require that markers be effective enough. In the final analysis the decision relative to marker system effectiveness, whether it must be quantified or not, will be based purely on judgment.

EEG-41 **COMMENT**

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Overall, it is difficult to understand what purpose is served by Chapter 9, that includes bits and pieces of the compliance picture, many of which are treated better in other sections of the CSR. The description of compliance with 40 CFR 191 given in section 9.1.1 is, as in Chapter 8, a summary of some parts of the performance assessment. The material should be

included in Chapter 8, and should be focused on performance assessment results. An analogous comment applies to Section 9.1.2; RCRA compliance status should be summarized in one place.

EEG-41 RESPONSE

DOE does not plan to reissue this compliance status report. Comments such as this one will be taken into consideration in preparing future compliance documents required by the regulations (i.e., the permit application, no-migration variance petition, and certification application).

EEG-42 COMMENT

CHAPTER 10 - FUTURE TEST PROGRAMS

The descriptions and discussions of future experiments appear to be adequate, though one could question whether they will yield usable results in a timely way. No mention is made of possible scheduling difficulties.

EEG-42 RESPONSE

Priorities and plans for additional testing and analyses have been evaluated. The results of DOE decision making were announced earlier this year. Those programs are under way and scheduled to conclude at such times to support development of the CCA and other relevant compliance submittals.

EEG-43 COMMENT

CHAPTER 10 - FUTURE TEST PROGRAMS

A few questions about the future experimental program do arise, however.

1. Section 10.1.1.2.1 does not mention further carbon dating experiments, although these have been suggested by more than one commentator.

EEG-43 RESPONSE

The DOE does not plan additional carbon-dating experiments.

EEG-44 COMMENT

CHAPTER 10 - FUTURE TEST PROGRAMS

A few questions about the future experimental program do arise, however.

2. Section 10.1.1.2.2 might be expected to refer specifically to multi-well tracer tests, but does not.

EEG-44 RESPONSE

Comment noted.

EEG-45 COMMENT

CHAPTER 10 - FUTURE TEST PROGRAMS

A few questions about the future experimental program do arise, however.

3. Section 10.1.3.2 discusses the development of the actinide source term model but fails to resolve the uncertainty that may occur if experimental results are not the same as those predicted by the Pitzer model. Will the model be changed to accommodate experimental results, as should be done, or will DOE keep a model not validated by experiment?

EEG-45 RESPONSE

The fact that the model will be reconciled with the experimental data when the data are obtained (and assuming good, reproducible data) was regarded as a given that did not require discussion in the CSR. When the additional data and information are acquired, the DOE will make the decision. The decision to either change the model, or not, will hinge on what the data indicate pending qualification of the data. Bear in mind that the data could also drive revised modeling assumptions.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RADIATION AND INDOOR AIR
COMMENTS ON THE COMPLIANCE STATUS REPORT FOR THE WIPP
(DOE/WIPP 94-019, Rev.O)

EPA-1 COMMENT

LETTER

During continuing discussions between ORIA and OSW on a variety of WIPP-related issues, the concept has emerged that it may be beneficial, to both DOE and EPA, for DOE to submit a combined compliance application and no migration variance petition. This would help avoid unnecessary inconsistency in compliance assessments and prevent a re-examination of the No Migration determination when the 191 application is received.

EPA-1 RESPONSE

The DOE understands that the intent of congress with regard to the RCRA and the AEA is for the regulatory programs to be complementary. However, the implementation processes are significantly different. Because of this, the DOE believes separate applications leading to separate submittals is appropriate. However, some portions of the various applications are similar (like site characterization, quality assurance, and others). The DOE is striving to assure that these similar sections are, in fact, the same to the extent allowed by the regulations. In this manner, issues and concerns over these sections can be addressed separately for both rule-makings.

EPA-2 COMMENT

LETTER

Finally we continue to have a series of specific technical concerns regarding the compliance application and the schedule for their resolution. While we did not expect them to be addressed in this document, it is important that they be addressed as soon as possible. Among the most important of these issues are: 1) It is unclear that the current DOE waste characterization program will provide data to substantiate the waste characteristics and categories used in the performance assessment. 2) The results of an engineered barriers study must be available in the very near future for timely incorporation into facility design and performance assessment. 3) A very large quantity of

old data must be qualified to form a basis for the certification decision. 4) Neither the 92 Performance Assessment nor the CSR describes the specific passive and active institutional controls DOE expects to use at the WIPP. These will need to be described in detail in the compliance application. In addition, any credit claimed for them in performance assessment will have to be rigorously justified.

EPA-2 RESPONSE

1. The process used for data and information organization and the reporting format used in the DOE's Baseline Inventory Report (BIR) has significantly improved the overall presentation of DOE's knowledge of waste inventories and characteristics. This should also function to make this information more user friendly. The BIR will be continually updated to ensure the most current information is available for use in DOE's compliance evaluations.

2. This comment indicates that it is a foregone conclusion that the DOE will need to incorporate engineered alternatives/engineered barriers, in addition to the shaft sealing system, into the disposal system in order to achieve compliance. The DOE has not yet reached this conclusion. Engineered alternatives should not be viewed as, or used for quick fixes to indications of less than "optimal" repository performance. Decisions on engineered alternatives will be made carefully, deliberately, and with clear and specific knowledge of the performance related need being satisfied.

3. The program is currently designed to identify engineered alternatives with potential benefits as a portion of the DOE's Assurance Requirements Program. The DOE has developed a plan for QA relevant to the certification decision. This plan is described in the DCCA and will be applied to the existing data.

4. A design concept for active and passive controls is also included in the DCCA. The level of detail will be adequate upon submittal of the Compliance Certification Application (CCA). If the DOE claims credit for any part of these programs, adequate justification will also be included in the CCA.

EPA-3 COMMENT

OVERALL REMARKS

This report appears to be a management level document. Therefore, the CSR contains an insufficient level of detail for a thorough technical or programmatic review.

EPA-3 RESPONSE

The Compliance Status Report differs from subsequent compliance submittals in that the Compliance Status Report does not provide the exhaustive detail and supporting information that a compliance submittal would need in order for a regulator to make a certification or determination of compliance.

EPA-4 COMMENT

OVERALL REMARKS

In consideration of a possible compliance application submittal as early as December 1996, the EPA expected the CSR to be much more comprehensive, particularly with regard to schedules, commitments, and descriptions of deliverables and final designs. The CSR did not provide a detailed "snapshot" of the current status of nor the future plans for compliance.

EPA-4 RESPONSE

The intent of the Compliance Status Report was to focus on the status of the Project, acknowledging that compliance is not yet documentable. We intended to identify general requirements, programs designed to satisfy the requirements, areas where compliance is not yet achievable, and the future action(s) needed to achieve compliance. Any areas/components that are identified as being weak will be given close attention in development of the CCA and other relevant compliance submittals.

EPA-5 COMMENT

OVERALL REMARKS

The Introduction states the CSR provides an assessment of compliance "in order to focus on-going and future experimental and engineering activities." It is the EPA's understanding that the System Prioritization Method serves this purpose as well; therefore, the EPA

anticipates the content of the CSR (and the Performance Assessment on which it is based) may change significantly.

EPA-5 RESPONSE

The System Prioritization Methodology was designed as a decision making tool for assisting the WIPP Project in planning the appropriate suite of programs to pursue for an ultimate demonstration of compliance with the long-term disposal regulations. The results have since been used by the DOE to make these programmatic decisions. The results of the decision making process were announced earlier this year.

EPA-6 COMMENT

OVERALL REMARKS

There are many assumptions made within the text of the CSR. Assumptions must be supported with documentation and references when associated with a compliance application. In addition, with the promulgation of 40 CFR Part 194, the assumptions made in the CSR will require re-examination.

EPA-6 RESPONSE

The DOE agrees that assumptions must be supported with documentation and references in the compliance application. The DOE understands that with the promulgation of 40 CFR 194, assumptions made in the CSR may require re-examination.

EPA-7 COMMENT

OVERALL REMARKS

Based upon information presented to date by the DOE, the EPA does not see how a performance-based waste acceptance program can be developed in time for a 1996 compliance application.

EPA-7 RESPONSE

The current WAC is performance based. That is, the criteria and limitations are dictated by performance criteria throughout the operational(transportation and management at WIPP) portion of the disposal system. This is mentioned to indicate that the mechanics for implementing additional performance based criteria already exists within the current WAC - system. This

will greatly facilitate implementation. Furthermore, a PBWAC need not be implemented prior to submittal of an application since PBWAC will ultimately govern the shipment of waste, not the submittal of the application.

EPA-8 COMMENT

OVERALL REMARKS

The EPA recommends that the DOE include the view of stakeholders on the status and identification of issues in any future reports on the status of compliance.

EPA-8 RESPONSE

The DOE submitted the CSR to the Stakeholders. Their comments are being considered and will drive change to future compliance evaluations as appropriate.

EPA-9 COMMENT

OVERALL REMARKS

In the accompanying cover letter, the DOE states "the CSR will evolve into two documents." The EPA believes that it would be beneficial for the DOE to develop a combined compliance application and No-Migration Variance Petition.

EPA-9 RESPONSE

The DOE understands that the intent of congress with regard to the RCRA and the AEA is for the regulatory programs to be complementary. However, the implementation processes are significantly different. Because of this, the DOE believes separate applications leading to separate submittals are appropriate. However, some portions of the various applications are similar (like site characterization, quality assurance, and others). The DOE is striving to ensure that these similar sections are, in fact, the same as the event allowed by the regulations. In this manner, issues and concerns over these sections can be addressed separately for both rulemakings.

EPA-10 COMMENT

OVERALL REMARKS

In reference to chapter 6, "Test Programs," the EPA has not specifically addressed the resolution of outstanding issues within this comment package due to the inadequate level of information in the CSR.

EPA-10 RESPONSE

Although the level of detail in the CSR was not sufficient to permit EPA to evaluate issues fully, EPA did provide DOE with an informal review of the issues presented in the CSR. This informal review has been valuable in increasing DOE's understanding of the level of detail needed to consider an issue resolved. In addition, the informal review has also helped focus DOE's attention on aspects of issues previously considered resolved that EPA considers still open.

EPA-11 COMMENT

OVERALL REMARKS

In comparing the CSR with the DOE's Format and Content Guide, the EPA has noted a number of inconsistencies which are identified and detailed in chapter comments within this package. The EPA requests an explanation/justification for this.

EPA-11 RESPONSE

Any inconsistencies with the Format and Content Guide identified and detailed in your chapter comments will be addressed in the resolution of that comment. The general explanation is simple. During the process of CSR development, in areas where it made sense to deviate from the Format and Content Guide, the deviations were made. We believe the result is an improved product. If there were to be a revision to the CSR, the appropriate course of action would be to revise the Format and Content Guide to make it consistent with the CSR. The DOE does not intend to revise the CSR. Such lessons learned were incorporated into the DCCA and the draft NMVP, as appropriate.

EPA-12 COMMENT

EXECUTIVE SUMMARY

1. The statement regarding the 1992 PA calculations

showing likely compliance with 191.13 is very premature. The 1992 PA is, as admitted by the DOE, incomplete and includes assumptions that are not supported with current data, and thus make this statement invalid. It should be stricken.

EPA-12 RESPONSE

The CSR, as stated in the Executive summary, is not a statement or determination of compliance. As a document that provides the current status of compliance, we believe it appropriate to identify ongoing experiments and anticipated results. When the DOE submits its final 40 CFR 191 Compliance Certification Application in December 1996, supporting information will be included which justify the assumptions made in reaching a determination of compliance.

EPA-13 COMMENT

EXECUTIVE SUMMARY

2. The DOE states in the last sentence of the Executive Summary that future experimental programs will focus only on obtaining the information needed to resolve issues required for a demonstration of compliance. Although schedules for all tests are not available, this statement conflicts with the EPP as it has been explained to the Agency to date. The EPP consists of test conducted to resolve issues required for a demonstration of compliance, and tests whose results will provide us with confirmatory and other data needed to understand the performance of wastes in repositories. Is this a change in approach?

EPA-13 RESPONSE

This is not a change in the DOE's approach. The EPP was not written specifically for compliance, but was rather a compendium of studies with potential benefit. The DOE has since selected a focused path forward with regard to Experimental Programs. The SPM process was used as a tool to facilitate the decisions which resulted in the chosen path. The results of this programmatic decision making were announced earlier this year.

EPA-14 COMMENT

CHAPTER 1 - INTRODUCTION

Page 1-1.

53,700 m^2 should be changed to 53,700 m^3 of TRU waste

EPA-14 RESPONSE

Future compliance documents will include the correct units.

EPA-15 COMMENT

CHAPTER 1 - INTRODUCTION

Page 1-8.

The No-Migration Proposed Rule of 8/11/92 will not be finalized by 8/94.

EPA-15 RESPONSE

Comment noted.

EPA-16 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

The document presents the two different conceptual groundwater flow models, indicating that the regional model (rather than confined) will be used. However, this model requires a better understanding of regional recharge and discharge issues. Acquisition of this information is noted as a data gap (i.e. "open" issue) in comments pertaining to Chapter 6.0 of the document.

EPA-16 RESPONSE

Rather than requiring a better understanding of regional recharge and discharge issues, the regional model is designed to provide a better understanding. The regional model will be used to investigate some scenarios, such as climate change and subsidence over potash mines, but will be used for PA calculations only if results show that the two-dimensional confined model cannot represent all scenarios that have not been screened from the analysis.

EPA-17 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

The discussion on porosity and permeability of Salado anhydrite under various conditions (e.g. gas generation pressures in excess of fracture generation/opening pressures and under two-phase flow) should be expanded.

EPA-17 RESPONSE

Model development for fracture behavior and two-phase flow characteristics in the Salado anhydrite continues. PA treatment of Salado anhydrite permeability and porosity will be explained and justified in the CCA and other relevant compliance submittals. Some additional detail has since been provided in the DCCA, the draft NMVP, and the DCCA update.

EPA-18 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

The document indicates that Castile deformational features occur below the WIPP site, but does not elaborate upon the significance of this relative to the possible occurrence of a brine pocket immediately below the WIPP repository.

EPA-18 RESPONSE

Pockets of brine have been encountered in the Castile Formation by various oil drilling companies and Sandia National Laboratories (exploratory holes ERDA-6 and AEC-7). Of 62 deep boreholes into the Castile, ten (16 percent) penetrated pressurized brine reservoirs. Nine of these ten occurrences were associated with the deformation front abutting the Capitan Reef. This deformation front exists under the northern edge of the WIPP site. Of these nine, eight were associated with known anticlinal structures in the Castile. The remaining occurrence, located about 3 miles southwest of the WIPP site, was also closely related to an anticline.

REFERENCES

Borns, D. J., L. J. Barrows, D. W. Powers, and R. P. Snyder, 1983, *Deformation of Evaporites Near the Waste Isolation Pilot Plant (WIPP) Site*, SAND82-1069, Sandia National Laboratories, Albuquerque, New Mexico.

Earth Technology Corporation, 1988, *Final Report for Time Domain ElectroMagnetic (TDEM) Surveys at the WIPP Site*, SAND87-7144, Sandia National laboratories, Albuquerque, New Mexico.

Register, J. K., 1981, *Brine Pocket Occurrence in the Castile Formation, Southeastern New Mexico*, TME 3080, Department of Energy WIPP Project Office, Albuquerque, New Mexico.

EPA-19 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

The document makes no real mention of hazardous constituents in terms of contaminant transport. Apparently, the DOE is advocating the co-contamination concept in this regard, assuming that if a radioactive constituent release is not detected, this would indicate that hazardous constituents have not been released as well. However, the DOE has not presented sufficient information to demonstrate that a release of hazardous constituents would always occur in association with radioactive constituent release, and would never occur separately.

EPA-19 RESPONSE

Post closure/decommissioning contaminant transport was not modeled in the Salado in the 1992 PA. Since then, process models have been developed to describe transport of radionuclides and volatile organic compounds (VOCs) by advection. Radionuclides are assumed to be transported as soluble constituents of the brine phase, and VOCs are assumed to be part of the gas phase. The greater mobility of the gas phase dictates that priority for long term RCRA constituent transport be given to VOCs. RCRA metal solubilities will be acquired from available literature for use in transport modeling.

EPA-20 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Figure 2-6, page 2-8

This figure is not of the appropriate scale to present well location information, nor is the figure updated. The DOE should include a more detailed map showing the location of wells for which hydrologic data have been

acquired; the map shown in Figure 2-6 is too small to adequately present these well locations. This more detailed map, should include the location of the subsurface mine/unit, and include the location of all borings installed within the Land Withdrawal Boundary. Also include the approximate locations of any proposed wells/borings to be installed within the WIPP boundary.

EPA-20 RESPONSE

Additional information can be found in Figure 3 in SAND88-7002 (Figure 3.1) or Figure IV-14 in the SAND89-7147 report. Each of these maps require some updates to reflect the subsurface mine/unit and any proposed wells/borings.

An appendix containing all borings within the WIPP Site boundary (surface holes only) was included in the Draft Compliance Certification Application (DCCA). This appendix will be updated, as appropriate, for use in the CCA and other relevant compliance submittals.

REFERENCES

Brinster, K. F., 1991, Preliminary Geohydrologic Conceptual Model of the Los Medaños Region Near the Waste Isolation Pilot Plant for the Purpose of Performance Assessment, SAND89-7147 SAIC Contractor Report, Sandia National Laboratories, Albuquerque, New Mexico.

LaVenue, A. M., A. Haug, and V. A. Kelly, 1988, Numerical simulation of Ground-Water Flow in the Culebra Dolomite at the Waste Isolation Pilot Plant (WIPP) Site: Second Interim Report, SAND88-7002, INTERA Technologies, Inc. Contractor Report, Sandia National Laboratories, Albuquerque, New Mexico.

Swift, P. N., B. L. Baker, K. Economy, J. W. Garner, J. C. Helton, and D. K. Rudeen, 1993, Incorporating Long-Term Climate Change in Performance Assessment for the Waste Isolation Pilot Plant, SAND93-2266, Sandia National Laboratories, Albuquerque, New Mexico.

EPA-21 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-9, second paragraph

The text states that the Bell Canyon's "long, sinuous

channels separated by siltstones were deposited via density currents that flowed into the deep basin from the Capitan Reef." However, sinuous sand channels within siltstone intervals can be created under numerous depositional environments, and the document should sight additional information supporting this depositional environment interpretation (e.g. Bouma sequences). Further, the document should discuss the occurrence of porous/permeable sandstones in the Bell Canyon immediately below the WIPP, as the occurrence of these sandstones determines whether they would be potential targets for future oil and gas exploration.

EPA-21 RESPONSE

The long, sinuous channels separated by siltstones' is a description of lateral heterogeneity in the Bell Canyon. These might be similar to the channels that develop in a surface-deposited alluvial fan sequence. The Bouma sequences the commentor referred to are descriptive of vertical heterogeneity within a single density current deposit. The long, sinuous channels may in fact be composed of Bouma sequences, but have lateral heterogeneity due to variation in the composition of the density flow, due to the origin of the flow and its physics.

Additional information supporting this depositional environment can be found in the USGS Water-Resources Investigation Report 83-4016. The channel sandstones are associated with oil and gas production in the Bell Canyon. The oil fields developed in the Bell Canyon do not occur in any pronounced structural feature that could account for a trap. Hence, the oil, gas, and water found in the Bell Canyon probably occur in these types of elongated channels.

The Bell Canyon is the uppermost unit of the Delaware Mountain Group. The entire group, which includes the Bell Canyon, Cherry Canyon, and Brushy Canyon, encompasses a gross interval of about 4,000 feet. The Delaware Mountain Group is the uppermost hydrocarbon bearing zone in the WIPP site area. The Lamar limestone, a limestone zone about 30 to 60 feet thick, forms a cap over the first pay sand, commonly referred to as the Ramsey sand in the uppermost part of the Bell Canyon.

REFERENCES

Mercer, J. W., *Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medanos Area, Southeastern New Mexico*, USGS Water-Resources Investigation Report 83-4016.

Keesey, J.J. of Sipes, Williamson & Aycock, Inc. Consulting Engineers, 1976, *Hydrocarbon Evaluation Proposed Southeastern New Mexico Radioactive Material Storage Site Eddy County, New Mexico*, SAND77-7033, Sandia National Laboratories, Albuquerque, New Mexico.

EPA-22 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-9 to 2-10

Other Documents indicate that oil and gas exploration is a critical consideration under the human intrusion scenario, yet little discussion of the specific geology of these potential reservoirs has apparently been evaluated. The text should be modified to discuss the Morrow Sandstones and Atoka Formation, which are oil/gas-bearing horizons immediately below/adjacent to the WIPP.

EPA-22 RESPONSE

The Lower Pennsylvanian Series include rocks assigned to the Morrowan stages. These rocks, which mark the initiation of a major transgression climaxing in the Virilian, attain a thickness of about 1,250 feet in the Permian Basin and wedge out northward in southeastern New Mexico (Meyer, 1968). The stages of Morrowan present in New Mexico occupy the smallest area and contain, in the central and northern portions of the Delaware Basin, the largest proportion of coarse clastic material of the Pennsylvanian section. The Morrowan rocks in New Mexico consist largely of limestone and shaley limestone where fine-grained sediments predominate (Bachman, 1975). In the Sacramento Mountains, at the northwest extent of the area, the basal Pennsylvanian strata was deposited on a surface with at least 100 feet of local relief. The lowest parts of this surface were filled with coarse sandstone or cobble conglomerates derived from Mississippian charts. The percentages of shales and dark limestone increase upward into the Atokan. Southward across the Guadalupe Mountains area of the

Northwest Shelf, the Morrowan consists of 230 to over 400 feet of fine to coarse-grained, poorly sorted, locally conglomeratic quartz sandstone, mottled medium gray oolitic limestone, and medium to dark gray shale. Fine-grained detrital sediments trend southeasterly from the Pedernal Uplift into the western Delaware Basin. The rocks of the Morrowan within the Delaware Basin consist largely of brown to gray argillaceous limestones and gray quartzose sandstones with dark gray to black shale (Nicholson and Clebsch, 1961; Bachman 1975). The Morrowan rocks near the WIPP site consist mostly of fine- to coarse-grained sandstones with varying amounts of dark shale. The Morrow sand is a known hydrocarbon producer of oil and gas in this part of the Delaware Basin, particularly from fields developed in the area north of the WIPP site.

The Early-Middle Pennsylvanian rocks, assigned to the Atokan (or Derryan) Stage, consist of dark-colored sandstones, shales, and limestones, which attain a maximum thickness of about 1,000 feet. These rocks were deposited over the entire area, with the exception of the Pedernal Uplift to the north (Meyer, 1968). Interbedded shales and dark limestones constitute the top of the 200- to 500-foot section of the lower Pennsylvanian Atokan deposition to the Sacramento Mountains (Pray, 1954). Southward into the northern Delaware Basin, the units consists of gray to brown and black, fine-grained to dense limestone and chert and dark gray to black shale with minor sandstone. In the southern Delaware and Val Verde Basins region, the Atokan rocks consist mainly of sandstones and shales in the lower part and carbonate rocks in the upper part, reaching about 1,000 feet in thickness (Vertrees et al., 1959). The top of the Atokan section is transitional and is placed at the change from dominantly terrigenous detrital rocks below to predominantly carbonates above (Bachman, 1975). The Atoka is considered to have locally significant hydrocarbon potential in the WIPP site area of the Delaware Basin, particularly in the Los Medanos field, which is southwest of and nearest to the WIPP site.

REFERENCES

Bachman, G. O., 1975 New Mexico: in McKee and Crosby, et al., *Paleotectonic Investigations of Pennsylvanian System in the United States*, U.S. Geological Survey Professional Paper 853L, pp. 233-244.

Meyer, R. F., *Geology of Pennsylvanian and Wolfcampian*

Rocks in Southeastern New Mexico (abs.): University of Kansas manuscript.

Nicholson, A., Jr., and A. Clebsch, Jr., 1961, *Geology and Ground-Water Conditions in Southern Lea County, New Mexico*: U.S. Geological Survey and New Mexico Bureau of Mines and Mineral Resources, Ground-Water Report 6.

Powers, D. W., S. J. Lambert, S. Shaffer, L. R. Hill, and W. D. Weart, 1978, *Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico*, SAND78-1596.

Pray, L. C., 1954, *Outline of the Stratigraphy and Structure of the Sacramento Mountain Escarpment: In Fifth Field Conference, Southeastern New Mexico*, New Mexico Geological Society, pp. 92-106.

Vertrees, C. D., C. H. Atchison, and G. L. Evans, 1959, *Paleozoic Geology of the Delaware and Val Verde Basins, in Geology of the Val Verde Basin and Field Trip Guidebook*: West Texas Geological Society, pp. 64-73.

EPA-23 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-10, last paragraph

The DOE should modify the document to discuss theories concerning the age and origin of brines within the Castile. Also discuss whether any ongoing studies are taking place or additional studies planned to assess and evaluate the occurrence of the potential brine below the WIPP panels.

EPA-23 RESPONSE

Theories have been proposed for the source and history of the brine reservoirs within the Castile by J. K. Register (TSC/D'Appolonia Consulting Engineers, Inc.). There are four theories presented by Register, which include the following: (1) reservoir brine represents original Permian Delaware Basin waters trapped during evaporite crystallization; (2) reservoir brine represents fluid responsible for dissolution and recrystallization of evaporite minerals early in the history of the evaporite sequence; (3) reservoir brine is primarily composed of fluids released during the transformation of primary gypsum to anhydrite during

burial of the evaporite strata; and (4) reservoir brine represents water from a Delaware Basin aquifer that has moved through and dissolved evaporitic salt. Tied to the origin and history of reservoir brines is the method of reservoir formation and fluid accumulation. Two prevalent theories for reservoir formation follow: (1) salt flowage forms anticlinal structures providing lower pressure environments for brine and (2) reservoirs are not isolated pockets, but are connected to aquifers or other reservoirs by a system of "conduits" (Register, 1981). Flow and pressure characteristics as well as brine chemistry of reservoirs are consistent with a fluid origin involving dissolution and recrystallization of evaporite minerals soon after initial deposition. These fluids probably remain trapped between low permeability beds of only slightly soluble sulfate phases until formation of salt flowage features, such as anticlines. As development of these features proceeded, fluids migrated down pressure gradient and formed pockets near the crests or axes of the anticlines.

The drilling histories of wells intersecting brine pockets indicate that in each case, either artesian flow of brine ceased without any attempt at control or flow was controlled by addition of heavy drilling mud. Some dilution of the mud was noted for a period after increasing the mud weight, but was halted, therefore, suggesting near depletion of the reservoir. This pattern or flow curve is that which is expected to be produced by a confined volume of gas-containing fluid, not a constantly recharged fracture opening.

Geochemical evidence also tends to preclude brine pocket connections with aquifers in the Delaware Basin. The $^{18}O/^{16}O$ and D/H ratios of the ERDA-6 brine water are markedly different from any of the aquifer fluids sampled in the Delaware Basin. Additionally, radioisotopes present in the ERDA-6 fluid were examined to determine the age of its origin. The plutonium concentration of the brine was found to be less than 10^{-9} ppm, corresponding to the lower limit of detectability for the analytical method employed. Based on the uranium isotope disequilibrium model, the minimum residence time of brine in the ERDA-6 occurrence is 570,000 years. A more realistic age, calculated by the same method, is 800,000 to 1,000,000 years (Barr et al., 1977). Thus, it is extremely doubtful that ERDA-6 brine represents water constantly replenished from an aquifer.

It is highly unlikely that brine in Castile Formation

reservoirs represents original Permian Delaware Basin waters or that fluid results form dehydration of gypsum to form anhydrite. Cl/Br ratios for Permian Basin water, if similar to those of modern sea water, were 285 to 295 (Collins, 1975). The Cl/Br ratios for two of the brines were 515 and 775, much higher than those expected for "original" Permian water. Since halite crystallizing from sea water excludes Be from the NaCl lattice, halite has a Cl/Br ratio greater than 300 (Adams, 1969), as would a brine resulting from dissolution of halite. Hence, the NaCl in the Permian brines has been dissolved from rocks, but not necessarily the rocks in which the brines were found (Lambert, 1978).

Most of the known brine occurrences in the WIPP site area are associated with the deformation front abutting the Capitan Reef. This zone is comprised of a series of flowage features in the evaporitic beds; these flowage features include anticlines and synclines. Of the occurrences associated with the deformation, all except one are located in known anticlinal structures. Occurrences outside the deformation front are also thought to be closely associated with anticlines. It is apparent that brine reservoirs occur in association with anticlines and the absence of such a structure would certainly lower the possibility of brine reservoir intersection by a drill hole.

Further, Popielak and others (1983) concluded that the brines originated from ancient seawater with no fluid contributions from present meteoric waters, based upon analysis of major and minor element concentrations in the brines. The gas and brine chemistries, and some isotopic compositions, are distinctly different for each reservoir, indicating isolation and a distinct origin for each reservoir (Beauheim et al., 1990).

There are no ongoing studies currently focused on the evaluation of potential brine pockets below the WIPP panels.

REFERENCES

Adams, S. S., 1969, *Bromine in the Salado Formation, Carlsbad Potash District, New Mexico*, New Mexico Bureau of Mines and Mineral Resources, Bull. 93, pp. 1-122.

Barr, G. E., S. J. Lambert, and J. A. Carter, 1977, *Uranium Isotope Disequilibrium in Groundwaters of Southern New Mexico and Implications Regarding Age-*

Dating of Waters, SAND77-1779, Sandia National Laboratories, pp. 1-3.

Beauheim, R. L., and R. M. Holt, 1990, "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico*, Geological Society of America 1990 Annual Meeting Field Trip #14 Guidebook, Dallas, Texas, Dallas Geological Society, pp. 131-179.

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Lambert, S. J., 1978, *The Geochemistry of Delaware Basin Groundwater*, New Mexico Bureau of Mines and Mineral Resources, Circ. 159, pp. 33-37.

Popielak, R. S., R. L. Beauheim, S. R. Black, W. E. Coons, C. T. Ellingson, and R. L. Olsen, 1983, *Brine Reservoirs in the Castile Formation, Southeastern New Mexico*, TME-3153, U.S. Department of Energy, Albuquerque, New Mexico.

Register, J. K., 1981, *Brine Pocket Occurrences in the Castile Formation, Southeastern New Mexico*, WSTD-TME-3080, U.S. Department of Energy.

EPA-24 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-10 to 2-11

The DOE should modify the document [the Compliance Status Report] to discuss deformation within the Salado Formation, i.e., where this deformation occurs, whether brine is associated with deformation features that may be present, and how (if) this deformation impacts the WIPP panels.

EPA-24 RESPONSE

Deformation within the Salado Formation is discussed under chapter 6 of the Compliance Status Report (pp. 6-9 to 6-10). Salt deformation was a site selection criterion, and the WIPP site was initially selected in part to try to avoid structural complications associated with brine reservoirs. No significant natural deformation is expected to occur at

the WIPP site over the period of regulatory concern. Thus, deformation is not expected to impact WIPP panels.

The Salado Formation also dips gently, about 1 degree, southeast in the vicinity of the repository (Jarolimek et al., 1983). The draft Compliance Status Report briefly describes this dip on page 2-10. The effects of dip, if important in PA, will be treated in compliance evaluations for the CCA and other relevant compliance submittals. The requisite level of justification will be provided as well, as appropriate.

REFERENCES

Powers, D. W., and B. W. Hassinger. 1985. "Synsedimentary Dissolution Pits in Halite of the Permian Salado Formation, Southeastern New Mexico," *Journal of Sedimentary Petrology*. Vol. 55, no. 5, 769-773.

Jarolimek, L., M. M. Timmer, and R. F. McKinney. 1983. *Geotechnical Activities in the Exploratory Shaft—Selection of the Facility Interval, Waste Isolation Pilot Plant (WIPP) Project, Southeastern New Mexico*. TME 3178. Albuquerque, NM: US DOE.

Westinghouse Electric Corporation. 1989. *Geotechnical Field Data and Analysis report, July 1987-June 1988, Volume II*. DOE/WIPP 89-009. Carlsbad, NM: US DOE.

Westinghouse Electric Corporation. 1990. *Geotechnical Field Data and Analysis Report, July 1988-June 1989. Volume II*. DOE/WIPP 90-006. Carlsbad, NM: US DOE.

EPA-25 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-10, last paragraph

"Geologic periods of time" should be defined, as this could mean anything from thousands to hundreds of millions of years. This is significant because the origin of these brines reflects hydrologic activities that have occurred within the Salado relative to groundwater flow and occurrence.

EPA-25 RESPONSE

The "Geologic periods of time" refers to time since the

Permian (i.e., 245 million years). The age and origin of the brine in the Salado is believed to be consistent with the age and origin of the Salado Formation.

REFERENCES

Register, J. K., 1981, *Brine Pocket Occurrences in the Castile Formation, Southeastern New Mexico*, WSTD-TME-3080, U.S. Department of Energy.

EPA-26 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-12, second paragraph

The document should discuss the origin of halite within the sandstone and siltstones of the unnamed Lower Member, discussing specifically when the halite may have been deposited. Alternatively, reference where in the document this is discussed. Also, discuss the depositional environment of the unnamed Lower Member, indicating whether the depositional environment could have created preferential permeable pathways (e.g. channels).

EPA-26 RESPONSE

The unnamed lower member of the Rustler Formation, as well as the entire Rustler Formation, contains the least quantity of rock salt and the largest proportion of clastic material in the Ochoan evaporite formations. The unnamed Lower Member was deposited in the last stages of the saline Permian sea that inundated the Delaware Basin, and is coextensive with the Salado Formation in the WIPP site area. The origin of the halite in the interbeds of the unnamed lower member were deposited by a series of saline seas in the ancient basin. Lacking a shield of carbonate reefs, the unnamed lower member was deposited by marine transgressions and episodes of isolation and evaporation in mud flat to halite pan environments. The subaqueous environments were probably not deep and were succeeded by very shallow pan environments with subaerial exposure.

The lithofacies indicate that the different units within the unnamed lower member were subjected to some degree of separation from the open ocean. With such a depositional environment, with no evidence of tidal or other high energy shoreline deposits, it is highly

unlikely that permeable pathways (e.g., channels) were created.

REFERENCES

Holt, R. M., and D. W. Powers, 1988, *Facies Variability and Post-Depositional Alteration within the Rustler Formation of the Waste Isolation Pilot Plant, Southeastern New Mexico*, DOE-WIPP-88-004, U.S. Department of Energy, Carlsbad, New Mexico.

Powers, D. W., and R. M. Holt, 1990, "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico*, Geological Society of America 1990 Annual Meeting Field Trip #14 Guidebook, Dallas, Texas, Dallas Geological Society, pp. 79-106.

Powers, D. W., S. J. Lambert, S. Shaffer, L. R. Hill, and W. D. Weart, 1978, *Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico*, SAND78-1596.

EPA-27 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-17 to 2-21

The document implies that fracture occurrence within the Culebra is not "regular," and that gypsum fracture filling can be gradual (coinciding with incremental opening of fractures) or more rapid (with passive crystal growth in fractures). Further, Figure 2-12 implies that some fractures may be open, with no infilling. It would be useful to provide additional detail about the occurrence of fracture porosity within the Culebra and the percentage of fracture fill. What is the origin of the 30% fracture fill immediately west of the WIPP panels shown in Figure 2-12, and what "kind" of fill occurs in this area (passive vs. incremental)? Does this apparently anomalous fill feature tell anything about localized flow within the fractures in this area, relative to timing of fracture occurrence and infill?

EPA-27 RESPONSE

The document does imply that fracture filling is not "regular." Fractures with incremental fillings

probably have had relatively small apertures and little groundwater flow through them throughout their history. Fracture fillings that are predominantly passive probably had relatively large groundwater flow through them before passive gypsum crystal growth.

Figure 2-12 does imply that some fractures may be open, with no filling. Much of the fracturing within the Culebra in the vicinity of the WIPP site can be attributed to unloading (Holt and Powers, 1988). Further, Culebra transmissivity is generally higher where there is less overburden, suggesting higher amounts of open fractures.

The Culebra Dolomite Member of the Rustler Formation is characterized by a high fracture porosity. Bedding plane fractures are predominant. In WIPP-19 drill core, the bedding plane fracture density varies from 3 to 8 per vertical foot below 764 feet depth, and 1 to 3 per vertical foot above 764 feet. Clay modes in fracture surface scrapings in dolomite rock range from about 1 percent to 43 percent, with an average of 18 percent. Additional detail about the occurrence of fracture porosity within the Culebra and the percentage of fracture filling can be found in SAND90-7019 report, *Characterization of Fracture Surfaces in Dolomite Rock, Culebra Dolomite Member, Rustler Formation*. Further information on fracture porosity is available in *Mineralogy of the Culebra Dolomite Member of the Rustler Formation*, SAND90-7008.

The origin of the 30 percent fracture fill can be related to the fracture porosity within the Culebra. This anomaly is perhaps related to increased groundwater flow due to higher fracture occurrence.

The apparently anomalous fill feature does show some features of localized flow within the fractures in this area. The flow features show any early incremental fillings in these fractures must have been dissolved at some time in the past, and the fractures may have had relatively large groundwater flow through them before passive crystal growth.

REFERENCES

Beauheim, R. L., and R. M. Holt, 1990, "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico*, Geological Society of America 1990 Annual Meeting Field Trip #14 Guidebook, Dallas, Texas, Dallas Geological Society, pp. 131-179.

Holt, R. M., and D. W. Powers, 1988, *Facies Variability and Post-Depositional Alteration Within the Rustler Formation of the Waste Isolation Pilot Plant, Southeastern New Mexico*, DOE-WIPP-88-004, U.S. Department of Energy, Carlsbad, New Mexico.

Sewards, T., M. L. Williams, and K. Keil, 1991, *Mineralogy of the Culebra Dolomite Member of the Rustler Formation*, UNM Contractor Report SAND90-7008, Sandia National Laboratories, Albuquerque, New Mexico.

Sewards, T., 1991, *Characterization of Fracture Surfaces in Dolomite Rock, Culebra Dolomite Member, Rustler Formation*, UNM Contractor Report SAND90-7019, Sandia National Laboratories, Albuquerque, New Mexico.

EPA-28 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-21, first and second paragraphs

The document implies that most fractures within the Culebra occur along pre-existing clay interbeds, and these interbeds are commonly composed of corrensite which may have a significant role in chemical retardation. Clarify whether it is believed that flow occurs primarily through these horizontal fractures rather than through vertical fractures. If most fractures originate in clay beds, then lateral continuity of these clay beds would enhance the ability to model flow through the Culebra. Are these clay linings restricted to subhorizontal fractures, where as gypsum lining occurs in fractures of different orientation? Was gypsum deposited on top of the clay, or was some formed (secondarily) and deposited upon pre-existing gypsum? Clarify the occurrence of clay vs. gypsum filling in fractures.

EPA-28 RESPONSE

Lines of evidence that have been used to deduce which fracture set is currently the active flow path include visual observations in the air intake and waste handling shafts, examination of post-depositional gypsum fill, and examination of a rust-coating (possibly iron oxyhydroxide) on fracture surfaces. Those observations support fluid flow in the sub-horizontal fractures as well as the high-angle fractures, and it is not clear which fracture set is currently the preferred groundwater flow path. It is not likely that the fluid flow path can be elucidated without substantial work. It may also be difficult to defend flow through a particular fracture set across the entire WIPP site because of the heterogeneity in the Culebra rock fabric.

One of the fractures sets observed in the Culebra is high-angle fractures (greater than 45 degrees form horizontal) and are not distinctly controlled by distribution of clay or other minerals. Detailed examination of core samples of the Culebra has shown that many of the high-angle fractures are filled to various extents with gypsum. Beauheim and Holt (1990, figure 2-13) demonstrated that the percentage of high-angle fractures that are filled with gypsum crystals increases eastward across the site. The presence of post-depositional gypsum fill indicates that groundwater has flowed through those high-angle fractures sets in the past, but the age of these fillings is not known.

Fractures in the Culebra can be divided into two categories based on their orientation. One category includes those caused by parting along the sub-horizontal oriented planes of relative weakness in the rock resulting from the concentrations of clay minerals at bedding planes. Sub-horizontal fractures, therefore, have relatively greater concentration of clay minerals adjacent to them. There is typically not a discrete clay mineral layer (i.e., clay lining) that uniformly coats the surface of the fractures. Most of the clay minerals in the Culebra are detrital in origin, deposited along bedding planes while the evaporite minerals, such as dolomite, were forming. The clay minerals are concentrated in discontinuous lenses or are present as anastomosing networks, but are generally concentrated along sub-horizontal planes.

REFERENCE

Beauheim, R. L., and R. M. Holt. 1990. "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico, Field Trip #14 Guidebook, Geological Society of America 1990 Annual Meeting, Dallas TX, October 29-November 1, 1990.* Leaders: D. W. Powers, R. M. Holt, R. L. Beauheim, and N. Rempe. SAND90-2035J. Dallas, Texas. Dallas Geological Society, pp.131-179.

EPA-29 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-22, third paragraph

The Magenta has hydraulic conductivities similar to that of the Culebra, but the text does not discuss whether data indicate that fractures exist in the Magenta or what the fracture porosity is. While the focus of the studies has been the Culebra, it may not be sufficient to concentrate on this horizon only. For example, if a release were to occur from the WIPP in an area of the Culebra where vertical interconnection of the Magenta and the Culebra exists (i.e. in an area where post-depositional fracturing has occurred due to dissolution of the Salado and/or the Rustler), then contaminants could flow directly to the Magenta with little dispersion/diffusion within the Culebra. This possibility cannot be properly modeled unless the hydraulic characteristics of the Magenta are known and understood.

EPA-29 RESPONSE

Porosity within the Magenta is primarily intergranular and formed by the dissolution of gypsum. In those areas which originally contained abundant clastic gypsum, small open vugs have developed. Fracture porosity is less common, and the fractures are often filled with gypsum. Disruption and fracturing from unloading and dissolution have apparently been less effective in the Magenta than in the Culebra. The effects of the fracturing resulting from the halite removal on the hydraulic properties of the Magenta are not as pronounced as in the Culebra.

REFERENCES

Beauheim, R. L., and R. M. Holt, 1990, "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico*, Geological Society of America 1990 Annual Meeting Field Trip #14 Guidebook, Dallas, Texas, Dallas Geological Society, pp. 131-179.

Holt, R. M., D. W. Powers, R. L. Beauheim, and M. E. Crawley, 1990, *Conceptual Hydrogeological Model of the Rustler Formation in the Vicinity of the Waste Isolation Pilot Plant Site, Southeastern New Mexico*, SAND89-0862, Sandia National Laboratories, Albq. NM

Mercer, J. W., *Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medanos Area, Southeastern New Mexico*, USGS Water-Resources Investigation Report 83-4016.

EPA-30 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-23

The Magenta and other units overlying the Culebra are considered by DOE to be of little importance relative to contaminant migration, although vertical flow through these units may be important relative to recharge of the Rustler. The document provides little detail concerning the occurrence of low permeability vs. higher permeability areas within the overlying units (See Chapter 6.0 comments for additional commentary on this issue). Further, data are available to indicate that the supra-Rustler bed(s) may contain significant quantities of water locally, and are used as livestock water supply source in the immediate vicinity of the WIPP.

EPA-30 RESPONSE

Hydraulic tests for the Magenta in the WIPP site area were conducted in seven test holes and transmissivity values from these tests ranged from 4×10^{-3} ft^2/day to 3×10^{-1} ft^2/day. Hydraulic tests from the regional test holes south of the site showed the transmissivity ranged from 6×10^{-3} ft^2/day to 1.0 ft^2/day (Mercer, 1983; Beauheim, 1986, 1987). The two highest values of Magenta transmissivity, 375 and 53 ft^2/day, are found

in Nash Draw at WIPP-25 and WIPP-27, respectively, where dissolution of the Upper Salado has caused collapse and fracturing of the overlying Rustler.

Beauheim and Holt (1990) supplied additional information on water bearing zones within the Dewey Lake Formation. Water has been encountered within the Dewey Lake Formation at several drillholes near the southern WIPP site boundary, and several stock wells south of the WIPP site are possibly completed in the upper Dewey Lake Formation. Just east of this area there is an extensive, thick, active area of sand dunes, which could be a recharge area for these water-bearing sand units. Westinghouse's Water Quality Monitoring program recently drilled WQSP 6 as a Culebra test in Section S29, T22S, R31E. During the drilling of this well, a water source was encountered at a depth of 182 feet to 208 feet (i.e., Dewey Lake Formation); after pressurized testing for 15 minutes, an estimated discharge of 30 gallons per minute was observed.

REFERENCES

Beauheim, R. L., and R. M. Holt, 1990, "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico*, Geological Society of America 1990 Annual Meeting Field Trip #14 Guidebook, Dallas, Texas, Dallas Geological Society, pp. 131-179.

Holt, R. M., D. W. Powers, R. L. Beauheim, and M. E. Crawley, 1990, *Conceptual Hydrogeological Model of the Rustler Formation in the Vicinity of the Waste Isolation Pilot Plant Site, Southeastern New Mexico*, SAND89-0862, Sandia National Laboratories, Albuquerque, New Mexico.

Mercer, J. W., *Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medanos Area, Southeastern New Mexico*, USGS Water-Resources Investigation Report 83-4016.

EPA-31 **COMMENT**

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-25 to 2-26

While the Culebra may be the most permeable unit overall, portions of other units can be locally more

permeable. This possibility should be discussed. The DOE should address specifically where the other four fracture formation mechanisms have taken place (discussed on page 2-17), and how these mechanisms affect porosity/permeability distribution within the Culebra. In at least one location, the position of the water table in the Dewey Lake Red Beds Formation is known. Are there any other locations?

EPA-31 RESPONSE

Although it is possible that locally other units can be more permeable than the Culebra, this has not been observed. In general, the second-most permeable unit, the Magenta, is at least one order of magnitude less permeable than the Culebra. Because the area of interest for flow is regional due to the scale of the site, the effects of a possible higher permeability in units other than the Culebra is not important, because if this occurred, the local higher permeability would be isolated by less transmissive zones, and the regional effect would be slight. The Culebra is the regionally most transmissive unit, and the dominance of the Culebra flow system in Performance Assessment analyses is supported out by the experimental data collected and the scale of the flow systems modeled in PA.

EPA-32 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-26, first full paragraph

The document should discuss if, under current flow conditions, there is an upward or downward head between various water-bearing formations and what the resulting potential is for vertical groundwater flow between various supra-Salado intervals (i.e. Magenta and Culebra).

EPA-32 RESPONSE

In general, Magenta hydraulic heads are not equal to the underlying Culebra heads near the site. This indicates the potential for vertical flow. At the site, Magenta heads are greater than Culebra heads, indicating that flow to the Culebra from the Magenta is possible. West of the site, approaching Nash Draw, the heads in the Magenta become increasingly equal to those in the Culebra, indicating less and less potential for

vertical flow approaching Nash Draw. The flow rate between the Magenta and Culebra at the WIPP site is likely low due to the low permeability of the intervening aquitard; however, even low vertical flow rates can lead to large fluxes when integrated over large areas. Evaluating the effect of vertical flow is one component of the ongoing 3D regional flow studies.

EPA-33 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-30, second paragraph

The document presents the groundwater basin and confined aquifer models that have been (or will be) used to model groundwater flow in the supra-Salado units. The discussion describes the principles, constraints, and advantages of each, and indicates that physical retardation in the Culebra via diffusive loss into the matrix is expected to be significant, but does not elaborate upon this presumption more thoroughly. This is important because previous discussions indicated that fractures are lined with clay, which would significantly decrease the potential for diffusion (while increasing the potential for sorption), although gypsum lining of fractures would impede both diffusion and sorption. The discussion should provide additional detail concerning the affect of clay lining within fractures as it relates to fracture fill and diffusion.

EPA-33 RESPONSE

Parameters governing the use of diffusive loss in the Culebra are derived from in-situ tracer tests that have been conducted, and therefore represent the actual physical system present in the Culebra. The cumulative effects of gypsum, clay, fracture spacing, and all other geometrical and compositional factors in the tested area, as they relate to the tracer used, are present in the test results, and thus these tests are the best indicator of future performance of the system through which contaminants might pass.

EPA-34 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-33, second and third paragraphs

More detail is needed as to whether or not hydrochemical facies may be affected by groundwater flow within the Culebra. Are these facies affected by the occurrence of gypsum fracture filling? Is the variable chemistry of Zone C affected by the overall higher hydraulic conductivity of the Culebra in this area and/or potential fresher water infiltration?

EPA-34 RESPONSE

The major solute composition of groundwater in the Culebra Dolomite Member varies spatially in the vicinity of the WIPP site and can be described in terms of hydrochemical facies. Siegel et al. (1991a) present the most recent delineation of these facies. Potentiometric data indicate that current-day flow lines cross facies boundaries and that, in places, flow occurs from saline (about 3 molal) NaCl waters to more dilute (less than 0.1 molal) $CaSO_4$ type waters. The EEG pointed out that a satisfactory explanation for this change in water chemistry along proposed flow lines had not been presented as of 1985 (Neill et al., 1983; Ramey, 1985). In response to this observation, several studies have been performed to address this issue. A detailed review of that work would not add to existing published reviews (refer to Lappin, 1988; Lappin et al., 1989, sections 3.3.2 and 3.3.3; WIPP Performance Assessment Division, 1992, volume 2, section 2.2.3.6; U.S. Department of Energy, 1994, section 2.2.2). The most recently completed and published body of work on this topic used results from interpretations based on an extensive compilation of lateral changes in isotopic (stable and radiogenic) ratios of Culebra rock, mineral, and groundwater; solute (major and minor ions) concentrations in Culebra groundwater; and the mineralogy of the Culebra (Lambert, 1987; Lambert and Carter, 1987; Lambert and Harvey, 1987; Bodine et al., 1991; Siegel and Lambert, 1991; Siegel et al., 1991b; Lambert, 1991, 1992; Siegel and Anderholm, 1994). A concise summary of that work can be found in Siegel et al. (1991a, pages ES-1 to ES-5). The objective of the following discussion is only to provide a brief review of the results of some of the more extensive regional geochemistry investigations, and the interpretations that those authors made.

One conceptual model for the relationship between the facies distribution and the flow paths has been proposed by Chapman (1986, 1988). She coupled an extensive compilation of stable and radiogenic isotope ratios of Rustler Formation groundwaters with isotopic data from regional groundwaters and surficial waters. Chapman cited evidence for short residence times of Culebra groundwaters and postulated that recharge from the surface could account for the less concentrated groundwaters south of the WIPP Site. That explanation, however, is not supported by interpretations of isotopic and solute data presented by Lambert, Siegel, and others. Specifically, radiogenic isotopic signatures suggest that the age of the groundwater in the Culebra is on the order of tens of thousands of years (Lambert, 1987; Lambert and Carter, 1987; Lambert and Harvey, 1987). An alternative conceptual model was put forth by Siegel et al. (1991a, and references therein). Those authors contend that there has been a change in the location and amount of recharge since the last glacial maximum and that the present distribution of solutes and isotopes in the Culebra is a relict of a flow regime of a wetter climate, in which the recharge area was in the vicinity of Nash Draw resulting in an eastward paleo-flow direction. The current distribution of hydrogeochemical facies according to this interpretation, therefore, represents a rock-water system that is still slowly reaching a new chemical and physical equilibrium.

Currently, the issue of the relationship between water chemistry and groundwater flow in the Culebra remains unresolved. It is possible that the lack of resolution reflects the way the problem has been posed. Previous discussions, for example, have focused on flow directions but not flow rates. Computer models of flow in the Culebra suggest that flow rates are orders of magnitude slower in the region of the NaCl facies than in the region of the $CaSO_4$ facies (see for example, Lavenue et al., 1990). It is possible that the geochemical signature of flow from the NaCl facies to the CaSO4 facies is not observed because only minute amounts of water flow along this path. In addition, some of the previous studies have not considered, or have ruled out, transport of solutes from units above and below the Culebra. For example, the region of the NaCl facies correlates well with the extent of halite in strata above and below the Culebra. The possibility that the NaCl facies results from vertical advective or diffusive transport into a region of extremely slow flow in the Culebra has not been investigated in depth. Preliminary results of three-dimensional calculations

using the groundwater basin approach suggest that it will be helpful in addressing these issues to treat the hydrology as three-dimensional, transient system. The DOE will address this issue, as appropriate, in the process of developing final PA for the CCA. An adequate understanding of the Rustler, for the purpose of demonstrating adequate repository performance, will be described and justified in the CCA and other compliance submittals, as appropriate.

EPA-35 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-35 to 2-37

The document should describe the specific rock-water interactions involving a large rock/water ratio. Also, please clarify whether Figure 2-17 presents all data available for the Culebra; this figure shows approximately 20 Culebra data points, but it is unclear where these data were collected (within WIPP or elsewhere), or if these data are representative of all data available for the Culebra within the WIPP site and immediate area.

Also, the document should provide additional discussion of the Chapman hypothesis, including a brief discussion of the data she used to generate her hypothesis and how other data support/refute this hypothesis.

EPA-35 RESPONSE

The Rustler-Salado contact zone is a region in which rock/water ratios are high due to extensive reaction, primarily dissolution, of evaporite minerals by circulating groundwater; due to slow flow rates relative to the Culebra and Magenta members, the contact-zone has ample time for groundwater chemistry to reflect high rock/water ratios.

EPA-36 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-37, second paragraph

It is unclear as to what is referred to by "other analyzed waters." How were these waters determined to be "contaminated." Also, please indicate whether or not there are any spatial relationships between these two

categories of waters.

EPA-36 RESPONSE

Lambert, reported in Siegel et al., 1991 (SAND88-0196), described sampling methods and analysis for carbon isotopes for samples taken from the Rustler Formation and the Dewey Lake. The analysis included 21 samples from 16 boreholes, with several boreholes sampled twice. Carbon isotopic analysis is extremely sensitive to contamination with modern organic carbon, which can be introduced at depth through previously-developed water supply wells in the minuscule quantities which will contaminate a sample. Analysis of the samples revealed that 17 of 21 samples likely were contaminated enough by modern carbon to be unuseful for groundwater dating. The remaining four samples, three from the Culebra and one from the Dewey Lake, indicated that the waters analyzed had been isolated from atmospheric carbon for greater than 13,000 years; i.e., in groundwater circulation for at least 13,000 years.

EPA-37 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-37, second paragraph

The DOE should discuss the presence or absence of tritium in Culebra groundwaters beyond an interpolation from data obtained from Ogallala groundwaters.

EPA-37 RESPONSE

Lambert, reported in Siegel et al., 1991 (SAND88-0196), reported seven tritium analyses conducted on six Rustler samples and one Dewey Lake sample. One sample from the Rustler Formation in Nash Draw had a tritium concentration of 7 TU. In regions east of Nash Draw, one sample had 3 TU's, and five samples had less than 0.3 TU's. For this region, these values indicate no significant modern recharge component. Tritium analysis cannot be used to verify old groundwater, only to confirm modern recharge. A significant modern component (post-1950) in the groundwater would result in tritium concentrations of greater than 20 TU.

EPA-38 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-37, last paragraph

The document indicates that the strontium-87 to strontium-86 ratios increase upsection, and that this is indicative of the increased amount of seawater present within rocks at the time of deposition. However, examination of Figure 2-18 shows that in some instances, the Culebra ratio is nearly equivalent to that of "spring gypsite." Also, these ratios could be representative of post depositional alteration as well as syndepositional ratio development. Are there any additional supporting arguments for the interpretation presented in the document concerning strontium ratios.

EPA-38 RESPONSE

The text should have stated "This systematic increase partially reflects the increase in this ratio in seawater at the time these rocks were deposited." The follow-on paragraph, page 2-38, described the evidence for post-depositional alteration of these ratios by moving groundwaters.

EPA-39 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-39, third and fourth paragraphs

The uranium 234/238 isotope ratio discussion does not include detail relative to how the data was acquired, or even the precise location of data points. Further, while data indicate that overall recharge to the Rustler is minimal, the information presented in the document does not unilaterally support the contention that the Rustler Formation has not received recharge for the past 10,000 years. Further, the statement that the direction of present-day flow is not consistent with dissolved solids is not supported. (The document does specifically state that the conceptual model for geochemistry is considered to be tentative because there are alternative hydrologic inferences that can be drawn from the geochemical data although the text of the document does not adequately discuss these alternative hypothesis).

EPA-39 RESPONSE

Lambert and Carter, 1987, (SAND87-0388), discuss the sampling methods and other detail about the uranium isotopic evaluation program.

The Rustler Formation is not thought to not have received recharge in the last 10,000 years; rather, the residence time of the groundwater sampled has been 10,000 years; i.e., the amount of time it took for the sampled water to move from a place where it was in contact with the atmosphere to the position in which it was sampled.

The dissolved solids content of the Rustler and the flow directions of the water are consistent, although the present-day pattern may not be steady-state, but rather continuously changing. The distribution of dissolved solids in the Rustler is affected by many things, including present and past flow directions, fluxes, and velocities, the distribution of soluble mineralogy in the Rustler (evaporites, mainly), vertical flow between evaporite-rich, low permeability horizons of the Rustler and the Magenta and Culebra, and mixing between solute-rich waters and solute-poor waters where these two waters meet. Solute rich regions of the Magenta and Culebra are generally associated with the low-velocity groundwater flow and regions in which the intervening members (unnamed lower member, Tamarisk, and Forty-niner) are evaporite-mineral rich.

EPA-40 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-40 and 2-41

This section discusses hydrologic properties of the Salado, which are critical to the overall no-migration demonstration. Yet it does not appear that the methodology for fully evaluating pressure within the halite has been determined. Also, it is unclear from the discussion which "abnormal pressure" scenario is being advocated for the Salado. It would appear that the Salado is hydraulically isolated, but also has intrinsically low permeability which contributes to its overall condition.

EPA-40 RESPONSE

Natural fluid pressures in the undisturbed, stressed portions of the Castile and Salado formations cannot be accurately measured with present-day technology. What can be accurately measured are fluid pressures from sampled regions where stress has been decreased due to the excavation necessary for sampling. As the referenced section points out, fluid pressures from these sampled regions can be assumed to be a lower bound of the natural pressure.

Since 10,000 years is the relevant period of geologic time used in WIPP performance assessment, it makes no difference whether abnormal fluid pressures are explained on the basis of the hydraulically isolated-rock scenario or the geologically transient-phenomenon theory. Assuming for the moment that the geologically transient-phenomenon theory is correct and that abnormal pressures would degrade over geologic time, 10,000 years is an insignificant period of geologic time to appreciably reduce such abnormal pressures. Thus, under either theory, abnormal fluid pressures would remain substantially unchanged during the 10,000-year compliance period.

EPA-41 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-42, first and second paragraphs

The text indicates that brine pockets within the Castile Formation are limited in extent, and brine is thought to be stored in low-permeability microfractures (about five percent is stored in large open fractures). Although gravity surveys have been performed in the area of the WIPP which show the magnetic anomalies associated with the Castile disturbed zone, have high resolution seismic data been collected/processed in this specific area? These kind of data may be helpful in determining if the magnetic anomalies contain fluid, since DOE contends that not all magnetic anomalies are representative of brine pockets, but all brine pockets are associated with these anomalies.

EPA-41 RESPONSE

Seismic data have been collected for the WIPP site; however, these data are less informative and/or ambiguous with respect to brine reservoirs. The brine

reservoirs may be areas of significantly increased permeability due to fracturing, but are not necessarily areas of significantly increased porosity. The 'magnetic anomalies' referred to in the comment are not anomalies detected by a gravity survey, but rather anomalies detected by electromagnetic means, which are sensitive to conductors at depth such as might be created by a fractured region.

EPA-42 COMMENT

CHAPTER 2—SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-43, last paragraph

The text indicates that data are not consistent relative to the hydraulic heads within the Bell Canyon. However, it is unclear from the text whether lateral lithologic variations could significantly contribute to this inconsistency (see comment No. 3). It is possible that the Bell Canyon fluids (presumably undersaturated relative to Na, Cl, Ca, S04) could dissolve intervening evaporate beds, thus modifying the density (and head) so that these newly-saturated brines would not reach the surface. However, this implies that fluids would be present adjacent to the evaporite beds for a sufficient amount of time to allow for chemical equilibrium (or significant dissolution) to take place, which would not have the opportunity to occur if the Bell Canyon was "instantaneously" punctured. Clarify how this information was used when evaluating the human intrusion effects.

EPA-42 RESPONSE

Human-intrusion effects are evaluated for the Castile formation rather than the Bell Canyon, for the following reasons: Castile brine reservoirs are more permeable, and higher pressured, than the Bell Canyon (the Bell Canyon has moderate permeability, compared to brine reservoirs, the Culebra, Magenta, and Salado). Neither of the two possible mechanisms for upward flow in a borehole intersecting the Bell Canyon are likely to result in releases. In the first mechanism, the Bell Canyon borehole fluids are able to contact waste or waste fluids, and thereby Salado evaporites, due to degradation of the borehole in the Salado formation. In this case, the density of the upward fluid would rapidly increase and the borehole head would equalize with the Bell Canyon head, forcing flow to stop. In the second case, the borehole casing remains intact

through the Salado, prevents Bell Canyon fluid from contacting waste, and therefore upward flow of Bell Canyon fluid will be inconsequential.

EPA-43 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Pages 2-43 to 2-44

The EEG has prepared a map showing producing oil/gas wells, proposed locations, etc., but it is very different from Figure 2-19 in terms of well locations and well status. Please clarify these discrepancies within the text of the document. Further, the map should be modified to display producing horizons, as this would clarify the potential for production within some intervals below WIPP.

EPA-43 RESPONSE

A detailed map showing producing oil/gas wells in the vicinity of the WIPP site will be included in the compliance application along with available information on the producing horizons. This map will include locations of holes that have been approved for drilling. Locations that have been denied will not be shown.

EPA-44 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-49, first full paragraph

The DOE should address how they plan to model climate change. In addition, the DOE should address the potential erosive impact of climate change on the rock column.

EPA-44 RESPONSE

The events and processes associated with climate changes have been reconsidered in the current scenario screening work. It is correct to assume the potential climate change. However, even assuming climatic changes during the next 10,000 years equivalent to the most extreme climate of the last two million years (an improbable assumption), none of the events and processes will effect disposal system performance. Arguments supporting these assertions will be provided for review with the documentation of the scenario

development work.

EPA-45 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-51, first paragraph

The DOE should define the specific site conditions that combine to "inhibit recharge and hence, future dissolution of the geologic units above the Salado Formation." Also, please discuss the 1993 Rattlesnake Canyon seismic event, the origin of this activity (i.e. relationship to secondary recovery techniques for hydrocarbons), and impact it had on the WIPP.

EPA-45 RESPONSE

Chapter 6 of the DCCA, provides pertinent information relative to site conditions that combine to "inhibit recharge and hence, future dissolution of the geologic units above the Salado Formation.

An earthquake of 5.0 on the Richter scale occurred in Rattlesnake Canyon on January 2, 1992. It occurred above or within a large buried north-south oriented structure called the Central Basin Platform. The seismic history of this structure suggests events of a magnitude of 5.0 might be expected from time to time along its entire length. Prior to January 2, 1992 most seismic events occurred 40 to 60 km south of the Rattlesnake Canyon earthquake epicenter located midway between Eunice and Jal, New Mexico and about 3 km. east of the highway connecting these communities.

It has been suggested that the Rattlesnake Canyon earthquake may have been related to secondary oil recovery operation, however, this supposition has not been proven. The more important question is what were the WIPP specific consequences? This earthquake had no impact on the WIPP. Relevant discussion can be found in the DCCA.

EPA-46 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-52, first paragraph

Previous sections of the document indicate that a Castile Formation deformation feature occurs within the WIPP boundary and below the repository itself, but this

section implies that no structural features (within the Castile) have been identified within the WIPP site.

EPA-46 RESPONSE

The DOE did not intend to imply that there are no Castile Formation deformation features identified within the WIPP site. The intent of this section was to demonstrate that deformation similar to what has occurred in the Castile has not occurred in the Salado. Further, the deformation that has occurred in the Castile has not affected the Salado at the WIPP site.

EPA-47 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-52, third paragraph

Gas generation/transport is a critical element relative to volatile organic compounds that may be present in TRU-mixed waste, and should be included in any gas generation assessments. The document indicates that gas generation will preclude inflow of brine that could, in turn, inhibit further generation. However, alternative scenarios have been presented which indicate that permeability of the Salado (or interbeds) may be sufficient to allow brine inflow so that more gas would be generated. The DOE should discuss the spectrum of conceptual models for the effect of gas generation on the performance of the WIPP repository, and indicate why some alternatives have apparently been rejected.

EPA-47 RESPONSE

Scenario development and scenario screening in PA are well documented processes. These processes will be used in compliance evaluations to arrive at a prediction of expected repository performance based on reasonable conceptual models. Scenarios and concepts such as the alternatives you identify will be included. The results will be documented and justified in the CCA and other relevant compliance submittals, as appropriate.

EPA-48 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-53, first paragraph

The DOE should define how gas generation affects the

chemical behavior of radionuclides, and whether this could also affect hazardous constituents in the waste. Also, are there plans to acquire WIPP-specific threshold pressure data? Please explain why tight gas sands are the closest analog; other geologic units (that have very low permeability, such as oil shales) may offer better analogs.

EPA-48 RESPONSE

1. DOE/WIPP 94-008, Revision 0, in section 5.3 outlines four activities designed to provide information about waste interaction within the disposal room. These activities include; the evaluation of gas generation and consumption characteristics of the emplaced waste, the evaluation of concentrations of radionuclides expected in disposal-room brine, the evaluation of waste characterization results for the WIPP radionuclide and waste inventories, and the evaluation of waste characterization information to determine the types and amounts of hazardous materials in the waste, and through testing, determine solubilities of inorganic and organic waste constituents.

2. The Gas Generation Program is addressing these uncertainties. The first step is to determine if the uncertainty either directly or indirectly has a significant impact on performance. Treatment of uncertainties found to be important can then be accomplished through sampling within ranges for imprecisely known variables, making conservative modeling assumptions, and/or acquisition of additional data/information through experimental activities or other methods. Alternative conceptual models will be handled the same way.

3. Two-phase characteristics of salt (capillary pressure, relative permeability) have not been measured experimentally for WIPP-specific materials. An approximate analog approach was taken, based on the lowest permeability rock for which capillary pressure and relative permeability data have actually been measured. A tight gas sand core (Sample MWX 67-35) from the multi-well experiment (Morrow et al., 1986) was selected as the best available analog material. This sample is a fine-grained sandstone with bedding and 12 percent porosity. The dominant pore geometry consists of intergranular cracks between abutting quartz grains and solution pores partially filled

with dolomite. The permeability of this sample to brine is 43 microdarcies (~43. x 10^{-18} m^2) at 3.4 MPa confining pressure and 24 microdarcies (~24. x 10^{-18} m^2) at 34MPa confining pressure. Based on these results, and a study of threshold pressure (Davies, 1991), two-phase flow in pure or impure halite units is not anticipated. Two-phase flow is therefore confined in PA to the various anhydrite marker beds within the Salado Formation, making the selection of two-phase properties in the halite units (except for threshold pressure) unimportant.

REFERENCES

Morrow, N.R., J.S. Ward, and K.R. Brower. 1986. "Rock Matrix and Fracture Analysis of Flow in Western Tight Gas Sands," *1985 Annual Report, New Mexico Institute of Mining and Technology*. DOE/MC/21179-2032

Davies, P.B. 1991. *Evaluation of the Role of Threshold Pressure in Controlling Flow of Waste-Generated Gas into Bedded Salt of the Waste Isolation Pilot Plant*. Sand90-3246. Albuquerque, NM: Sandia National Laboratories.

EPA-49 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-53, first paragraph

It would be useful to include provisions assessing the effects of gas generation associated with hazardous waste constituents.

EPA-49 RESPONSE

The quantities of hazardous waste constituents that exist in the waste are insignificant compared to those materials that are expected to generate gas. These effects will not be assessed, but will be treated for through conservatism in modeling assumptions with respect to the RCRA source term, transport pathways, and the driving forces associated with transport mechanisms.

EPA-50 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-55, second full paragraph

Please explain how the pore structure of the anhydrite/salt affects two-phase characteristics and, hence, gas and brine flow (e.g. impact that surface area of pore space would have on residual saturation).

EPA-50 RESPONSE

As discussed in the response to EPA-48, two-phase flow in the Salado salt appears unimportant in PA except with regard to threshold pressure in the anhydrite. This is being investigated and will be managed as appropriate in PA for the CCA and other relevant compliance submittals.

EPA-51 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-57, first full paragraph

Please discuss the pros and cons of each of the halite models, and state whether data collected to date support one model more than other. Also, stratification of liquid and gas phases can occur when solubility of the gas is exceeded within the liquid, but this is highly dependant upon pressure within the system. What are the bounding assumptions concerning gas/brine stratification?

EPA-51 RESPONSE

These topics have been included in relevant portions of the DCCA.

EPA-52 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-60, first paragraph

The document indicates that pressurization of rooms could ultimately result in the creation of horizontal fractures, but the possibility of vertical fracture generation should be discussed because these could serve as conduits to more permeable beds (i.e. marker beds).

EPA-52 RESPONSE

The justification for not including vertical crack development is provided in Section 5.2.1.1, pages 5-23 to 5-27 in Butcher and Mendenhall (1993).

REFERENCE

Butcher, B.M., and F.T. Mendenhall. 1993. *A Summary of the Models Used for the Mechanical Response of Disposal Rooms in the Waste Isolation Pilot Plant with Regard to Compliance with 40 CFR 191, Subpart B.* Sand92-0427. Albuquerque, NM: Sandia National Laboratories.

EPA-53 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-61, second paragraph

The document indicates that the current model for compaction is for "as received" waste, and goes on to indicate that prediction of waste form changes cannot be made because of waste form uncertainties relative to time. The text then implies that reprocessing of the waste is desirable. Please clarify the nature of reprocessing suggested (e.g. supercompaction or specific repackaging of materials in drums or bins).

EPA-53 RESPONSE

Reprocessing as discussed here, is not specific with regard to methodology. The intent of this text was to indicate that any method of reducing waste porosity in a manner that removes or significantly reduces PA related uncertainty is desirable.

EPA-54 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-63 and 2-64

The DOE should provide a discussion regarding the estimated extent of the fracture process zone (FPZ) and the latter's interrelationship with the DRZ.

EPA-54 RESPONSE

The fracture process zone will be discussed, as appropriate, in the CCA and other relevant compliance

submittals.

EPA-55 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-66, paragraphs one through four

The document indicates that fracture generation and propagation are of concern, but should discuss whether fracture propagation in existing fractures (in the DRZ and elsewhere) were evaluated. Fracture opening, propagation, and generation pressures can be distinctly different, and could play different roles through the course of gas generation in the repository. Also, provide a time frame for evaluation of the "alternative conceptual model."

EPA-55 RESPONSE

This PA discussion has been revised and was included in the DCCA.

EPA-56 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-69, third full paragraph

Please define what is meant by "vertical structure within the Salado Formation resulting from the presence of the repository."

EPA-56 RESPONSE

The statement was designed to identify the possibility for vertical flow paths that were not otherwise specifically identified or defined within the paragraph. The issue has since been determined inconsequential and is therefore not an issue in the DCCA.

EPA-57 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-70, Paragraph one

The document states that "Persistence of the DRZ near the repository horizon and/or relatively permeable boreholes drilled from within the horizon may increase the effective thickness of the repository horizon

(emphasis added) by interconnecting it with adjacent stratigraphic zones." Explain, specifically, which adjacent stratigraphic zones the DRZ may interconnect. Note, the 1992 PA assumes a constant DRZ thickness and provides no supporting data to verify the environmental impact of a thicker DRZ that breaches the upper Salado boundary.

EPA-57 RESPONSE

This PA discussion has been revised and was included in the DCCA.

EPA-58 COMMENT

CHAPTER 2 SITE DESCRIPTION/SITE CHARACTERIZATION

Page 2-70, last paragraph

The document states that fractures can propagate to land surface in association with mining activities. This fracture generation must be relatively rapid (i.e. no greater that 50 years) because the effects are currently visible. How were these fractures detected? What effect did these fractures have on the mined structure below? Did they serve as fluid conduits even for a short period of time prior to sealing? Clarification of these issues is needed because the release scenarios do not account for occurrence of these fractures, unless these are the "vertical structures" discussed in comment No.42, above.

EPA-58 RESPONSE

The topic of subsidence due to potash mining is addressed in the Non-Salado Transport Position paper. It concludes that the effects are not expected to be significant to long-term repository performance.

EPA-59 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

The DOE will have to make a much stronger case for passive institutional controls than any presented to date in order for the EPA to certify any numerical credit factored into the disposal system performance predictions.

EPA-59 RESPONSE

The DOE understands that for numerical credit taken for

passive institutional controls adequate justification must be provided. Justification for use of Expert Judgement is provided by 40 CFR 191, Appendix B. Expert judgement is factored into the predictions of PA

Without guidance from the EPA as to a future that should be assumed, and using EPA guidance in Appendix B of 40 CFR 191 for calculations involving human intrusion, performance assessments for the WIPP have addressed this issue. In light of the importance of human intrusion in performance-assessment calculations the DOE deemed it appropriate for the WIPP to consider the input of individuals (independent of the Project) whose experience and expertise included examining human actions, history, trends, applicable technology, etc. Without these outside, independent judgments, assumptions made in PA might have been called into question. This was done to ensure that judgments were objective with respect to compliance. While the expert judgment process was undertaken to address human intrusion in the most adequate means practicable, it was done so with the knowledge that any attempt to predict and quantify the actions of future societies is subjective, uncertain, and would be therefore fraught with controversy.

Tierney (1991, pg. C-8) observed that treating λ as a constant over the 10,000-yr period of performance is unrealistic since it is equivalent to ignoring potential deterring effects of markers/monuments. During 1990-1992, Sandia National Laboratories assembled two groups of external experts with the purpose of formally addressing questions of future human intrusion into the WIPP through the Expert Judgment Panel process. Deliberations of these experts have led to insights concerning future human intrusion and, in particular, subjective probabilities of human intrusion in the presence of markers and monuments. One insight is that realistic drilling intensities are functions of time whose functional form can be inferred from subjective probabilities obtained from the expert panels, SAND92-0700/3 (Hora, August 25, 2992, Memo in Appendix A).

REFERENCES

Tierney, M.S. 1991. *Combining Scenarios in a Calculation of the Overall Probability Distribution of Cumulative Releases of Radioactivity from the Waste Isolation Pilot Plant, Southeastern New Mexico*. SAND90-

0838. Albuquerque, NM: Sandia National Laboratories.

SNL (Sandia National Laboratories), *Preliminary Performance Assessment for the Waste Isolation Pilot Plant, December 1992, Volume 3: Model Parameters.* SAND92-0700/3. Albuquerque, NM: Sandia National Laboratories.

EPA-60 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Likely, it will not be productive for the DOE to strive for consistency between 40 CFR Part 191 and 40 CFR Part 268 where none was intended

EPA-60 RESPONSE

We agree. The DOE will ensure that both consistency and inconsistency are managed as appropriate in the parallel development of the CCA and the NMVP.

EPA-61 COMMENT

CHAPTER 3—FACILITY DESCRIPTION

Page 3-2, last paragraph and page 3-18, last paragraph
The text on page 3-2 states that within a period of 60 to 200 years that the repository rooms are expected to close and consolidate into a mass comparable to intact salt. The text on pages 3-18 and 3-19 indicates that modeling of salt creep indicates that creep closure of rooms and the resulting consolidation of the waste in the rooms could be largely complete within 100 years. Other discussions in section 2.7.4 (and elsewhere) describe the reversal of creep closure due to gas generation. It is unclear whether the modeling results described in chapter 3 take into account the effects of gas generation on creep closure rates.

EPA-61 RESPONSE

The performance assessment modeling includes the effects of gas generation and pressure buildup. In general, the repository rooms are expected to achieve their maximum closure between about 60 and 200 years after a room is filled. The effect of gas generation is that the degree of closure (porosity reduction from the initial condition) is somewhat less than would be the case without gas generation. However, the room closure rate is relatively fast compared to predicted

rates of gas generation and pore pressure buildup (despite pore volume reduction due to compaction), so that accounting for reasonable uncertainties in gas generation rate does not produce large differences in time of maximum closure. Any gas pressure buildup after the time when maximum closure is achieved could cause the porosity in the compacted waste and backfill to increase. We do not expect a "reversal" of room closure that would create a cavity bearing any resemblance to the original mined opening.

EPA-62 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-11, Paragraph one

Please define "short-term seal components" and provide a time line for sealing components effective life and reference supporting data.

EPA-62 RESPONSE

The term "short-term seal component" refers to any component that is modeled to be effective for about 100 years. "Long-term seal component" refers to a component that is expected to last from 100 years to 10,000 years. During the 1992 PA calculations, an arbitrary division between short-term and long-term components of 200 years was used. This difference has been reconciled in current and future calculations, and 100 years will be used for the design basis until we identify the need to do otherwise.

A 100-year period for the short-term seal components is not a new concept. The 1990 No-migration Variance Petition described the performance period for the short-term components as 100 years. (Westinghouse, 1990, Vol. VII). Earlier relevant reports had also used this same period (e.g., Stormont and Arguello, p. 1).

The short-term seal components, which are primarily in the upper shaft seal, are intended to limit the flow of brine and groundwater into the long-term seal component, which will consist primarily of a salt column. If brine and groundwater reach the salt column of the long-term seal in early repository histories, they could affect consolidation of the salt and consequently impact the long-term seal performance.

The 100-year period had been chosen because preliminary

work indicated that crushed salt in the salt column of the long-term seal will consolidate within about 100 years after WIPP closure to nearly the same permeability as that of the host rock salt (Nowak et al., 1990). Modeling had also shown that the hydraulic conductivity of the upper flow system is completely dominated by a lower seal of crushed salt 90 years after seal emplacement (Ehgartner, 1991, p. 25). Thus, the design life of the short-term components need only be effective for 100 years.

REFERENCES

Ehgartner, Brian. 1991. *A Coupled Mechanical/ Hydrologic Model for WIPP Shaft Seals*. SAND90-2826. Albuquerque, NM: Sandia National Laboratories.

Hansen, F. D., M. K. Pickens, J. R. Tillerson, J. D. Schreiber, and P. Vaughn. October 4, 1994. *Repository Seals Program Position Paper*. Albuquerque, NM:Sandia National Laboratories (commonly called the "Seals White Paper").

Nowak, E. J., J. R. Tillerson, and T. M. Torres. 1990. *Initial Reference Seal System Design: Waste Isolation Pilot Plant*. SAND90-0355. Albuquerque, NM: Sandia National Laboratories.

Stormont, J. C., and J. G. Arguello. 1988. *Model Calculations of Flow Through Shaft Seals in the Rustler Formation*. SAND87-2859. Albuquerque, NM: Sandia National Laboratories.

Westinghouse Electric Corporation. 1990. *Waste Isolation Pilot Plant No-Migration Variance Petition*. DOE/WIPP 89-003, revision 1. Carlsbad, NM: Westinghouse Electric Corp. for U.S. Dept. of Energy.

EPA-63 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-16, Paragraph one

Field tests of seals and in-situ measurements of the extent and properties of the DRZ are critical to supporting a No-Migration Determination. Please provide details as to when and how these tests will occur and data will be generated.

EPA-63 RESPONSE

Final evaluations of the shaft sealing system are ongoing. Information about the PA treatment of the DRZ can be found in the DCCA and the DCCA update. Results from these evaluations will be used as appropriate in compliance evaluations for the CCA and other regulatory submittals, as appropriate.

EPA-64 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-18, second paragraph

The text of the document discusses that a backfill material of pure unconsolidated crushed salt was used in 1992 PA calculations. However, the text does not specify the locations within the repository that the 1992 PA calculations assumed that the salt backfill would be placed (i.e., disposal rooms, panels, and/or drifts). The DOE should state where crushed salt backfill was assumed to be located in the 1992 PA calculations and where crushed salt will be assumed to be located in future studies.

The text of the document discusses the properties of the crushed salt backfill with respect to fluid flow and to the migration of radionuclides. However, the document does not describe how the presence or absence of the crushed salt backfill in the disposal rooms, panels and/or drifts will effect the mechanical behavior of the repository after closure. Based on the discussions of shaft seal behavior, it appears that the use of crushed salt backfill may reduce the time required for completion of creep consolidation in the panels and drifts. This might result in a reduction in the migration of gas or brines from the disposal rooms to the shafts.

The text of the document indicates that studies are underway to establish if backfill is required. However, these studies are not described as a potential issue in Chapter 6 or as a test program in Chapter 10 of the CSR. Please describe the issues related to backfill of the panels, drifts and disposal rooms and the types of tests being conducted to resolve the issues.

EPA-64 RESPONSE

Backfill is not part of the current compliance baseline. Backfilling options, and other potential engineered alternatives are being evaluated in the EA benefit/detriment analysis. This study will identify candidates for the assurance requirements program based on the qualitative analysis performed in the EA study. PA results will identify whether or not there is a performance related need to use one of these options to improve calculated performance with respect to meeting the containment requirements. If such a need is identified, these engineered alternatives could be considered as candidates for the compliance baseline.

EPA-65 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-18, paragraph three

The impact of shallow salt dissolution at the contact between the Salado and the Rustler as a result of potentially realistic activities (i.e., mining and underground injection wells) in the area surrounding the site has not been modeled and this natural process should not be ruled out. (Also see Chapter 6 Comments)

EPA-65 RESPONSE

Current scenario development work includes injection wells and other mining activities for further consideration in the PA. The results of scenario screening will be included in the CCA and other relevant compliance submittals. Additional information can be found in the DCCA.

EPA-66 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-19, second paragraph

The text states that continued gas generation could increase pressure within the repository sufficiently to reverse brine inflow or adversely impact repository performance. Please identify the potential adverse impacts on repository performance.

EPA-66 RESPONSE

Adverse effects, based on most recent uncertainty and

sensitivity analyses of gas generation, include reduced consolidation rates, gas-driven spalling, and interbed fracturing beyond the DRZ to boreholes, and the repository shafts. It is important to remember that the PA modeling system is highly non-linear. In the process of developing final PA adverse affects, gas generation will be identified, characterized, and treated. The final set of adverse gas generation impacts and the methods used to treat them will be discussed and justified in the CCA and other relevant compliance submittals, as appropriate.

EPA-67 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-23, fourth paragraph

The quotation taken from the April 6, 1990, proposed no migration determination for the WIPP facility that is cited in the middle of the fourth paragraph was not transcribed correctly. The following text - "either during operations or after closure, is best addressed through a consideration of the likelihood of intrusion." must be inserted between the word "intrusion" and the words "and the imposition.

EPA-67 RESPONSE

Your comment is accurate and is respectfully noted.

EPA-68 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-23, 24

The EPA does not believe that long-term passive institutional controls (PICs) should be relied upon to reduce the likelihood of inadvertent, intermittent human intrusion in order to comply with the release limits in 40 CFR 191. 40 CFR 191 and its appendices discuss the roles of PICs to "deter" or "reduce the likelihood" of inadvertent human intrusion and to "provide confidence" but do not suggest reliance upon PICs to meet the quantitative requirements. Rather the 191 PIC provisions are a part of the Assurance requirements and are intended to promote "defense in depth." The DOE will have to make a much stronger case for passive institutional controls than any presented to date in order for EPA to allow numerical credit to be factored into disposal system performance

prediction.

EPA-68 RESPONSE

The 1992 PA presented the calculations and their results for intrusion probabilities estimated for cases with and without passive markers. Complete modeling of repository performance must include the effects of the entire disposal system. Determining the effects of passive institutional controls is important in consequence analysis and is not intended to be used as a reliance factor for compliance with release limits in 40 CFR 191.

The DOE will continue work to quantify and justify credit for PICs in PA as a contingency should they be needed in the future. A design concept for PICs was included in the DCCA as a part of the assurance requirements program.

EPA-69 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Page 3-23

The April 6, 1990 No-Migration Determination (NMD) was a proposal, the final NMD is dated November 14, 1990.

EPA-69 RESPONSE

The word "proposed" is included in the text.

EPA-70 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Relationship to Format and Content Guide - In Chapter 3 (Facility Description) the CSR has not addressed a description of the shafts under Engineered Barriers. It is our understanding that DOE will include an engineered barrier study as part of the application.

EPA-70 RESPONSE

The compliance documentation will include discussions of all engineered barriers that are planned for the WIPP disposal system in order to achieve compliance. The results of the EA benefit/detriment analysis will be used in development of the CCA and other relevant compliance submittals. There are no plans to include the results of this study in the compliance submittals.

Engineered Alternatives not selected are not relevant to any demonstration of compliance.

EPA-71 COMMENT

CHAPTER 3 - FACILITY DESCRIPTION

Relationship to Format and Content Guide - In Chapter 3 Closure has been deleted from the description of closure/post-closure activities in the Operations section. Also, all references to contingency planning and emergency response, waste removal, waste management and safety training, reclamation and restoration activities, and active and passive controls, have been deleted. Will this information be provided in the application.

EPA-71 RESPONSE

Many of these items are only relevant to operational activities which were specifically excluded from the CSR as this document focused on the long-term performance issue. This information will be included in the CCA and other relevant compliance submittals, as appropriate.

EPA-72 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Based upon information presented to date by the DOE, the EPA does not see how a performance-based waste acceptance program will be developed. Apparently, the performance assessment will be based upon the Integrated Data Base (IDB), a big picture, facility-wide, management tool. The WIPP characterization program appears to be based upon drum-by drum transportation requirements established by the NRC and documented in the WIPP Waste Acceptance Criteria (WAC). The current link between the Performance Assessment and waste characterization is a black box labeled "Performance-Based Waste Envelope." Although the EPA strongly endorses the concept of basing waste acceptance criteria upon the expected repository performance, DOE has not demonstrated how their current characterization program or a proposed waste envelope will validate the assumptions of performance assessment. For example, how will a waste envelope assure that inhomogeneous waste forms emplaced in the repository perform like the homogeneous waste form assumed in performance assessment.

EPA-72 RESPONSE

The Performance Assessment (PA) will be based upon the best estimates of the total inventory of TRU waste to be emplaced in WIPP. The inventory is incorporated in the WIPP TRU Waste Baseline Inventory Report (WTWBIR) which was published subsequent to the CSR. The inventory as reported in the Baseline Inventory Report (BIR) forms the basis for future input to the PA process. The PA process will in turn identify the parameters critical to repository performance that must be controlled to demonstrate compliance. Any additional criteria based upon the repository performance will be added to the existing Waste Acceptance Criteria (WAC) as Performance Based (PB) WAC. The current characterization and certification programs have been providing analytical data to the base of process knowledge. This data will become a part of the Project Technical Baseline (PTB) by inclusion in the BIR, and will be available to the PA process to establish the acceptable waste envelope. Waste that does not meet this envelope will not be shipped to WIPP.

EPA-73 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

The document is void of the detail needed to justify many of the broad statements made. For example, the section on chemical comparability (4.1.7) provides no support documents or referenced analyses to support its conclusion that "no chemical incompatibilities will exist in the wastes that are to be disposed of at the WIPP site." Clearly, significant support material would be required in a certification application.

EPA-73 RESPONSE

Chemical incompatibilities are largely avoided through existing WAC restrictions which exclude reactive, corrosive, and explosive substances. Extensive chemical compatibility studies were performed and included as part of the TRUPACT-II Safety Analysis Report for Packaging (SARP), Rev. 4 as Appendix 2.11.12. This information is also documented and was included in the WIPP RCRA Part B Permit Application and the draft NMVP.

EPA-74 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Although a fair amount of information is provided on waste types, little to nothing is provided on how they relate to performance or on the relative amounts of these materials in the projected inventory.

EPA-74 RESPONSE

The WIPP TRU Waste Baseline Inventory Report (WTWBIR, or just BIR) Revision 0, was published after the CSR was distributed. The BIR uses information on waste streams and overall inventory information from the waste generators to provide information as input to the Performance Assessment (PA) process.

EPA-75 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Extrapolation/scaling has not been justified for predicting future wastes. The current inventory does not take into account differences in percentages of future waste types and how waste types may perform under repository conditions.

EPA-75 RESPONSE

The BIR has attempted to improve upon the future waste generation information. Future BIR estimates will include predictions of waste to be generated as a result of decontamination and decommissioning (D & D) activities. This waste will be generated under strict certification, characterization, and quality assurance programs. This will control and properly identify the important constituents. These programs will provide the opportunity to minimize the generation of wastes of less than optimal composition through the use of waste minimization and substitution techniques.

EPA-76 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Descriptions in 4.1.6 provide the processes and types of waste generated; however, little is provided on how process knowledge is used, where and why it is or is not acceptable, the level of confidence in the data, and quality assurance procedures for determining waste characteristics based on process knowledge.

Furthermore, concentration ranges or amounts of the waste types are not provided, nor are they looked at in terms of how specific categories or characteristics are representative of performance assumptions used in the PA source term.

EPA-76 RESPONSE

The strict requirements of product quality and concerns for safety inherent to weapons activities that generated these wastes required that precise product information be maintained. Documentation confirming this existing process knowledge is being generated as a part of current characterization programs. The headspace gas sampling and the solidified waste coring programs are examples of the verification work taking place in these characterization programs to formally document the existing process knowledge. The requisite level of QA will be applied here, as well.

EPA-77 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

The "detailed assessment of chemical compatibility of the wastes" should be referenced. EPA would like to review this report. In addition, the EPA requests a description of the system of controls that will be emplaced to assure that waste characterization comports with waste actually disposed of at the WIPP.

EPA-77 RESPONSE

This information is available in Appendix 2.10.12 of the TRUPACT-II Safety Analysis for Packaging (SARP), Rev.4 and in Rev. 5 of the RCRA Part B Application to the State of New Mexico.

EPA-78 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

This chapter does not provide a cohesive, detailed description of the proposed waste envelope/waste characterization plan. Much of the information provided in Tables 4.6 and 4.7 appear to apply to transportation concerns rather than performance assessment or performance based acceptance. It is difficult to see how information from the current WAC and Integrated Database feeds into the development of the performance assessment, and therefore, the performance-based envelope.

EPA-78 RESPONSE

Many of the current WAC requirements are based upon the performance criteria necessary for the safe shipping, handling and storage of WIPP TRU waste. Currently, the shipping package restrictions are very limiting, and therefore assume a major role in the certification of waste for WIPP. Additional waste acceptance criteria may be identified through the evaluation of long-term disposal system performance. These, too, will be turned into criteria that the generators must satisfy prior to shipment of waste to the WIPP.

EPA-79 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

This document should provide a detailed description of the criteria important to the development of the performance-based envelope. It should also include justifications for rejection of waste parameters deemed unimportant in the development of this criteria.

EPA-79 RESPONSE

A description of the criteria important to the development of a performance-based envelope will be derived from results of the performance assessment process (PA). Uncertainty and sensitivity analyses will identify any waste related parameters which could serve to improve performance. These parameters will be candidates for PBWAC criteria.

EPA-80 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

The issue of coordinating quality assurance and waste acceptance at the various waste generator sites has not been addressed. A Waste Acceptance Plan incorporating the performance-based envelope with error bands should be administered for all facilities in order to promote consistency and compliance with the established envelope. In addition, a program to standardize measurement and instrumentation based on the NIST standards should be developed and incorporated.

EPA-80 RESPONSE

The Quality Assurance Program Plan, was issued for the Test Phase. This document has since been revised for application to the Disposal Phase. The QAPP requires

each generator site to develop and implement a Quality Assurance Project Plan (QAPjP) that documents the administrative, procedural and quality assurance programs that will be implemented to certify and characterize the waste to WIPP criteria. Included in the QAPP requirements are the data quality objectives, an approved performance demonstration program for analytical and assay data, and an approved QA program. WIPP must approve the QAPjP and will conduct a preliminary an follow-up audit to verify the proper implementation of the QAPjP at each generator site that will ship waste to WIPP. The verification will include the review of analytical and assay procedures and the traceability of standards. As performance based criteria are identified through PA, criteria will be added to the WAC if needed. Any such additional WAC criteria will be implemented by the same programs at generator facilities that are designed to implement the requirements of the QAPP through their QAPjPs and implementing procedures. Should any future WAC criteria drive the need for change to the QAPP, QAPjPs, or implementing procedures, the required changes will be made.

EPA-81 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Relationship to Format and Content Guide - In Chapter 4 (Waste Description) the Inventory Control subsection of the Waste Envelope section has been eliminated. Please identify where this information will be provided in the draft application.

EPA-81 RESPONSE

Section 4.2.3 of the application deals with the inventory control. The waste inventory to be shipped must be defined in Certification Plans submitted to WIPP for approval. The waste covered by the Certification Plans will be characterized to the requirements of the WAC and the QAPP and certified. Periodic audits and assessments will provide the assurance that waste is being certified to WIPP requirements. This ensures that the waste to be shipped to WIPP is included in the envelope described in the permit application. The "assurance" process is discussed in chapter 4 of the DCCA.

EPA-82 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Relationship to Format and Content Guide - In Chapter 4, the Future Waste Characterization Activities subsection of the Waste Characterization section has been eliminated. Please identify where this information will be provided in the draft application.

EPA-82 RESPONSE

Future waste characterization activities will follow the programs currently set up to characterize waste and will be included in the Waste Characterization Plan section of the application. Future waste generation will be performed under waste certification and characterization programs that will require accurate documentation to be generated. Waste preparation, documentation, and containerization activities will be conducted so as to ensure positive identification of waste contents. Subsequent sampling and testing of the waste generated will be performed to the quality standard prescribed in the QAPP.

EPA-83 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Relationship to Format and Content Guide - In Chapter 4, the Interactions with Natural Barrier Systems and Interactions with Engineered Barrier Systems subsections of the Waste Transformation Processes in the Repository Environment section have been eliminated. Please identify whether this information will be provided in the draft application.

EPA-83 RESPONSE

A summary of the waste transformation processes in the repository environment has been presented in section 2.7 of the CSR. The interactions with natural and engineered systems is a primary concern of the Performance Assessment process. Ongoing studies are concentrating on parameters that effect the repository system, including the influence of both natural and engineered barriers. A discussion of the interactions as they are currently understood is included in the DCCA.

EPA-84 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

No discussion is included in Chapter 4 on the National TRU Program. Since this program is likely to be instrumental in developing waste characterization for WIPP some mention of it seems appropriate.

EPA-84 RESPONSE

The National TRU Program is administered through the DOE Carlsbad Area Office (CAO). The National TRU Program Office (NTPO) controls all of the DOE TRU waste programs that will be used to characterize waste to be shipped to WIPP. The WIPP WAC, the QAPP and the BIR are documents published and controlled by the NTPO to ensure the consistent communication and application of requirements to generators and to ensure the appropriate level of quality of resulting information.

EPA-85 COMMENT

Chapter 4 - Waste Description

Page 4-1, third paragraph

The document provides general information pertaining to the retrievably stored and newly generated wastes. Please provide a more detailed discussion of the waste streams and the relative differences the waste streams may have on repository performance.

EPA-85 RESPONSE

Such waste stream information has been incorporated into the BIR. The BIR will be used as a source for input into future PAs and will be the waste information source for the CCA and other relevant compliance submittals.

EPA-86 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-2, paragraph 3

The mention of the Integrated Data Base, which apparently forms the basis of the Baseline Inventory Report, states that it is "compiled from completed surveys or data calls [of the generator sites] required by DOE." By DOE's own admission, many of the generator

facilities ignored or incompletely address these surveys, which would seemingly affect the accuracy of the IDB. Although the IDB may be a useful management tool for DOE, the case is not made that the IDB is an appropriate tool for gathering detailed, quality assured, data inclusion in performance assessment models.

EPA-86 RESPONSE

The BIR has become the DOE's document for reporting TRU waste information. The BIR will be used in future PAs for waste related input as it will be the most comprehensive and accurate source available. The BIR is now supported by its own data calls to generator sites. This provides the PA with a source for focused information which can be independently verified, as appropriate.

EPA-87 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-5, second paragraph

The document states that DOE has established the WIPP TRU Mixed Waste Characterization Data Base. It would be useful to provide greater detail of this data base, including how it was established, how the inputs are collected and identification of the outputs.

EPA-87 RESPONSE

The WIPP TRU Mixed Waste Characterization database was envisioned at the time the CSR was published. Work is currently underway to modify the existing WIPP Waste Information System (WWIS) to include characterization data such as headspace gas analysis. The WWIS has previously had provisions to accept all of the data required by the WAC. Detailed characterization data has been collected at the INEL on all of the waste that was included in the test program. In addition, headspace gas sampling programs at the INEL and at the RFP have contributed to the existing body of available characterization data. This information, along with other data from programs at other generator sites will be added to the revised WWIS as it becomes available.

EPA-88 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-7, second paragraph

The document states results of headspace sampling of TRU mixed waste drums provide data on concentrations of volatile organic compounds (VOCs) but an insufficient variety of waste forms prevents reporting these results. It would be better to report data that is available now, with appropriate qualifications.

EPA-88 RESPONSE

Headspace gas analysis data is available from sampling programs in place at the INEL and at the RFP. These programs will continue and will ultimately include available waste characterization related data, including headspace gas sampling and analysis. Data will be included in the BIR as they become available. Statistical representativeness is one of the criteria that will be considered prior to use of these data in the compliance program.

EPA-89 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-7, paragraph 3

This section 4.1.6 states "[t]he project-specific nature of the operations that generate many of the combustibles and noncombustibles make the detailed segregation of various waste materials unnecessary." This implies the reliance upon process knowledge for waste characterization, which is acceptable only if this process knowledge is adequately validated, which is currently not the case.

EPA-89 RESPONSE

What we intended to indicate here was reliance on process knowledge for waste classification. Waste classification is the starting point for the statistically based waste characterization program. The requisite level of waste characterization, along with the required level of validation, will be acquired and documented for all waste prior to shipment to the WIPP. Waste characterization will identify opportunities to validate process knowledge and to improve the waste classification process for future

use.

EPA-90 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Pages 4-7 through 4-20

The document presents a general description of each waste form. Please provide a more detailed discussion of each waste form including: the volume of each waste form for both retrievably stored and newly generated; any analysis of options which has been performed to mitigate the generation of hazardous wastes; and a comparison of the importance of each waste form in terms of repository performance (i.e., which wastes are expected to be problem wastes and which ones are not) with a justification.

Is section 4.1.6 the new definitive list of waste forms? If so, they do not correspond to those found in the 1992 PA. No explanation is given for the difference.

EPA-90 RESPONSE

The collection of waste forms in this section is not new. It is just a discussion of the various types of waste included in the TRU inventory that is arranged by the Waste Matrix Code Groups (WMCG) used in the BIR. The waste, which is described in detail in the BIR, has been assigned to the waste matrix codes (WMC), otherwise referred to as treatability codes developed for use in the MWIR. The BIR has adopted the WMCG system for combining waste that has similar physical and chemical waste form properties. The inventory in the BIR is the basis for current and future PA calculations.

EPA-91 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-16, last paragraph

The document states that the 35-gallon drum is pierced with four holes to allow entrapped air to escape during supercompaction. Have there been any studies of the composition of the air forced out of the drum during supercompaction? What is the justification for using the capability of supercompaction to model creep closure repository conditions.

EPA-91 RESPONSE

Most of the existing waste must be packaged or repackaged into the 35 gallon drums used in the supercompaction process. Headspace gas would be thus sampled prior to the supercompaction process, if necessary. Supercompaction is used to simplify waste management through volume reduction. Assumptions have been made as to the characteristics of waste as creep closure reduces the volume. These are reasonable parallels to draw for the purposes of PA related assumptions and will be corrected as differences in end products of the two processes become known to be important in PA, and can be quantified.

EPA-92 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-17, first paragraph

The document states that during supercompaction the waste undergoes the physical transformation of volume reduction and no chemical transformations or reactions are known to occur. Provide results and conclusions of studies to confirm all aspects of this statement. Furthermore, provide a more detailed discussion of supercompaction including any analysis of options which has been performed to decrease the presence of hazardous constituents in the wastes.

EPA-92 RESPONSE

The section states that waste characterization and certification activities are conducted prior to supercompaction. This is because post - compaction sampling and analysis is not feasible - nor are they necessary. The process is designed only to remove void space. No mixing is performed nor are any matrix enhancements included. Supercompaction is only applied to waste that are amenable to compaction (no solidified waste forms). Waste segregation prior to compaction assumes consistency and eliminates reactants. There is no need to perform studies to confirm this statement. It is reasonable to assume that since no chemicals are added, only pressure and temperature could drive transformation and/or reaction. Pressure is mitigated, and temperature change due to supercompaction is minimal.

EPA-93 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-20, first paragraph, bullets and second paragraph

The document states that some RH TRU mixed waste forms are similar to some CH TRU mixed waste forms and lists five similar waste forms. The document goes on to state there is one other similar waste form, a heterogenous solid consisting of metalographic samples. Provide a more detailed discussion of the heterogenous solid waste form including whether this waste form fits into one of the other waste forms or is an entirely new waste form.

EPA-93 RESPONSE

This waste fits into the heterogenous solids portion of the matrix parameters categories as shown in the BIR. It is distinguishable from the similar CH waste form only through surface dose rate. The waste streams are described in detail in the site treatment plans portion of the MWIR.

EPA-94 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-20, fourth paragraph

The document states that a detailed assessment of the compatibility of the chemical components has been performed. Please provide more specifics of this compatibility assessment. The EPA does not assume that these restrictions are successful in ensuring that waste is acceptable for disposal with respect to 40 CFR part 191. The compatibility study emphasizes the effects of components on each other. While this is a bona-fide concern under RCRA, the EPA is also very concerned about the effect of waste components on aggregate waste properties. For example, how does the presence of various chemically compatible compounds affect solubility or retardation?

EPA-94 RESPONSE

The documentation of the chemical compatibility studies performed upon the waste can be found in the TRUPACT-II SARP, Appendix 2.10.12. The issue of compatibility in the disposal system will be addressed in PA. Effects

of waste constituents on solubility and retardation will be identified and treated, as appropriate.

EPA-95 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-20, fourth paragraph

The document states no chemical incompatibilities will exist. Provide justification for this statement. Present specific measures (i.e., what instruction were the generators given, follow up on the how the generators are responding to the instructions) which will ensure this projected outcome.

EPA-95 RESPONSE

The WIPP WAC does not allow, reactive, corrosive, or explosive items in the waste. These restrictions and some others are designed to address the issue of chemical compatibility. The generator sites, in order to ship waste to WIPP, are required to implement a waste certification and characterization program that meets the criteria of the WAC and the data quality objectives of the QAPP.

EPA-96 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-22

Among the primary waste parameters used in the 1992 PA are the volumetric ratios of different waste forms. Therefore, it would appear that one objective of a performance based waste acceptance criteria would be to ensure preservation during disposal of ratios used for performance calculations. Neither the Waste Acceptance Criteria nor the performance-based waste envelope nor the phased disposal concept addresses this preservation of the waste-form ratio.

EPA-96 RESPONSE

The BIR will be used as the inventory basis. This inventory will be used as input to PA. PA results will be used to identify any additional performance based restrictions on acceptable wastes that may be needed. Acceptable wastes will be within this envelope. The ratios will be preserved with regard to actual waste ratios being consistent with PA assumptions. Any

future issues that develop will be addressed at the time they are identified, but none are anticipated. The BIR reflects the best estimate to date of the TRU waste inventory. It will be this inventory and the associated ratios that are included in the PA process.

EPA-97 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-22, paragraph 1

The description of the performance-based envelope "considers only physical and chemical form of the waste" ignoring the radioactive properties which may be important to the PA. EPA endorses the concept of the performance-based waste acceptance criteria, and is awaiting detailed information on how DOE plans to implement this concept.

EPA-97 RESPONSE

The radioactive properties are part of the physical considerations being investigated in the PA. The estimate of the radioactive source term to be included in the PA process will be extrapolated from the inventory information published in the BIR. If PA results indicate that the radioactive component of the source term is important, PBWAC restrictions will be considered as an option.

EPA-98 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-22, second paragraph

The document states some waste forms or constituents may be identified which will require additional quantitative analysis through waste characterization or additional experimental evaluation prior to their inclusion in the performance-based envelope. Please provide additional information (i.e., which waste forms and constituents, what type of quantitative analysis, what type of experimental evaluation) pertaining to these waste forms or constituents.

EPA-98 RESPONSE

The identification of the waste forms or constituents which may require additional characterization will be a product of the current PA. Any additional

characterization activities required to identify and/or quantify constituents will be planned, conducted, and documented, as appropriate.

EPA-99 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-22, third paragraph

The document states waste parameters likely to have significant impact on repository performance may require increased characterization. Please provide additional information (i.e., which waste parameters, what type of increased characterization) pertaining to these waste parameters.

EPA-99 RESPONSE

Currently, the waste parameters that are important to repository performance (such as the radionuclide content) are controlled by restrictions in the WAC. Any additional waste parameters important to repository performance will be identified by the PA. As they are identified, WAC modifications in the form of performance based restrictions will be considered as options to mitigate the PA related issue identified.

EPA-100 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-22, third paragraph

The document states waste parameters shown to have little or no impact on repository performance will be candidates for reduced characterization. Provide additional information (i.e., which waste parameters, what type of reduced characterization) pertaining to these waste parameters.

EPA-100 RESPONSE

The waste parameter impact on the repository performance will be a product of the PA. Reduced characterization may consist of a reduced sampling frequency of waste streams where statistics indicate it would be reasonable to do so. Future waste characterization efforts will focus on identifying and quantifying those aspects and/or constituents that are most important to the compliance of the repository as determined by the PA process.

EPA-101 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-22, fourth paragraph

The document states waste characterization programs will provide additional evaluation data. The document goes on to state the data will be evaluated in future compliance evaluations to determine if expanding the envelope of acceptable wastes is feasible. Provide specific details of the waste characterization programs, evaluation data, compliance evaluations, feasibility of expanding envelope, and acceptable wastes.

EPA-101 RESPONSE

Specific details of the waste characterization program requirements and data quality objectives are contained in the QAPP, QAPjPs, and implementing procedures which are designed to meet the requirements of the WAC. If in the future it is determined that WAC restrictions can be relaxed, such options will be considered. If it is determined that additional restrictions are needed for adequate repository performance, these will be considered as well. The acceptable waste envelope will be described and bounded by the WAC restrictions in place at the time of waste shipment. Waste characterization must precede shipment of waste to the WIPP. These data will be maintained in the WIPP operating record.

EPA-102 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-23, third paragraph

The document states waste that exceeds boundary conditions or could lead to an exceedance of process tolerance limits will not be approved for acceptance or will be returned to the generator site. Present specific measures which will ensure this projected outcome.

EPA-102 RESPONSE

Specific requirements that would restrict the type or amount of waste that was determined by the PA process to exceed the boundary conditions will be added to the

current WAC as performance based criteria. The sites would then have to revise their programs to preclude shipping waste that did not meet the most current, applicable criteria. Programs are planned to audit and otherwise monitor the certification programs at each generator site affected by the latest requirements to ensure continued viable certification programs.

EPA-103 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-23

Section 4.2.2. and Section 4.1.6 are used as the boundary conditions in terms of compatibility and waste category without support or analysis of their effects (or lack of effect) on repository performance. This approach is unacceptable without a study that categorizes and evaluates how combinations of these materials will affect repository performance.

EPA-103 RESPONSE

The affect that the various waste forms have upon the repository will be evaluated in the PA process. Such detailed studies as the ones suggested will only be initiated if the PA results indicate that such waste related inputs are important, and if other methods to treat for waste related uncertainty are not chosen as better paths to compliance. In all cases, PA related uncertainty will be treated, as appropriate. Boundary conditions and process tolerance limits will be modified as needed for compliance demonstrations.

EPA-104 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-23

Table 4-5 should have a third column: which identifies the controlling element or factor that leads to drum, room, panel, or repository specific boundary conditions.

EPA-104 RESPONSE

A table that identifies such parameters will be considered as an option if the result of the PA indicates the necessity to establish such PBWAC requirements.

EPA-105 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-25, paragraph 2

This paragraph states that the "waste form is assigned by the generator sites." How far developed is this program and how consistent and comparable are the sites to each other?

EPA-105 RESPONSE

With regard to the development of the program, the sites must identify the Item Description Codes (Ides) that they will use to certify to the WIPP WAC. This information is required in the certification documentation that they submit to WIPP for approval. The Ides are specific to waste streams at each generator site. Many of the waste streams are similar. The various waste stream Ides have been collected in the MWIR. Subsequently, in the BIR, they have been organized into the Waste Matrix Codes (WMC). WIPP will maintain control of the waste envelope through implementation of the waste certification program at the generator sites. Only the waste described in the WIPP approved certification plans, and verified via the assurance audits, can then be shipped to WIPP. With regard to comparability, the EPA can now draw its own conclusion based on the information in the BIR.

EPA-106 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-25, paragraph 2

This paragraph states, "the WIPP project regards RTR analysis as an acceptable waste examination technique for TRU waste...." At this time, many of the generator sites either have no RTR instrumentation or have systems that are inaccurate in their measurements, particularly when dealing with unknown and/or heterogenous waste matrices.

EPA-106 RESPONSE

RTR is used to verify that the waste has been assigned to the correct IDC by the various waste generators at each site. RTR can also determine the presence of some of the prohibited items such as free liquids and pressurized containers and thereby be used to exclude

WAC restricted wastes. RTR and other radiographic systems are used to identify various waste stream matrix materials quite reliably. These radiographic systems are not exact measurement systems that can provide a precise analytical result. The results of these examinations are highly dependent upon the skill and training of the operator. As such, they are required to be controlled as "special processes" as defined in NQA-1. This is one of the areas that WIPP has concentrated on in the past during the confirmation audits that were performed to qualify the generator site certification programs. The plans are to provide RTR or other similar radiographic capability for each site that will ship waste to WIPP. Mobile systems are being developed to assist the smaller volume waste generators by providing cost effective radiographic capability for use in their certification programs.

EPA-107 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-25, fourth paragraph; Pages 4-32 through 4-38, Table 4-7.

The document presents a summary of WAC limiting parameters for CH TRU waste. Provide a summary of the WAC limiting parameters for RH TRU waste.

EPA-107 RESPONSE

The WAC parameter limits for RH are included in Table 4-6. As the RH shipment program evolves, any further restrictions identified for waste to be shippable to WIPP will be published in a future revision of the WAC.

EPA-108 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-25, last paragraph

The document states these criteria should be considered in waste generation practices along with WAC certification requirements, and these criteria will be published and implemented at all generator/storage facilities. Present specific measures which will ensure these projected outcomes.

EPA-108 RESPONSE

Each generator site that will ship waste to WIPP must submit a certification plan to WIPP for approval. These certification programs will describe the processes each generator site will employ to meet the WIPP criteria. Upon approval of the certification plan, WIPP will perform an initial audit to ensure that the generator site has implemented the approved certification program. WIPP will perform follow-up audits as required thereafter to ensure certification program practices consistent with the requirements of their approved certification plans. WIPP will review and approve all substantive changes to certification plans prior to their implementation.

EPA-109 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-25, last paragraph

The document states the Inventory Control Criteria will guide future waste generation practices. How will the Inventory Control Criteria be implemented and used as a guide?

EPA-109 RESPONSE

The WIPP inventory will be controlled through the requirements of the WAC. As performance criteria are identified by the PA process they will be considered for addition to the existing WAC (PBWAC). It is reasonable to conclude that generator facilities will control future waste generating processes such that as much of the resultant waste fits the WIPP WAC as is practical.

EPA-110 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Pages 4-26 through 4-31, Table 4-6

The document presents many criterion in Table 4-6, WIPP WAC. However, criterion such as incompatibility and acceptable waste forms are not addressed.

EPA-110 RESPONSE

The WAC applies to all WIPP acceptable waste forms. The incompatibility of the various waste forms is

largely controlled through the WAC prohibition of reactives, corrosives, and explosive substances. Further compatibility was documented in the TRUPACT-II SARP, Revision 3, Appendix 2.10.12. Compatibility of the waste with the disposal system will be evaluated in PA. DOE will evaluate these results, and if additional waste related restrictions are necessary for compliance, modifications to the WAC will be made, as appropriate.

EPA-111 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Pages 4-32 through 4-38, Table 4-7

The document presents many criteria in Table 4-7, Summary of WAC Limiting Parameters. However, criteria such as incompatibility and acceptable waste forms are not addressed.

EPA-111 RESPONSE

See resolution to comment 110 above.

EPA-112 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-39, paragraph 1

There is mention here of waste acceptance criteria certification programs, but no details of it. Also, there is no mention of the Performance Demonstration Program (PDP), which is designed to check the measurement capabilities of each of the generator facilities in accordance with NIST standardization.

EPA-112 RESPONSE

The waste certification programs at the generator sites are implemented according to a WIPP approved Certification Plan. Audits will be conducted at the generator sites to ensure implementation of the approved certification plan. The requirement for PDPs and NIST standardization at the generator sites is included in the QAPP and is therefore required as a part of the certification programs.

EPA-113 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-39, first paragraph

The document states wastes which do not meet the WAC may require treatment or processing until certification can be obtained. The DOE should present options that will be examined as part of the engineered barrier study.

EPA-113 RESPONSE

The EA benefit/detriment analysis includes options to modify waste forms, an alternative which would serve as barriers for potential contaminant migration.

EPA-114 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-39, second paragraph

The document states WAC certification programs are overseen though periodic audits. Please provide additional information pertaining to the audits (i.e., content, frequency, reporting, authority of auditors).

EPA-114 RESPONSE

Initial audits are conducted by WIPP at each generator site to ensure the proper implementation of the approved certification plans. These audits are conducted as required by DOE Order 5820.2A. Annual audits are conducted from then on to ensure that the programs continue proper implementation of the certification plans. Unannounced audits and surveillances are planned as an additional certification assurance measure. These are formal audits that are conducted according to the guidelines set forth in NQA-1 using prepared checklists conducted by qualified auditors with expertise in their respective audit area. Formal audit reports are generated and the audit finding resolutions are tracked to completion. Follow-up audits are conducted as necessary to confirm proper implementation of corrective actions. Failure of the sites to satisfactorily resolve audit findings may result in the cancellation of the certification authority for the waste streams that are affected by the findings.

EPA-115 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-39, second paragraph

The document states TRU waste received will not exhibit the established waste restrictions. The document goes on to state the WAC certification programs result in controlled and consistent chemical and physical waste properties. By what specific measures will these projected outcomes be achieved.

EPA-115 RESPONSE

The WACCC approval and audit program ensures the proper implementation of the certification programs at the generator sites. WIPP review and approval of the certification plans ensures that WAC restrictions are met through goals and programmatic restrictions in the plans. The training of waste operation personnel, the control of TRU waste packaging procedures, and the documentation of the waste generation and certification processes are all parts of the certification programs at the generator sites that are verified by the audit and surveillance programs.

EPA-116 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-39, last paragraph

The document states the Baseline Inventory Report (BIR) will include waste characterization information. What are the projected dates of completion and availability?

EPA-116 RESPONSE

The initial issue of the BIR was distributed in June, 1994. Revision 1 of the BIR was issued in February, 1995. Periodic updates will occur in the future.

EPA-117 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-40

In the second paragraph, it is stated that "[d]uring the WIPP disposal phase, ... the DOE will determine and report the species and curie quantity of radionuclides

... on a drum-by-drum basis." The third paragraph states that for "[c]ompliance demonstrations ... the physical waste form parameters of interest will be presented based on an average content of the TRU waste inventory and not on a drum-by-drum basis." The EPA finds this approach inconsistent with our understanding of the development of the performance-based waste envelope, in that species and curie quantity should be considered for compliance demonstrations. In addition, the possibility of load management alternatives (as mentioned in the last paragraph) should also include consideration of species and curie quantity. Also, it may be necessary to investigate both load management and species and curie quantities on a drum-by-drum basis rather than by average content of the total inventory.

EPA-117 RESPONSE

The knowledge of the isotopic distributions of the various radioactive species and curie quantities has resulted from both intrusive and non-intrusive measurements at the waste container level from the various waste streams. These container level measurements have been routinely made at various facilities as a part of accountability, safety, and more recently the WAC certification programs. WAC certification programs have been in effect at the major generator sites since 1985. These measurements have provided the basis for overall projections needed by the PA process. The PA process will identify any further repository performance based restrictions, if necessary. Individual containers will be assayed prior to shipment to WIPP to ensure compliance with the WAC and shipping requirements to provide a basis for tracking the total nuclide inventory at WIPP at any given point in time. This will also provide a basis for the calculation of future activity that is based upon actual measurements.

EPA-118 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-40, paragraph 3

"[T]he physical form waste parameters of interest will be presented based on an average content of the total TRU waste inventory and not on a drum-by drum basis." How will this be done? Process knowledge is not yet reliable for use in waste characterization; therefore, averaging unknown quantities cannot be done accurately.

Also, by this method of averaging, the effects of some of the waste forms may be minimized. DOE needs to substantiate this proposal for averaging physical parameters and detail the effect upon load management.

EPA-118 RESPONSE

The BIR, which was issued in 1994, averages the waste matrix parameters for the purposes of input to PA. These averages, along with ranges of values provides adequate information for reasonable predictions in PA. These averages do not represent a substitute for a container by container waste characterization program in which wastes have been shown to conform to the established waste envelope.

EPA-119 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-40, last paragraph

The document states physical waste form parameters that do not affect compliance will be excluded from future waste characterization programs, and the waste characterization requirements will be revised, as necessary. Provide specific details of the waste form exclusions as well as the waste characterization requirement revisions. The appropriate regulatory agencies must be notified of the waste characterization requirement revisions. In addition to notification, the regulatory agencies must have review rights and approval authority.

EPA-119 RESPONSE

Waste form parameters that are important to the repository will be defined through the PA. As these parameters are identified, the specific details with regard to potential exclusions and revisions you request will be available. Any such additional or revised parameters will be identified and quantified in the characterization program to the extent necessary to verify PA model inputs. Subsequent characterization programs will include the amount and type of waste characterization activities that are required to maintain control of those parameters that have been defined as important to the repository performance. Other parameters, shown to be unimportant, need not be waste characterization targets unless knowledge of them is driven by another regulation.

EPA-120 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-40

The statements made on this page are not supported by any documentation or analysis. Presenting physical parameters of interest in a compliance demonstration on an average content of the total TRU waste inventory and not a drum by drum basis has not been justified and should not be used unless it is shown that such a scale is appropriate and\or bounding. Analysis to date indicates that "hot spots" may have a significant affect on total releases. Likewise, the amount of certain waste types may have a measurable affect on solubility and therefore on long-term releases from a borehole in the event of human intrusion. Given this, the department needs to perform analyses to show which physical characteristics are appropriate for reporting as averages on the repository scale, and which should be monitored and disposed in a more tightly controlled manner, such as the panel-, room-, or drum-scale.

EPA-120 RESPONSE

Sensitive waste characteristics will be defined by the PA process. If the characteristics are determined as important to the repository performance as indicated by the sensitivity studies, then the role that the characteristics will play in the overall process will be further evaluated. These evaluations will indicate whether or not average values are adequate or if more detailed information is needed. Revisions to waste characterization programs would be made if necessary.

EPA-121 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-40

The last paragraph on this page discusses the possible use of load management. This appears contradictory to the earlier paragraph.

EPA-121 RESPONSE

The concept of load management is an additional assurance measure that can be applied to the repository inventory if it becomes necessary to do so. The primary inventory control will be provided through the

strict enforcement of the WAC. Load management will become a tool that can be employed to avoid less than optimal spatial distributions of certain waste types if the PA process indicates that such control is desirable. However, any load management program would complicate the shipment and handling of the various waste types that must be shipped from the generator sites. These decisions will therefore be made cautiously and other options will be considered.

EPA-122 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-41, last paragraph

The document states generator/storage sites will determine if their waste is hazardous, identify EPA hazardous waste codes and complete compliance documentation. Please provide additional details of the determination, identification and completion processes. Also, please include discussion of specific measures which will ensure these projected outcomes.

EPA-122 RESPONSE

The details of a generator site's RCRA compliance activities are not relevant to WIPP since they are for the most part, structured to meet the requirements of their local regulators. WIPP will require the generators to provide certain information as part of the waste acceptance process regardless of whether or not the generator has to provide this information for another purpose. We see no reason to believe that their regulators would require any less rigor from RCRA waste characterization then would the WIPP certification program.

EPA-123 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-42, third paragraph

The document states the TRU wastes fall into three major categories with further subdivisions within these broad groups which will be decided by the generator/storage sites. How was this categorization scheme devised and how does this categorization differ from the waste forms previously presented in this chapter?

EPA-123 RESPONSE

The three categories correspond to the major categories (and their respective subcategories) used to report the TRU waste according to the requirements of the Federal Facility Compliance Act. The categories correspond to the various "treatability groups" used in reporting the waste in the MWIR. Waste forms previously defined are systematically rolled up into these categories. Specific information on the roll-up of the various waste forms is published in the BIR. The BIR contains a convenient chart that shows the methodology used to roll-up the various waste forms into the major waste categories.

EPA-124 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-42, last paragraph

How is it that the definition of retrievably stored TRU waste is determined by prior implementation of the QAPP?

EPA-124 RESPONSE

Retrievably stored TRU waste has been reported in the DOE Integrated Data Base (IDB) for many years. The definition of retrievably stored waste predates the QAPP, and is generally used to apply to any waste that was generated after the early seventies when the Atomic Energy Commission (AEC) concluded that TRU waste should have greater confinement from the environment than burial in the near surface. Since then TRU waste has been segregated from other waste types and placed in retrievable storage. The intent of the use of the definition in relation to the QAPP is to distinguish newly generated waste from retrievably stored waste.

EPA-125 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-43, fourth paragraph

The document states the waste characterization information provided in the IMWIR will be used to assess the needed design capacity for sampling and analytical facilities. What are the additional specific uses (i.e., design capacity) of the IMWIR information.

EPA-125 RESPONSE

The MWIR information is a major part of the data used in the BIR. MWIR data are used for all of the currently stored waste. The MWIR data are waste stream specific, and can provide insight as to the volume of the various waste streams. The IDB data on TRU waste is also used in the BIR and combined with the MWIR data to provide a refined prediction of projected waste volumes.

EPA-126 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-43, last paragraph

The document presents general information regarding process knowledge. Please provide information pertaining to the status and accuracy of process knowledge compiled to date.

EPA-126 RESPONSE

Process knowledge verification has been approached in a number of ways. The INEL published a lengthy report (EEG-WM-6503, TRU WASTE SAMPLING PROGRAM: VOLUME I--WASTE CHARACTERIZATION, September, 1985) that sampled waste sent to the INEL from RFP. Process knowledge verification has also been developed during the characterization conducted on the waste that was repackaged in the WIPP test bins. This testing consisted of RTR, RA, headspace and inner bag gas analysis, and 100% visual sampling. The strict requirements of product quality and concerns for safety in the highly structured weapons activities that generated these wastes required that precise product information be maintained. Any additional documentation required to confirm process knowledge is being generated as a part of current characterization programs. The headspace gas sampling and the solidified waste coring programs at the INEL are an example of the verification work taking place in these characterization programs. Work is also being performed at the RFP to combine building process logs with information that was previously available to further complement process knowledge at the Rocky Flats Plant.

EPA-127 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-44, second paragraph

The document presents general information regarding analytical data. Please provide information pertaining to the analytical data compiled to date and the accuracy of that analytical data.

EPA-127 RESPONSE

Analytical data generated as a result of characterization and sampling programs were reported in documents such as EEG-WM-6503, TRU WASTE SAMPLING PROGRAM: VOLUME I--WASTE CHARACTERIZATION, September, 1985. We have also compiled data in the headspace gas sampling and analysis programs. Requirements for data accuracy and precision are included in the QAPP, the QAPjPs, and implementing procedures. Evidence of the requisite level of precision and accuracy will be generated in the applicable waste characterization programs prior to shipping those wastes to WIPP.

EPA-128 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-44, third paragraph

The document states some waste transformation processes have been identified as important for the purposes of assessing repository performance and other waste transformation processes may be evaluated in the future. How was it determined which processes were important and which were not.

EPA-128 RESPONSE

The determination of the relative importance of specific transformation processes to the performance of the repository is a function of uncertainty and sensitivity analyses. Relative importance is based on the sensitivity of the calculated result to unit change in particular transformation process related input(s).

EPA-129 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Pages 4-44 through 4-48

The document presents various waste transformation processes. DOE should present these processes in flow diagram format in order to illustrate the waste transformation issues.

EPA-129 RESPONSE

See resolution to EPA comment number 128.

EPA-130 COMMENT

CHAPTER 4 - WASTE DESCRIPTION

Page 4-48

Please provide more information on the linkage of the Baseline Inventory Report (BIR) to the performance based waste envelope in Chapter 4.

EPA-130 RESPONSE

The BIR is input to the PA. The PA process will in turn, determine the set of waste related WAC restrictions that should constitute the limits of the waste envelope based on calculated repository performance.

EPA-131 COMMENT

CHAPTER 5 - MONITORING

This chapter cites RCRA requirements only in regard to the VOC Monitoring Programs for the mixed repository and shafts. However, it is important to recognize that several additional RCRA permit requirements apply that could require more extensive monitoring of various environmental media. Section 268.6(m) states that requirements under 40 CFR 260 through 271 must be met. For example, the permit standards (under New Mexico jurisdiction) of 264 Subpart X contain monitoring requirements, and 264.15 (Inspections) and Subpart G (Closure and Post-Closure) also apply. These regulations overlap and reinforce the 191 regulations and DOE Orders, specifically regarding operational safety and occupational health monitoring (including the Waste Handling Building) and post-closure

monitoring.

EPA-131 RESPONSE

The CSR was written with the intent to establish the project's status with respect to 40 CFR 191 and 40 CFR 268. The DOE has addressed the requirements of 20 NMAC 4.1 (formerly HWMR-7), including those found in Sections 260 through 271, in the WIPP RCRA permit application.

EPA-132 COMMENT

CHAPTER 5 - MONITORING

Although it may be technically correct to focus on 268.6 compliance, a brief discussion of the other relevant RCRA permit requirements will facilitate integration of both the 191 and 268.6 demonstrations with the Part B permit application. These may be outlined in Section 11, Other Laws.

EPA-132 RESPONSE

The DOE recognizes that there are various RCRA regulations that apply to the disposal of waste at WIPP and that these regulations overlap in certain areas. However, the CSR was written with the intent to address only those requirements in 40 CFR 191 and 40 CFR 268.

EPA-133 COMMENT

CHAPTER 5 - MONITORING

The DOE states that it will expand its Environmental Monitoring Plan to include nearby cities, villages, and ranches, upon receipt of waste. A baseline was set by the RBP. To what extent does the baseline already include data from these proposed locations?

EPA-133 RESPONSE

The expansion of the Environmental Monitoring Plan is currently under evaluation and no final determination of additional sampling locations, if any, has been made. The current baseline information and sampling locations can be found in DOE/WIPP 92-007 Site Evaluation Report, 1991. Specifically, Appendix 1, which is a copy of DOE/WIPP 92-037, Statistical Summation of the Radiological Baseline for the Waste Isolation Pilot Plant, contains the relevant information. Nearby cities and ranches are included in

the baseline.

EPA-134 COMMENT

CHAPTER 5 - MONITORING

The DOE states that subsidence and seismic monitoring will be used in post-closure monitoring of the WIPP to evaluate aspects of the WIPP without jeopardizing the containment capabilities. Additionally, DOE states long term monitoring will focus on evaluating the integrity of the repository rather than detecting specific contaminants to ensure containment of the waste throughout the closure/post-closure period of the WIPP. This implies that the Department has no plan for directly detecting the movement of radionuclides or chemical contaminants to the accessible environment after closure. Of the options being evaluated for long-term monitoring of the WIPP facility's performance (hydrological, geological, geochemical/geophysical, and structural factors) only hydrological monitoring has the capability of directly monitoring movement of contaminants toward the accessible environment. The other options only monitor design aspects of the WIPP related to assumptions used in the Code development of the PA. The Agency requests that DOE explain any other non-destructive monitoring techniques that may be employed and provide documentation demonstrating the inability to directly monitor for radionuclides without jeopardizing the integrity of the repository.

EPA-134 RESPONSE

Direct monitoring to detect migration of radionuclides, VOCs, and metals through the Salado Formation (specifically the anhydrite layers) will jeopardize the integrity of the repository with respect to its long-term performance. Additional discussions of the potential for other long-term non-destructive monitoring techniques was provided in the DCCA and the draft NMVP, along with the DOE's rationale for not proposing direct monitoring of radionuclide and chemical movement.

EPA-135 COMMENT

CHAPTER 5 - MONITORING

Relationship to Format and Content Guide - In Chapter 5 (Monitoring), the Post-Closure Monitoring section has been eliminated. The EPA believes that a detailed plan on post-closure monitoring should be included in the

compliance application.

EPA-135 RESPONSE

The DOE has provided plans for post-closure monitoring in the DCCA. Post closure monitoring for RCRA will be described in the NMVP.

EPA-136 COMMENT

CHAPTER 5 - MONITORING

Page 5-7, first paragraph

Given the current AKYZO NY Salt Mine experience, long - term subsidence monitoring is both advisable and scientifically important to provide relevant data to future programs.

EPA-136 RESPONSE

The analogy to the AKZO facility is inappropriate because of the high extraction ratios and abundance of fresh water. The DOE has included subsidence monitoring in its plans. These plans were provided in the DCCA. Long-term monitoring for RCRA will be described in the NMVP.

EPA-137 COMMENT

CHAPTER 5 - MONITORING

Page 5-7, fourth paragraph

Long-term monitoring is related to 268.6 compliance, but the type of monitoring is unclear. Please clarify what long-term monitoring is planned to address 268.6 compliance.

EPA-137 RESPONSE

A monitoring plan will be included in the NMVP that describes the monitoring system designed to comply with all applicable RCRA long-term monitoring requirements.

EPA-138 COMMENT

CHAPTER 6—TEST PROGRAMS

Chapter 6 on Test Programs does not discuss experiments

currently under way designed to resolve issues, but instead provides a brief discussion of current issues and DOE's position on whether these issues are resolved. Neither the time provided for review of this report nor the level of detail included in the document allows for EPA to evaluate this list for completeness or accuracy. Therefore, EPA has performed an informal review of this material. It is the understanding of the EPA that the SPM will allow for the re-examination of this list of issues and test programs.

EPA-138 RESPONSE

EPA's review of the issues discussed in the Compliance Status Report has been helpful in focusing attention on important issues and in providing guidance—albeit informal—on the extent to which an issue has, or has not been satisfactorily resolved.

EPA-139 COMMENT

CHAPTER 6—TEST PROGRAMS

The document focuses on a specific subset of issues, but does not discuss the full range of topics that affect compliance assessment, particularly those relative to compliance with 40 CFR 264 and 268. For example, this section of the document does not discuss issues relative to waste characterization, which are clearly important issues to both the NMVP and Part B permit. The DOE should clarify that only a subset of the relevant issues is discussed in this chapter with a focus on those pertinent to 40 CFR 191, or DOE should include the full spectrum of compliance issues which has yet to be resolved.

EPA-139 RESPONSE

Issues relative to compliance with 40 CFR 264 were not discussed as they were beyond the scope of this document. The full spectrum of issues relative to compliance demonstration will be addressed in the CCA and other relevant compliance submittals.

EPA-140 COMMENT

CHAPTER 6—TEST PROGRAMS

Those issues presented within this section are not discussed in such a manner that the full spectrum of topics associated with the issue is presented. Thus,

issues that are truly "open" are discussed as "resolved" within the document. For example, the text may imply resolution of the "entire" issue has been accomplished, where in truth only a portion of the issue has been resolved (see the discussion on Paleoclimate)[1]. All discussion should be modified to clearly state the specific issue which was addressed, as many topic associated with the overall issues discussed have not been resolved.

EPA-140 RESPONSE

EPA's comments on the extent to which EPA considers an issue resolved have been invaluable in focusing DOE attention on the important aspects of an ultimate demonstration of compliance. Every effort will be made in the future to clearly state the specific issue being addressed.

EPA-141 COMMENT

CHAPTER 6—TEST PROGRAMS

DOE has identified most pertinent issues and classifies their status according to their current understanding as to whether the issues are resolved. Approximately 150 references are provided to support the DOE conclusions; however, neither a summary of the information where the issue is resolved is provided, nor the applicable section of the document. In order to provide the information necessary to resolve outstanding issues, the EPA suggests such documentation be provided in an Appendix to follow-up reports to the CSR.

EPA-141 RESPONSE

DOE will provide EPA with the relevant segments of referenced documents cited in the Compliance Certification Application and other relevant compliance submittals.

EPA-142 COMMENT

CHAPTER 6—TEST PROGRAMS

Several issues appear inappropriately resolved through

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[1] This refers to an EPA comment that the effects on the WIPP of climatic shifts—such as those shown in the paleoclimatic studies—have not been resolved. (See comment 14 to this section).

use of the term reasonable expectation. For example, thermal expansion is identified as resolved by calculations of Thorne and Rudeen (1980); but no further information is provided. To resolve this issue DOE should provide information such as what thermal loading was assumed in the study and how that compares to RH and CH waste. A determination that there is a reasonable expectation of compliance with the containment requirements based on the record before the implementing agency should not be construed to mean issues can be resolved without a thorough review of the facts. The EPA suggests in future documents that DOE provide pertinent facts that support resolution of the issue as they know and understand them. Reasonable expectation is a judgment value of the implementing agency, in this case EPA, based on the full record before it.

EPA-142 RESPONSE

The DOE agrees that issue resolution will require an acceptable level of documentation. The definition of "issue" may, however, be the question. The DOE has never considered thermal output of TRU waste to be an issue. The DOE looked at thermal properties of salt when the project included experiments with Defense High Level Waste and when there were non-radioactive tests to simulate the emplacement of heat producing waste in salt repositories.

EPA-143 COMMENT

CHAPTER 6—TEST PROGRAMS

What does it mean when the DOE considers an issue resolved? The intro states "an issue is considered resolved if all the current compliance-related, technical aspects of the issue have been addressed." However, issues such as the importance of the Dewey Lake Beds in evaluating compliance for disturbed scenarios including future wetter climates, have not been presented to the EPA for review and are clearly not resolved. It does not appear that the Department is using a consistent approach to resolving issues. It is also recommended that for unresolved issues positions of various stakeholders be provided.

EPA-143 RESPONSE

This comment appears to be related to EPA comment 140, which suggested that discussion of the issues should be

modified to identify clearly the specific issue addressed. Adoption of EPA's suggestion in EPA comment 140 should remove any ambiguity as to whether an issue is or is not resolved. The positions of various stakeholders will be considered.

EPA-144 COMMENT

CHAPTER 6—TEST PROGRAMS

One unresolved issue is a determination of the waste parameters to be used in Disposal Room Modeling. Current modeling uses an aggregate for the compaction properties of the waste. With the wide variability of the waste and the potential for significantly different waste streams in the future than those produced in the past, the sensitivity of performance to this parameter should be evaluated.

EPA-144 RESPONSE

Uncertainty and sensitivity analyses will identify the parameters that are important to PA. If final PA indicates that compaction properties require further attention, the issue will be addressed.

EPA-145 COMMENT

CHAPTER 6—TEST PROGRAMS

The issue of the dissolution front of the Pecos River may, in fact, be resolved. However, other causes of dissolution may not be resolved (for example, dissolution caused by casing or plug failure in resource recover and evaluation wells, both above and below the repository level). These forms of dissolution are well documented throughout the Permian Basin. These types of dissolution may cause salt deformation and collapse, and surface collapse and subsidence. Therefore, dissolution as a potential hazard at the WIPP has not been removed.

EPA-145 RESPONSE

The discussion of dissolution in the CSR focused on dissolution from naturally occurring phenomena. Dissolution from artificially created events, such as casing or plug failure in resource recovery and evaluation wells, is being addressed in PA. Results of these evaluations will be provided in the scenario development and scenario screening discussions included

in the CCA and other relevant compliance submittals.

EPA-146 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-2, last paragraph

The document states that borehole plugs were considered to have reached acceptance performance (levels), but this conclusion is not supported within the document. What is this performance level? How was it determined? What materials are planned to be used, and are there any important long-term considerations that must be taken into account when using these materials?

EPA-146 RESPONSE

The plugging of boreholes has been extensively investigated. The DOE will assume a reasonable permeability value in PA for borehole plugs. This permeability value will be justified in the CCA. It should be noted that most of the boreholes are located sufficiently far from the repository that sealing will likely not be required. If PA results indicate to the contrary, DOE will consider plugging boreholes as an option, as well as other methods, to rectify the issue.

EPA-147 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-3, third paragraph

Section 2.0 of this document implies that additional geophysical surveys will be conducted relative to the Castile structural anomaly below the WIPP panels to further assess whether this pocket contains brine. Please clarify whether this will be performed.

EPA-147 RESPONSE

There are no additional studies currently planned relative to the Castile structural anomaly. The potential for Castile brine reservoirs are reasonably treated in PA. The most current information can be referenced in the DCCA and the update.

EPA-148 COMMENT

CHAPTER 6—TEST PROGRAMS

Pages 6-4 through 6-5

Although most issues associated with deep dissolution and karst development have been resolved, some dissolution issues remain. For example, dissolution has affected (and may continue to affect) the occurrence/destruction of fracture-filling material, and could definitely affect the WIPP for the human intrusion scenario. Also, there has been no assessment to date of the potential impacts of mining activity adjacent to the site relative to dissolution.

EPA-148 RESPONSE

The most current information on these topics can be referenced in the DCCA, the update, and the draft NMVP.

EPA-149 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-6, last paragraph

While karst feature development at WIPP is currently limited and does not appear to be an issue presently (see paper written by the EEG in 1994 for the State of New Mexico concerning karst), it is still an element of PA and no migration variance determinations which will focus on the effects of climatic changes relative to WIPP. Therefore, dissolution under varying climatic conditions is a part of ongoing assessments, and cannot be considered completely resolved.

EPA-149 RESPONSE

The most current information on these topics can be referenced in the DCCA, the update, and the draft NMVP.

EPA-150 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-7, second paragraph

The document correctly indicates that natural background radiation values should be determined, but has not discussed the potential for "background" VOCs

that could occur at the WIPP site and surrounding areas due to normal facility operations, that could directly affect detection of hazardous constituent releases.

EPA-150 RESPONSE

The most current information on these topics can be referenced in the DCCA, the update, and the draft NMVP. No monitoring program is currently proposed for the operational timeframe as the DOE has concluded it would not provide meaningful data. The same strategy is being used in development of the final NMVP.

EPA-151 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-7, fourth and fifth paragraphs

Although the paleoclimate itself has been determined, the effects that climatic shifts (such as those shown in the paleoclimatic studies) would have on the WIPP in the future have not been resolved.

EPA-151 RESPONSE

The most current information on these topics can be referenced in the DCCA, the update, and the draft NMVP.

EPA-152 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-9, last paragraph

Because the issue of brine occurrence within the Castile is not resolved, the effects of salt deformation—which DOE states occurs with every brine pocket—cannot be considered resolved, except that the presence of the features has been determined. Again, "how" the issue is resolved should be clarified within the text of the document. The occurrence of the Castile features below WIPP has been resolved, but the effect of these features on WIPP PA/no-migration determinations has not been resolved.

EPA-152 RESPONSE

The issue of brine occurrence within the Castile is resolved. Brine is present in the Castile (Popielak et al., 1983) and is reasonably treated in PA. Rock

mechanics and geological data indicate that it is reasonable to assume that no significant natural deformation will occur at the site over the period of regulatory concern.

REFERENCES

Popielak, R. S., R. L. Beauheim, S. R. Black, W. E. Coons, C. T. Elligson, and R. L. Olsen. 1983. *Brine Reservoirs in the Castile Formation, Waste Isolation Pilot Plant (WIPP) Project, Southeastern New Mexico.* TME 3153. Albuquerque, New Mexico: U.S. Department of Energy.

EPA-153 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-10, last two paragraphs

Please clarify whether the subsurface panels have been constructed to withstand the same earthquake as the surface structures.

EPA-153 RESPONSE

Design class II confinement structures and components are designed to withstand a design basis earthquake (DBE). The underground falls into design class IIIB. There are therefore no design requirements for the underground regarding earthquakes. The WIPP FSAR documents that potential earthquake effects on underground structures are minimal.

EPA-154 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-14, first two paragraphs

The text of the document should be expanded to indicate that chemical retardation processes are also important relative to hazardous constituents, as well as radioactive constituents.

EPA-154 RESPONSE

The issue of chemical retardation in the transport of hazardous chemical constituents will be addressed in the final NMVP.

EPA-155 COMMENT

CHAPTER 6—TEST PROGRAMS

Pages 6-15 to 6-17

Please provide a discussion of observed vs. predicted room closure; discussion of model accuracy and acceptability is not sufficient to demonstrate that room closure is fully understood.

EPA-155 RESPONSE

The discussion presented in the CSR was intended to cover somewhat more ground than just the problem of the disagreement between observations and the initial computations of room closure. The first point presented is that careful checks have been made to establish that the models being used for WIPP analyses are not flawed mathematically or in the coding. Clearly this would be important to establish even if no specific discrepancy between observation and prediction existed. However, it is particularly important to current concerns because it pointed to the conclusion that the resolution of the discrepancy between observation and model should be sought in the description of the physical behavior of the formation.

The second part of the discussion was intended to summarize the resulting improvements in understanding the formation and its deformation characteristics, but the distinction between discussion of physical issues and of model manipulations was not very clearly presented. Several aspects of formation behavior were re-examined when the discrepancy between initial model calculation and observed effects was identified. One possibility was that transient effects in the salt deformation might be greater than expected; transient response would have a particularly large impact on observed behavior (which covers a considerably shorter time scale than the interval projected for completely closing a room). Another issue was the fact that the initial modeling was done using creep properties measured for clean salt, which is not representative of the entire formation in situ. In addition, the formulas used to describe the creep behavior were examined with attention to possible alternative creep laws. Finally, the detail to which the local stratigraphy was modeled in the initial calculations was reconsidered. The formation includes thin, weak seams of shale, or clay, which are insignificant

volumetrically but which provide a locus for shear failure that can allow large displacements to develop.

The resolution of the discrepancy between observed room closure rates and model results involves contributions from all these effects. The central feature of the improved deformation model is the adoption of an alternative creep law which had originally been put forward in 1979 (Munson and Dawson, 1979 and 1982), and further refined by inclusion of specific properties for argillaceous, as well as clean, salt (Munson et al., 1989) to better represent the two major salt layers at the site. This creep formulation addresses transient creep behavior with work hardening, as well as long time scale steady creep, and employs a different criterion for deformation under a multi-axial stress field than did the creep law used in the initial modeling (Tresca rather than von Mises yield). Detailed laboratory testing of core material under uniaxial and multi-axial loads (Mellegard et al., 1992) verified that the behavior of the salt could be better described as suggested by Munson and Dawson. In addition, based on further study of the stratigraphy of the formation near the repository level, Munson proposed an improved value for the friction coefficient used in the model to represent slippage along the clay seams (Munson, 1992). A sensitivity study was made with the model to determine the impact on model results due to varying levels of detail in the description of the stratigraphy. Not surprisingly, the clay seams closest to the repository were found to account for by far the largest portion of the slippage, with the four beds nearest the repository contributing about 90 percent of the total effect of stratigraphy.

With these model revisions and improvements, new closure simulations agree closely with observed behavior. This includes both the original set of observations and additional data that have been gathered since the problem with the initial model results came to light. These data include measurements in both rooms and shafts for both unheated and heated conditions (Munson and Devries, 1991). In addition, good comparison with observation has been achieved in a test designed specifically to present a difficult simulation problem, involving an excavation with large variations in length scale in all three dimensions (Munson et al., 1993). Agreement of the improved closure model with a large and varied body of observations is the principal basis for concluding that a good understanding of creep closure has now been achieved. Current information on room closure modeling

can be referenced in the DCCA and the update.

Note: All the above references are included in the reference list at the end of Chapter 6 in the CSR, with the exception of Munson, 1992, which is "Appendix A: Mechanical Parameters for Volume 3, SAND92-0700," *Preliminary Performance Assessment for the Waste Isolation Pilot Plant, December 1992. Volume 3: Model Parameters.* Sandia WIPP Project. SAND92-0700/3. Albuquerque, NM: Sandia National Laboratories. A-107 through A-123.

EPA-156 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-19, second paragraph

Please clarify how the Bell Canyon could be a source of brine at the repository level if the repository were not pressurized. Questions pertaining to the Bell Canyon are still apparent (see Chapter 2.0 comments). Further, an understanding of the uppermost source of drinking water is required under the PA; since the Dewey Lake may contain potable water and has not been assessed, characterization of these units cannot be considered resolved.

EPA-156 RESPONSE

If the repository were not pressurized, the Bell Canyon could be a source of water at repository levels if a connecting borehole provided a flow path, and that flow path did not allow contact with soluble evaporites along its entire length. Thus, the borehole would have to be open to the Bell Canyon, and open in the Salado Formation only to the repository. It is reasonable to conclude that this is of low probability. If the fluid rising slowly from the Bell Canyon (due to the Bell Canyon's relatively low permeability) contacts soluble minerals, the density of the column of water in the borehole will rapidly increase, and water rise will stop due to equilibrium between head in the borehole and the head in the Bell Canyon.

EPA-157 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-23

The effects of gas generation are discussed only in terms of flow and transport. It is important to include the effects of disposal room modeling and how gas generation and different waste forms may affect final porosity in these discussions.

EPA-157 RESPONSE

Current information on these topics can be referenced in the DCCA and the update.

EPA-158 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-24, third paragraph

The effect that a release of Bell Canyon water would have on the WIPP has not been resolved, as discussed in previous comments.

EPA-158 RESPONSE

See discussion in EPA-156 for this answer.

EPA-159 COMMENT

CHAPTER 6—TEST PROGRAMS

Page 6-24 through 6-30

All of these issues significant to PA compliance must also be evaluated relative to compliance with 40 CFR 264 and 268. Specifically address compliance relative to requirements of these significant regulations.

EPA-159 RESPONSE

The 40 CFR 264 Subpart X defines environmental performance standards for "...operators of facilities that treat, store, or dispose of hazardous waste in miscellaneous units...." WIPP is a miscellaneous unit. The requirements in this Subpart are for the operational phase and require a permit from the NMED.

The RCRA permit has since been submitted to the EPA. Not all of the long-term issues in PA are included in the RCRA permit issued under 40 CFR 264. Generally, the permit covers closure and post closure for about 30 years after closure. Compliance with requirements in 40 CFR 268 and 191 will be addressed separately in the NMVP and the CCA (respectively).

EPA-160 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

The subject of audits should have been specifically addressed within the scope of this document. Though a DOE auditing plan exists, for purposes of the WIPP, it appears to be ineffectively administered. Conclusions from previous audit reports indicate inconsistency among auditors, lack of accurate procedural guidance for auditors, an inadequate audit schedule, as well as the total lack of auditing activities, particularly with regard to subcontractors. This could potentially cause problems with validation of data used in the performance assessment and the eventual compliance application.

EPA-160 RESPONSE

Several levels of independent assessment are implemented in the CAO QA program. DOE performs independent assessment of major project participant processes and products; each program participant (SNL, WID, and DOE generator site M&O contractors) internally assess their programs using personnel independent from the work; and subcontractors undergo source inspections, surveys and audits performed by the project participants.

In addition to independent assessment, the CAO implements a management assessment program founded on routine verification of work and quality goal accomplishment by workers and management.

EPA-161 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

This document should have clearly outlined the management hierarchy for quality assurance, including the mechanisms for interaction with all facets of the WIPP.

EPA-161 RESPONSE

DOE has established a QA document hierarchy to ensure the requisite level of control and priority are established. The QA program will be described in the CCA and other relevant compliance submittals.

EPA-162 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 1, paragraph 3

From 1975 to 1977, there were no formal QA programs applied to WIPP geotechnical data collection activities. This introduces the dilemma of "qualification of existing data" for which there is no uniform DOE guidance existing to date.

EPA-162 RESPONSE

No data from the 1975 to 1977 period are expected to be used in the compliance analysis. If they are to be used they will be qualified. A process for existing data qualification has been developed in 1994 by the CAO and SNL, with input from EPA.

The process is based on guidance from NUREGs 1298 and 1297, and is being implemented on existing data packages now. The data qualification process begins with identification and prioritization of data sets needed for compliance calculations or settlement of compliance issues. A data package is assembled by a team and is evaluated for completeness. An independent review team reviews the package for adequacy in meeting equivalent QA program requirements (evaluating the QA controls in place at the time of data collection). If necessary, alternative methods for qualifying the data are selected (i.e., corroborating data, confirmatory testing, peer review, or abandonment).

EPA-163 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 2, paragraph 2

Future QA programs for the WIPP will be based upon the Carlsbad Area Office Quality Assurance Requirements and Description (QARD), not expected for release until August 1994. Given that the DOE WIPP schedule projects a 1996 compliance application submittal, this would

imply that the overwhelming amount of data used in the demonstration of compliance would exist before implementation of this new QARD. Therefore, what are DOE plans for re-qualifying this data?

EPA-163 RESPONSE

The referenced document, "Quality Assurance Requirements and Description," was issued in June 1994 as CAO-94-1012, U.S. Department of Energy Carlsbad Area Office Quality Assurance Program Description.

The requirement for QA has been constant throughout the WIPP Program. Implementation has been through a series of requirements that have evolved over the years to provide emphasis on areas of growing importance for the preservation of safety and protection of human health and the environment. The WIPP QA program is expected to remain a viable management system, reflecting necessary changes in requirements as they become effective. The DOE does not plan to re-qualify any data that is determined to meet the applicable QA requirements at the time it was generated. Where the data is to be used for significantly different purposes from those intended when it was collected and where existing QA documentation may be determined inadequate when compared to the appropriate standard, DOE will consider re-qualification as an option.

EPA-164 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 2, paragraph 2

This to-be-issued QARD "will be based on applicable requirements of the DOE Order 5700.6C, ANSI/ASQC E4 (ASQC, 1993), QAMS-005/80 (EPA,1980), and ASME NQA-1 ... [and as guidance] NUREG-1297, NUREG-1298, NUREG-0856, and NUREG/BR-0167. This to-be-issued QARD should address the requirements of NQA-2 (part 2.7) and NQA-3 as well. In addition, the DOE should consider guidance in the forthcoming 40 CFR Part 194 when evaluating existing data.

EPA-164 RESPONSE

The CAO QAPD (June 1994) has been prepared to implement the requirements of NQA-1, NQA-2 Part 2 and 7, and NQA-3.

EPA-165 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 3, paragraph 2

The plan that "[e]ach CAO program participant will develop and implement appropriate methodology for qualification of existing data ..." may result in the creation of an inordinate (and potentially unmanageable) number of QA plans, considering the volume of projects done since the days of site characterization in the 1970's. With this many QA programs addressing "existing data," determining whether or not the required Data Quality Objectives (such as, comparability, reproducibility, validation, completeness, etc.) have been met will be difficult. A single program for validation of old data is recommended.

EPA-165 RESPONSE

See response to EPA-163

EPA-166 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 3, paragraph 4

The Performance-Based Waste Acceptance Criteria (WAC) has not yet been issued. Quality Assurance guidance should be included in the WAC rather than creating a different plan for each of the ten generator sites (in order to promote uniformity and consistency). Each site should, however, be responsible for the implementation of the Quality Assurance requirements and for documentation of this activity. In addition, as part of the WAC, each generator should be required to calibrate all instrumentation with NIST standards in order to ensure data traceability, comparability, and reproducibility among all generator sites. The issue of instrumentation error bands must be addressed before the submittal of a compliance application.

EPA-166 RESPONSE

The Waste Acceptance Criteria (WAC) document, rather than including unique QA requirements, references existing QA requirements that are applicable to all DOE TRU waste generator site certification programs. In particular, the current WAC promotes compliance with

the QA requirements of DOE Order 5700.6C, *Quality Assurance*, and states that programs developed and implemented using ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, are acceptable. Both of these QA standards require that equipment used for measuring and tests be calibrated and maintained against certified equipment having known valid relationships to nationally recognized standards. The issue of instrumentation error will be addressed.

EPA-167 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 4, paragraph 1

The incorporation of process knowledge for use in waste characterization must first undergo a quality assurance review.

EPA-167 RESPONSE

QA controls for process knowledge include design documentation (e.g. specifications, drawings, process models), construction and acceptance test records, operating reports, and process stream analyses.

EPA-168 COMMENT

CHAPTER 7.0 - QUALITY ASSURANCE

Page 4, section 7.2

This section on Models and Codes should have specifically addressed the QA status of all existing codes used in performance assessment.

EPA-168 RESPONSE

Model and code QA for the PA is being addressed on a schedule that will support development of the CCA and the NMVP per the current disposal decision plan. The EPA has been made aware of the status of these efforts since the issue of the CSR.

EPA-169 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Although we recognize that the EPP currently has a series of studies underway to define or bound some of

the conceptual models, to some extent the conservative alternative conceptual models listed at the top of page 8-3 represent the only conceptual models that are defensible at this time. However, DOE continually points to the results of their PA with the unproven assumptions as indicating compliance of the WIPP with 40 CFR Part 191. The Agency cautions against the use of results from PAs with indefensible input values.

EPA-169 RESPONSE

DOE recognizes the concern expressed here. DOE's experimental program is designed to obtain defensible input values to evaluate the validity of alternative conceptual models. The performance assessment done for the CCA and the NMVP will have available to it more data and information related to input values than the assessment done in 1992. Assumptions made in the PA modeling will be justified, as appropriate, in the CCA and other relevant compliance submittals.

EPA-170 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

The Agency suggests that upon promulgation, the DOE adopt the proposal in 40 CFR Part 194 when addressing human intrusion rates.

EPA-170 RESPONSE

Comment noted.

EPA-171 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

One concept not identified in the model validation and verification section is the use of natural analogs as a method to provide confidence in the selected model. Will the use of natural analogs to help verify the appropriateness of DOE's models be used where possible?

EPA-171 RESPONSE

Yes. The DOE will continue to use natural analogs where possible and practical.

EPA-172 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

This chapter describes the methodology used to evaluate the WIPP disposal systems, including model development, scenario selection and analytical approach. The chapter is so short on specifics that it is unclear what approaches will actually be taken.

EPA-172 RESPONSE

The most current information can be referenced in the DCCA and the update. A more detailed description will be developed for the CCA and other relevant compliance submittals.

EPA-173 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Standard procedures on inputs to the models will ultimately need to be developed along with their justification.

EPA-173 RESPONSE

Standardized quality assurance procedures for both code development and for development and traceability of inputs and output are under development. This effort includes qualification of existing data. Relevant procedures for PA models are the Sandia National Laboratories WIPP Quality Assurance Program's procedures QAP 9-1, QAP 19-1, QAP 4-1, QAP 20-2, and QAP 20-3.

EPA-174 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

A "testing" of various model assumptions needs to be conducted and a discussion prepared as to how varying model assumptions can change the controlling parameters.

EPA-174 RESPONSE

Compliance analysis is the process of assessing the effective containment of regulated-waste contaminants relative to long-term performance standards through the use of PA. This process requires the detailed

assessment of technical processes and parameters that are characterized by a high degree of uncertainty. This uncertainty can result from uncertainty in the physical parameters or the models (and their associated assumptions) used to simulate the performance of the system. The PA methodology, which is probabilistic in nature, facilitates a rigorous uncertainty and sensitivity analysis to help identify and rank those uncertain parameters and processes that have the greatest potential to influence the results. This process in turn provides the information necessary to identify those computer models, and thereby their assumptions, that have the greatest potential to influence the results.

To ensure the product quality in the design and development of process models, systematic quality assurance procedures have been implemented (or are currently being developed) for the conduct of model design, development and review. These procedures include QAPs 3-1, 3-2, and their related procedures. These and related procedures describe the process of documenting the design and technical review of individual PA process models.

EPA-175 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

When all the model components are assembled, what is the methodology for determining overall reliability? (And, the effect(s) of individual component performance on the overall system?)

EPA-175 RESPONSE

The goal of the PA process is to develop and document a "reasonable degree of certainty" and a "reasonable expectation" that the WIPP will comply with the regulatory standards for the containment of regulated waste contaminants for the regulatory time frame of 10,000 years. This is accomplished through the development of computer models that simulate the parameters, individual processes, and phenomena (both natural and human-induced) that are anticipated to affect the WIPP over this period. Those individual models are then integrated into an overall PA modeling system that, when exercised, provides an estimate of the performance of the repository and an indication as to the uncertainty in the result.

In the strict sense, fully integrated PA model validation is not possible or practical. The regulatory time frame of 10,000 years precludes comparison of simulated results to empirical observations. Therefore, the methodology for determining the reliability of the fully integrated PA model is essentially one of confidence building. This includes building confidence in the development of the individual process models, identifying their interdependencies (if any), and integrating them, in a self-consistent manner, into a fully integrated PA model. Building confidence in the individual process models is accomplished through a rigorous process of validation and verification. The validation process can be accomplished in one of two ways: (1) through the testing of isolated processes and/or the matching of previous uncontrolled observations or (2) calibration and history matching. Both of these validation methods are described in detail in Sections 8.1.2.1 and 8.1.2.2 of the Compliance Status Report.

EPA-176 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

The use of expert panels is appropriate but should be treated like other methodologies, i.e., written procedures along with QC Plans should be developed. Since many experts disagree about which hazards present the greatest risks, their use in determining uncertainty is probably more useful than in ranking inputs.

EPA-176 RESPONSE

Quality assurance procedure QAP 9-3, Use of Expert Judgment Panels, is in the process of being developed. This procedure will be applied to all future expert elicitation processes. When applied, this procedure will ensure a consistent and systematic approach to eliciting the opinions of experts, describe the process of compiling the results of those elicitations, and provide guidance regarding the interpretation of the results. The elicitation and use of expert judgment, as documented in the Compliance Status Report, is based on a formalized process. This process is documented in Rechard et al. (1993).

REFERENCE

Rechard, R. P., et al., "The Use of Formal and Informal Expert Judgments When Interpreting Data for Performance Assessments," Sandia National Laboratories report, SAND92-1148, February 1993.

EPA-177 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Page 8-8, first paragraph

Please cite specific examples of how the confidence-building calibration and history-matching model validation method is being used.

EPA-177 RESPONSE

LaVenue and RamaRao, 1992, (SAND92-7306), and related reports, have used various stochastic models to calibrate continuous, Culebra transmissivity fields to observed, discrete data. These are calibration and history-matching methods which increase confidence in the suitability of a given parameter distribution for use in models.

EPA-178 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Page 8-13, first paragraph

The document states that "concerns raised during the development of the WIPP have led to the inclusion of three additional events and processes not identified by the panel: gas generation by the degradation of the waste, waste-related explosions, and nuclear criticality." Please reference where in the 1992 PA the latter two are presented and evaluated.

EPA-178 RESPONSE

The three referenced events are identified in the technical basis for the 1992 PA, Volume 2, Chapter 4, Section 4.1.1, Lines 20-22 and Table 4-1.

The Summary of Screened Events and Processes (Volume 2, Section 4.1.4, Page 4-7, Lines 7-10) states: "...explosions caused by the ignition of gases created by waste degradation have no effect on the long-term

performance of the disposal system and can be eliminated from scenario development." This is based on the consequence criteria in Appendix B of 40 CFR 191 as described in the 1992 PA document: "...events and processes may be omitted from the performance assessments if there is a reasonable expectation that the remaining probability distribution of cumulative releases would not be significantly changed by such omissions." (See Volume 2, Pg. 4-3, Lines 15-18.)

The Summary of Screened Events and Processes (Volume 2, Section 4.1.4, Page 4-7, Lines 7-10) also states: "Nuclear criticality requires additional evaluation before a screening decision is made." No further evaluation is presented in the 1992 PA Scenario Construction.

Table 4-2 indicates that the justification for screening out nuclear criticality explosions is "low probability." Based on Appendix B of 40 CFR 191 as described in the 1992 PA document, this means that "the event is estimated to have less than one chance in 10,000 of occurring over 10,000 years." (See Volume 2, Pg. 4-3, Lines 12-13.)

The most recent scenario development and scenario screening information can be referenced in the DCCA and the update. This information will be provided in its final form as part of the CCA and other relevant compliance submittals.

EPA-179 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Page 8-14

In evaluating compliance, the EPA will not necessarily exclude "systematic drilling of multiple boreholes for resource production or other purposes, and modes of intrusion other than exploratory drilling" from analysis of inadvertent human activities.

EPA-179 RESPONSE

Your comment is respectfully noted. However, the Agency should bear in mind that such a concept is in direct conflict with the technical basis used by EPA to develop the containment requirements that exist in the 40 CFR 191 standard today.

EPA-180 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Page 8-17, Table 8-3

The DOE should justify why the category of "injection wells" is screened out as "physically unreasonable." Given the identified potential for oil and gas well development and the well established practice of waste injection and production stimulation wells in the oil and gas industry, this determination is very questionable. For example, the possibility of injection at the Engle well, near the H-9, or the Devon Energy Corp. Todd 26 Federal #3 salt water disposal well causing the heads in the Culebra to rise, or the water flows created in the Salado because of casing failures and cement problems in the Vacuum Field 15 miles northeast of the WIPP site. The possibility of fluid injection affecting the WIPP disposal site in the future is a realistic scenario and should not be screened out.

EPA-180 RESPONSE

The reason for marking injection wells as "physically unreasonable" is stated on page 8-18. "Intrusion by injection wells into the waste-emplacement region is not modeled explicitly in the PA, because drilling technology and the resultant consequences are assumed to be the same as for exploratory drilling."

The Commentor expresses concern about several possible consequences of the presence of an injection well. Some such issues, such as potential cross communication due to cementing problems, are the same as for other wells, such as exploratory wells. However, the commentor also points out the need to consider events related to injection operations near the repository. The most current information regarding these issues can be referenced in the DCCA update.

EPA-181 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Page 8-26

The DOE has stated that they will use a single CCDF determined as the mean of the family of conditional distribution functions to demonstrate compliance. The

DOE should state the level of statistical confidence associated with the mean CCDF.

EPA-181 RESPONSE

The mean Complimentary Cumulative Distribution Function (CCDF) represents the entire spectrum of possible outcomes and their associated probabilities as calculated by the PA model. A discussion of the level of confidence associated with the mean CCDF will be included in the Compliance Certification Application.

EPA-182 COMMENT

CHAPTER 8—COMPLIANCE ANALYSIS

Page 8-30

The DOE states that they have formalized a process for eliciting judgment from expert panels. The Agency will be specifying requirements for the background of experts, the constituency of expert panels, and soliciting expert judgment from the panel as part of the Compliance Criteria (40 CFR 194). The Department should be prepared to modify their process to follow forthcoming requirements in this area.

EPA-182 RESPONSE

Conformance to applicable regulatory requirements, as they are established, is intended.

EPA-183 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

The DOE has compiled a plan to satisfy the requirements of active institutional controls, which includes "long-term" control measures. The EPA wishes to caution the DOE that these measures are required to be in place as long as is practicable after disposal and is requesting clarification on DOE's interpretation of "long-term".

EPA-183 RESPONSE

Comment noted.

EPA-184 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Page 9-1, second paragraph, first sentence

This sentence is true only in the limited context of the no-migration petition. Additional RCRA regulatory standards applicable to the WIPP are in 40 CFR Parts 264, 265, 268, and 270. Failure to acknowledge other applicable standards creates the impression that 268.6 is the only RCRA rule of concern. Citation of other regulations - especially those which contain requirements similar or complementary to 191 and 268.6 - will provide simple cross-references which should be helpful to DOE, EPA, state permit application reviewers, and the public.

EPA-184 RESPONSE

The DOE recognizes that there are various RCRA regulations that apply to the disposal of waste at WIPP and that these regulations overlap in certain areas. However, the CSR was written with the intent to address only those requirements in 40 CFR 191 and 40 CFR 268. The requirements of other RCRA regulations will be considered and addressed on separate paths.

EPA-185 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Pages 9-6 and 9-7

Discussion of future uncertainty analyses and scenarios does not mention planned development of additional human intrusion (mining) scenarios. The 1992 PA report seemed to commit further effort to such a scenario(s), and extensive comments were provided to the DOE in this regard. Please explain the plans for development of mining scenarios.

EPA-185 RESPONSE

The 92 PA considered the effects of subsidence due to in local potash mines. As noted in the 1992 preliminary PA (e.g., V. 1, p. 3-11, l. 16-19; V. 1, p. 6-3, l. 19-24), the effects on groundwater flow and radionuclide transport due to subsidence related to potash mining will be examined in PA as appropriate. The most current documentation regarding these issues can be referenced in the DCCA and the update.

EPA-186 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Page 9-7, second and third paragraphs

Discussion of groundwater monitoring includes no mention of 40 CFR 268.6 or other applicable RCRA regulations (e.g., 264.118 and 264.601), which are used to require both operational and post-closure groundwater monitoring at many Subpart X units. Please discuss how the WIPP will comply with these requirements.

EPA-186 RESPONSE

The DOE believes there is no possibility of migration of RCRA contaminants from the disposal unit during operations and the RCRA post-closure period. Consequently, the DOE has provided information in its RCRA permit application that groundwater monitoring is not needed. This issue will also be addressed in the NMVP.

EPA-187 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Page 9-12

The EPA reference is wrong. It should be 40 CFR 191.14(d).

EPA-187 RESPONSE

Comment noted.

EPA-188 COMMENT

CHAPTER 9 - REGULATORY COMPLIANCE ASSESSMENT

Page 9-14, first and second paragraphs

The mine and shaft VOC monitoring program is the only specific example given for RCRA compliance. Post-closure monitoring is only vaguely described. The DOE should provide more complete references to RCRA monitoring requirements (e.g., WHB-VOC monitoring, and groundwater sampling and analysis programs). Please provide details of proposed post-closure monitoring methods and programs.

EPA-188 RESPONSE

The most current information regarding RCRA monitoring plans can be referenced in the WIPP RCRA Permit Application Rev. 5 and in the draft NMVP.

EPA-189 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

This chapter presents in a preliminary and summary fashion, a number of key issues that need to be addressed in the Future Test Program but very few specifics as to when and how. In particular, it is critical to address rock mechanics issues relative to the DRZ and creep phenomena, and gas generation/ migration in a time frame that supports the no-migration variance petition and performance assessment of the WIPP for compliance with 40 CFR 191.

EPA-189 RESPONSE

DOE recognizes the importance of these issues and intends to address them fully in the compliance certification application and no-migration variance petition.

EPA-190 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-2, first paragraph

Please provide more detail and support the statement that "tight gas sands data are simply the closest analog for which detailed data are available." What other analogs were considered and why were they not considered.

EPA-190 RESPONSE

The cited paragraph deals with measurement of two-phase flow properties of the Salado anhydrite. When this part of the CSR was written, no site-specific laboratory data were available for threshold pressure, capillary pressure, and relative permeability of Salado Formation halite or anhydrite. That has changed since the CSR was written. Capillary pressure for WIPP anhydrite has been measured in the laboratory (see response to comment 191, below). Threshold pressure can be extrapolated from that.

However, when the CSR discussion of two-phase flow was written, such data were not available and evaluation of two-phase properties focused on two approaches. One approach was to select approximate analog materials for which complete two-phase measurements had been made. It is that approach which this section describes.

The decision to use tight gas sands as the analog for properties of Salado Formation anhydrite is described in a 19 Nov 90 memo from P. Davies and A. LaVenue to R. Rechard (see Memo 11 in *Data Used in Preliminary Performance Assessment of the Waste Isolation Pilot Plant (1990)*, SAND89-2408, Albuquerque NM: Sandia National Laboratories). Basically, the rationale to use tight gas sands was as follows:

Significant gas penetration into the Salado halite may not occur because of high threshold pressure. Given their higher permeabilities and lower threshold pressure, the Salado interbeds are expected to be the primary units controlling gas release.

The analog material for the anhydrite interbeds was selected based on the lowest permeability material that could be found for which complete capillary pressure and relative permeability had been measured. The analog material was a tight gas sand from a multi-well experiment with an intrinsic permeability on the order of a few microdarcies. The dominant pore geometry of this material consists of intergranular cracks, small solution pores partially filled with dolomite, and some small fractures. Data from the laboratory measurements of this material were incorporated into a slightly modified version of the Brooks and Corey (1964) model to produce complete capillary pressure and relative permeability relations found in Table 1 to the referenced memo (SAND89-2408, Memo 11). The most current information of this topic can be referenced in the DCCA and the update.

EPA-191 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-2, second paragraph

The paragraph states that "neither capillary pressure nor relative permeability has been measured on Salado core samples in the laboratory" and the values applied for these parameters are based on measurements reported in the literature. Please provide detail on the data

available in the literature, how it was derived, what was the basis for the determination of relevance and applicability. Also, it is unclear how the Brooks-Corey relative permeability component can be considered an insignificant parameter since capillary pressure and relative permeability have not been measured on Salado samples.

EPA-191 RESPONSE

Capillary pressure for anhydrite has been measured in the laboratory, and the data are found in a report presented to the GEOVAL Conference in Paris in October 1994 (Beauheim et al., undated). Threshold pressure can be extrapolated from that. No laboratory tests are planned to obtain capillary pressure for halite. The Brooks-Corey correlation, which is used to obtain relative permeability, is still considered a reasonable approach in PA.

REFERENCES

Beauheim, R., S. Howarth, S. Webb, K. Larsen, and P. Vaughn. (No date). *Integrated Modeling and Experimental Modeling to Predict Brine and Gas Flow at the Waste Isolation Pilot Plant*. SAND94-0599C. Albuquerque, NM: Sandia National Laboratories (unpublished as of 1-13-95).

EPA-192 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-3, second and third paragraphs

Please provide time frames regarding when anhydrite fracturing will be incorporated into the PA model.

EPA-192 RESPONSE

An approximation of anhydrite fracturing has been incorporated into the PA model.

EPA-193 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-3, fourth paragraph

What is the gas generation pressure threshold at which migration away from the repository through anhydrite interbeds occurs, to what extent does migration occur and to what concentration level?

EPA-193 RESPONSE

The most current information on this topic can be referenced in the DCCA and the update.

EPA-194 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-4, second paragraph

When will the Room Q test data be available?

EPA-194 RESPONSE

Some Room Q data was made available during a presentation on rock mechanics at the stakeholders meeting and technical exchange with the EPA held in Albuquerque during the last week of October, 1994. The handout on rock mechanics that accompanied the presentation included Room Q data.

EPA-195 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-9, third paragraph

When will DOE provide the laboratory data on the sorptive properties of the Culebra?

EPA-195 RESPONSE

Applicable laboratory data will be provided in the CCA.

EPA-196 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-12, fourth paragraph

Please provide data and appropriate references regarding the Munson-Dawson (M-D) constitutive model for creep continuum deformation and its applicability to the WIPP. It is noted that the model does not take either brine or gas concentrations into account.

EPA-196 RESPONSE

The most recent information on this topic can be referenced in the DCCA and the update. The appropriate references are provided, as well.

EPA-197 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-13, first paragraph

The DOE should reference and present the data defining the extent and permeability of the DRZ and explain the rationale regarding how these are expected to change over time. Note the 1992 PA states that the DRZ extent is constant.

EPA-197 RESPONSE

The most recent information on this topic can be referenced in the DCCA and the update. The appropriate references are provided, as well.

EPA-198 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-14, first paragraph

Regarding gas, besides answering the question "Where does it go and how far," please address the question: What concentration?

EPA-198 RESPONSE

It's assumed that the concentration that's of interest to EPA here is the VOC concentration in the gas. This is handled now in PA by a computer code called VAST. VAST is a post-processing code that's run after BRAGFLO. VAST takes the flow field from BRAGFLO and performs a contaminant transport calculation which results in release concentrations. Thus, by running BRAGFLO and VAST, concentrations of VOCs released in the gas phase can be calculated for various times and distances.

EPA-199 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-14, second paragraph

Review of mechanistic models involving fracture opening is warranted, particularly those based on reservoir stimulation hydrofracture treatments in the petroleum industry. Please explain what your program will entail, including available data and references for your sources.

EPA-199 RESPONSE

There are currently no plans for experimental work in these areas. The most current information on modeling fractures can be referenced in the DCCA and the update. The current assumption is that sufficient gas permeability exists to limit pressure buildup in the repository to a point sufficiently lower than lithostatic pressure.

EPA-200 COMMENT

CHAPTER 10—FUTURE TEST PROGRAM

Page 10-15

The CSR defends the use of the simplified creep-closure model, but states that the error may be significant for events that take place over the first several hundred years (predicts less gas pressure than is likely). Please explain the defense of this model in light of the error being greatest at the time of predicted maximum creep closure. In addition, please address the adequacy of this model for condition where a room/ panel/repository has already been saturated by Castile brine.

EPA-200 RESPONSE

The most recent information on creep closure modeling and justifications for the methods employed can be referenced in the DCCA and the update.

EPA-201 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - GENERAL COMMENTS

The chapter is very loosely organized. It would be easier to read if the discussions were organized into categories (e.g., all laws regarding water, wildlife, hazardous waste or constituents, or miscellaneous). In addition, the organization within each discussion varies. For example, the discussion of the National Historic Preservation Act intersperses an explanation of the components of the law with an explanation of WIPP compliance activities. Other discussions, present the law in sum followed by the WIPP compliance activities.

EPA-201 RESPONSE

Your comment is noted for the purposes of future compliance submittals.

EPA-202 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - GENERAL COMMENT

The introduction to this chapter could be used to establish which Federal laws apply to the WIPP and to establish a sense of organization to the chapter. (See General Comment 1).

EPA-202 RESPONSE

Comment noted; see response to EPA-201.

EPA-203 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - GENERAL COMMENT

The discussions are uneven in detail and presentation. Some discussions are presented in good detail, which outlines specifically what the DOE is doing at the WIPP to ensure compliance. In other discussions, WIPP compliance activities are implied rather than stated. Specific examples of this will be presented in the specific comments section which follows.

EPA-203 RESPONSE

Comment noted; see response to EPA-201.

EPA-204 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - GENERAL COMMENT

This chapter is very broad and general with respect to why certain regulatory programs do not apply to the WIPP. While the report appears to be generally accurate in determining which regulations and statutes apply to the WIPP, the reasoning is not provided in the report; the reader must accept the DOE interpretation of applicability with little justification of the provided interpretation. In general, the entire chapter should be expanded to include a more comprehensive picture of what applies to the WIPP and the WIPP's compliance activities.

EPA-204 RESPONSE

Comment noted; see response to EPA-201.

EPA-205 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-1

The report states that 14 individual sites (eligible for inclusion in the National Register) outside of the $4mi^2$ central area were discovered since 1980. The New

Mexico State Historic Preservation Designation of No Adverse Effect was issued in 1980. This designation was based on a mitigation plan submitted prior to 1980, and a similar plan was submitted to the National Advisory Council on Historic Preservation, which "concurred that the WIPP mitigation plan is appropriate to protect cultural resources." This determination should be revisited to include the sites discovered since 1980, or, the Compliance Status Report should be revised to include the sites.

EPA-205 RESPONSE

Of the 14 individual sites (eligible for inclusion in the National register) only 6 are located within the current land withdrawal area. The remaining eight are within the area that was known as Control Zone IV. These are under the management of the Department of Interior. The archaeological report (Mariah, 1987) which revealed these fourteen sites was transmitted to the State Historic Preservation Officer. None of the six sites within the WIPP's land withdrawal area were scheduled for surface disturbing activities, therefore revising the mitigation plan was not deemed necessary.

EPA-206 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-1

The Archeological Resources Protection Act requires that DOI must issue a permit for excavation and/or removal of archeological resources from public or Indian lands. According to the CSR, four sites were excavated at the WIPP, but there is no mention made of a DOI permit. Also, the WIPP Mitigation Plan apparently does not address the 14 additional sites discovered since 1980 (see previous comment). Were any of these sites excavated?

EPA-206 RESPONSE

The mitigations were performed under Federal Antiquities Permit No. 81-NM-223. The fourteen sites eligible for inclusion in the National Historic Register discovered in 1987 have not been excavated.

EPA-207 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS

Page 11-2, first paragraph

The discussion in the first full paragraph, under Endangered Species Act, is unclear. The report states that 50 CFR 402 specifies that "EPA is prohibited from authorizing activities likely to jeopardize the

continued existence of any threatened or endangered species or its critical habitat. The Section 7 [of 50 CFR 402] may involve a biological assessment and "formal consultation," followed by the issuance of a "biological opinion" by the U.S. Fish and Wildlife Service..." The report then states that the Fish and Wildlife Service has determined that WIPP facilities will have no impact on four threatened or endangered species, and, "therefore, that a formal consultation nor biological opinion processes have been required for the WIPP project by the U.S. Fish and Wildlife Service."

What was the actual sequence of events? Did the Fish and Wildlife Service issue a biological assessment or a biological opinion? How was this determination made? This discussion should be modified to include pertinent dates and/or a sequence of events to clarify.

EPA-207 RESPONSE

In order to comply with the Section 7 consultation requirement, the DOE requested a list of endangered species from the U. S. Department of the Interior, Fish and Wildlife Service (FWS) to determine if such species are known to have a critical habitat on or in the vicinity of the site. As required by Section 7(c) of the Endangered Species Act Amendments of 1978, Mr. J. L. Stegman, FWS Region 2 Acting Regional Director, provided correspondence on November 15, 1979 that 1) listed those species, both proposed and listed, that could occur in the WIPP's proposed project area 2) identified that no critical habitat for endangered species had been identified at the WIPP site and 3) requested a biological assessment that included the listed species. This correspondence also established that if the biological assessment revealed the proposed project had no evident affect on the listed species, there was no need for further consultation. As requested by this correspondence, the DOE prepared a "Biological Assessment" (Hart, et al., 1980) for the purpose of identifying listed species that were likely to be affected by the SPDV program and other potential site usage. The Biological Assessment documented that the listed species would not be affected by the project. This report was forwarded to the FWS for their review, completing the requirement for the consultation process mandated by the Endangered Species Act.

REFERENCES

Stigman, J. L., Letter dated November 15, 1979, from Jerry L. Stigman, Acting Regional Director, U.S. Department of the Interior, Fish and Wildlife Service, to DR. D.T. Schueler.

Hart, et al., 1980, Biological Assessment: Potential Impacts on State-Designated Endangered Species From the Proposed Construction and operation of the Waste Isolation Pilot Plant, TME 3010

EPA-208 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-4

The discussion on the Clean Water Act presents an overall picture of the regulatory program. In each paragraph, the text presents DOE's understanding of the regulatory program in general. This explanation is followed by one sentence explaining how the program applies/does not apply to the WIPP. The discussion should expound on how the regulatory program applies to the WIPP and how the facility is complying with the program.

EPA-208 RESPONSE

The following information is provided as an update to the information contained in the CSR. The WIPP has no process or point sources discharges, and is currently exempted from obtaining a standard NPDES permit. On February 14, 1994, the DOE submitted an information package to the EPA Water Management Division to request a written determination if an NPDES permit will be required for sludges generated at the WIPP sewage treatment facility. This information package was developed to demonstrate compliance with requirements established in the NPDES sewage sludge regulations promulgated in 40 CFR Part 122.21.

On March 31, 1994, the EPA Region VI Permits Issuance Section notified the DOE that they had received the information package, and that the information would be reviewed to determine whether the facility is a "treatment works treating domestic sewage." Based on this determination, the agency stated they would notify the DOE when a full and complete "sludge only" application must be submitted so that the EPA could prepare a permit.

The WIPP completed development of the WIPP NPDES Storm Water Pollution Prevention Plan (PPP) in March 1993. The NPDES Storm Water Permit rules require that a PPP be developed for each facility covered under the permit by April 1, 1993. The PPP identifies and assesses potential pollutant sources and describes all Best Management Practices that will be implemented to ensure that storm water runoff does not contact regulated pollutants.

The Best Management Practices implemented to comply with the requirements of the WIPP NPDES Storm Water

Pollution Prevention Plan include: 1) The construction of storm water retention basins to collect all Zone 1 storm water discharges; 2) The covering of all material storage areas to prevent contact with precipitation runoff; 3) The covering of the Sandia Diesel generators; 4) Construction of berms around all material storage areas outside of Zone 1; and 5) The storage of all recycled batteries in the Excess Storage Area on spill containment devices. Additionally, disturbed areas that are no longer in use are being reseeded. Reclamation of the unused portions of the Construction Landfill has been completed.

No sampling is required to demonstrate compliance with the WIPP Storm Water Permit unless a discharge occurs from one of the retention basins. Operational permit compliance activities are limited to quarterly inspections of retention basins, spill containment devices, reclamation sites, and site house keeping practices.

EPA-209 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-4

The third paragraph states that, of the "standard NPDES program of the CWA," only 40 CFR 459, Photographic Point Source Category, applies to the WIPP. Does not 40 CFR Part 436, Mineral Mining and Processing Point Source Category also apply?

EPA-209 RESPONSE

The third paragraph of page 11-4 should be disregarded. Since the CSR was written, the WIPP has implemented a special photographic waste recycling program in conjunction with Kodak Corporation. All liquid photographic chemicals are now recycled at the Safety-Kleen photographic chemical recycling facility in Denton, Texas. Within the next two years the WIPP photographic program will eliminate all wet photographic processes and utilize digital photographic technology.

40 CFR Part 436, Mineral Mining and Process Point Source Category is not applicable. Although there is no specific category for the salt mining or salt repositories, Subpart N Potash Subcategory (Part 436.140) was evaluated. The WIPP has no mining or process discharges that discharge to waters of the United States, in fact the WIPP has no process discharges of any type. All storm water discharges that contact mining wastes, e.g., salt or overburden, are contained in zero discharge evaporation basins as defined in the WIPP NPDES Storm Water General Permit.

EPA-210 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-8

The first full paragraph on this page states that the 1990 ROD to proceed with the Test Phase committed the DOE to prepare a new FSEIS for the disposal phase. This section of the report should be revised to address the fact that the Test Phase will not be conducted and that the facility will proceed directly to the disposal phase. What impact, if any, does this have on the FSEIS?

EPA-210 RESPONSE

The CSR will not be revised. The DOE is currently planning the preparation of a second Supplemental Environmental Impact Statement (SEIS-II). The SEIS-II will present information, data, and analyses that have become available since the Final Environmental Impact Statement of 1980 and the Final Supplement Environmental Impact Statement of 1990. The SEIS-II will also address proposed changes to the actions described in the Records of Decision (46 FR 9162 and 55 FR 25689). The SEIS-II will be unaffected by the cancellation of a WIPP underground test phase. Relevant information obtained from the Enhanced Laboratory Program will be used in place of information that was previously expected to be derived from WIPP underground tests.

EPA-211 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-8

Throughout the discussion of the Resource Conservation and Recovery Act, the report should be revised to clarify the relationship between the implementing Federal regulations and the implementing New Mexico regulations.

EPA-211 RESPONSE

The CSR will not be revised. This information is being provided to supplement that previously contained in Chapter 11 of the CSR.

On January 11, 1991, the State of New Mexico adopted the entire body of 40 CFR Parts 260 through 266 and Parts 268 through 270 of the EPA's regulations implementing Subtitle C with only a few substitutions and minor exceptions. The following table shows the correspondence between the Federal and State implementing regulations. The Federal regulations

through July 1, 1990, were adopted into the New Mexico Hazardous Waste Management Regulations (HWMR).

Correspondence between the Federal Regulations Implementing the Resource Conservation and Recovery Act and the State Regulations Implementing the New Mexico Hazardous Waste Act

Implementing Regulations under RCRA	Hazardous Waste Management Regulations (HWMRs) under HWA	Adoptions, Modifications, and Exceptions
40 CFR Part 260	Section 101 Section 102	Adopts Part 260 into Part I by reference Modifies several definitions; deletes Sections 260.1(b)(6), 260.22, and 260.30 through 260.33; provides NMED 24-hour emergency-response telephone number
40 CFR Part 261	Section 201	Adopts Part 261 into Part II by reference
40 CFR Part 262	Section 301	Adopts Part 262 into Part III by reference
40 CFR Part 263	Section 401 Section 402	Adopts Part 263 into Part IV by reference Deletes Section 263.20(e)
40 CFR Part 264	Section 501 Section 501	Adopts Part 264 into Part V by reference Deletes Sections 264.149 and 264.150
40 CFR Part 265	Section 601 Section 602	Adopts Part 265 into Part VI by reference Deletes Sections 265.149 and 265.150
40 CFR Part 266	Section 701	Adopts Part 266 into Part VII by reference
40 CFR Part 268	Section 801	Adopts Part 268 into Part VIII by reference
40 CFR Part 270	Section 901 Section 902	Adopts Part 270 into Part IX by reference Adds New Mexico permitting procedures

Implementing Regulations under RCRA	Hazardous Waste Management Regulations (HWMRs) under HWA	Adoptions, Modifications, and Exceptions
----	Section 1001	Requires compliance with applicable laws
	Section 1002	Effectuates HWA
	Section 1003	Replaces 40 CFR Part 124 with Section 902 of the HWMRs
	Section 1004	Severability
	Section 1005	Effect of stay or invalidation of Federal regulations
	Section 1006	incorporated by reference
	Section 1007	Amendment of prior regulations
		Saving clause

The State's regulations are applicable to WIPP on three counts. First, WIPP is a generator of hazardous waste and is thus required to comply with the RCRA requirements of 40 CFR Part 262 (Part III of the New Mexico HWMRs). As long as WIPP ships its hazardous waste off-site to an EPA-approved TSDF within 90 days, no RCRA permit is required for this activity. Second, when WIPP receives waste from the generator sites, WIPP will be responsible for subcontracting the transporter. This activity will be regulated under the transporter requirements of 40 CFR Part 263 (Part IV of the HWMRs). Third, WIPP will be a disposal, storage, and/or treatment facility for TRU mixed waste, which mandates that WIPP receive a RCRA permit. The permit will be received from both the NMED and the EPA because the former is not yet authorized for HSWA requirements or for other recent changes made by the EPA in the Federal regulations.

EPA-212 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-9

The first full paragraph presents a brief description of how the WIPP is complying with RCRA's generator requirements. However, this description is very brief. There is no presentation of what types of satellite accumulation areas are being used or the segregation and waste management methods used.

EPA-212 RESPONSE

Specific implementing plans and procedures exist for managing site generated hazardous waste. These programs are discussed in more detail in the WIPP RCRA Permit Application.

EPA-213 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-9

The discussion of how the WIPP will comply with 40 CFR 264 and 265 never describes which unit will be permitted. Although this is implied, it should be clarified. Also, the report does not indicate when the DOE will submit a revised RCRA Part B permit application to NMED.

EPA-213 RESPONSE

The DOE issued a revised RCRA Part B permit application to the NMED in May, 1995.

EPA-214 COMMENT

CHAPTER 11.0 - OTHER FEDERAL LAWS - SPECIFIC COMMENTS

Page 11-12

The first full paragraph simply states that DOE will comply with the requirements of the Hazardous Materials Transportation Act. What specific action is the DOE taking to comply as related to the WIPP.

EPA-214 RESPONSE

The CSR will not be revised. WAC restrictions will ensure compliance with applicable requirements of the HMTA. We will ensure that applicable WAC requirements are incorporated into certification plans at the generator facilities. Site specific HMTA requirements are described in more detail in the RCRA permit application.

EPA-215 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

This document does not address DOE plans for thoroughly evaluating engineered alternatives. Given the effort associated with the development of a performance-based WAC and a waste envelope used to define waste acceptability, the EPA would expect discussion of parallel activities to investigate engineered alternatives for retrievably stored TRU waste. This

will allow for evaluation of the system's ability to enable that waste to be within the envelope defined for the WIPP. In addition, the EPA believes that it may be difficult to incorporate a sincere, detailed study on engineered barriers into a 1996 compliance application at this late date.

EPA-215 RESPONSE

The DOE does not propose the use of engineered alternatives, including waste treatment, beyond what is needed to meet the containment standards. However, it is highly likely that the public will ask the DOE and possibly the EPA to consider additional engineered measures to increase confidence through mitigation of uncertainty about PA results. The decision making in this regard will be supported by an engineered alternative cost benefit/detriment study that the DOE is currently conducting. This study will provide an assessment of the relative merits and detriments associated with various alternatives. The results of this study will be used in developing the assurance requirements programs that will be included in the CCA. The DOE does not plan to include all results of the EA study in the CCA as some of the information will not be germane.

EPA-216 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

The summary issue descriptions are very general in most cases, so that many details and the full meaning of the "Descriptions" and "Comments" are unclear.

EPA-216 RESPONSE

Since Chapter 12 was intended as a summary, the text was intentionally terse. Cross reference was provided to the appropriate section of the document for additional detail.

EPA-217 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

The issue of human intrusion rates has not been resolved. Guidance in 40 CFR 191 should not be used to estimate intrusion rates. The EPA is developing criteria for consideration of human intrusion in the compliance criteria. In addition, the DOE should be prepared to present evidence to back up any claim of credit for passive institutional controls.

EPA-217 RESPONSE

Your comment on intrusion rates is respectfully noted. However, the Agency should bear in mind that such a

concept is in direct conflict with the technical basis used by EPA in development of the containment requirements that exist in the 40 CFR 191 standard today. With respect to numerical credit for passive controls, the DOE is aware that sufficient evidence will be required to justify any such credit if the Agency is to approve.

EPA-218 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-3

The DOE discusses PA providing performance requirements relative to Shaft Plugging. The issue is not what performance they are supposed to have, but what performance the seals can be demonstrated to achieve under a large scale closure operation.

EPA-218 RESPONSE

Both the performance requirements and the demonstration of effectiveness are the "issue". Fulfilling requirements for burden of proof of the performance of any engineered component whose lifetime is thousands of years is, at best, a difficult task. Obviously, long-term experiments and testing programs are not feasible. Instead, a combination of realistic design parameters, a reasonable degree of testing of materials to ensure compatibility, and reasonable construction goals will provide the best method of ensuring that long-term performance will be as predicted. One way performance assessment aids this process is through the identification of performance targets for the various components. For example, a shaft seal that must have very low final permeability may require extraordinary engineering and construction measures to achieve a high initial density. On the other hand, if performance assessment demonstrates that the final permeability need not be very low, then construction may be greatly simplified.

Striking the balance between long-term performance, technical feasibility, testing, and constructability will involve multiple trade-offs. Performance assessment is the numerical tool that will allow such trade-offs to be made wisely.

EPA-219 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-6

The NMED questioned the completeness and quality assurance of the background radiation studies in its "Assessment of Off-Site Radioactivity Surveillance

System at the WIPP". Our evaluation of DOE documents have also caused the same questions to be asked. Before the background radiation issue is completely closed the QA issue must be resolved.

EPA-219 RESPONSE

The DOE would be interested in the specifics of the EPA's evaluation. The NMED evaluation was not a general condemnation of the quality of the DOE's off site radiation surveillance program. In fact, the quality of this program is well documented and has been subjected to numerous internal and external audits. The results are reported annually (and have been since 1986) and are subjected to extensive review and analysis. The bottom line is that there are always better ways to make measurements, particularly as measurement technologies improve and as the understanding of the effects of radiation on humans develops. The DOE has adjusted its monitoring practices several times in response to such developments in technology. Such improvements to our program will continue in the future, as appropriate.

EPA-220 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-7, 12-24

Proper handling of climate change is an open issue in the compliance criteria. The DOE approach may be acceptable but that has not been determined.

EPA-220 RESPONSE

Until additional guidance is provided, the DOE will continue with its present approach. The DOE recently completed a new more rigorous scenario screening process to support the compliance submittals. The handling of climate and its effects is more structured, although the bottom line in terms of treatment in the PA is the same.

EPA-221 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-10

The potential for subsidence may not be limited to mining practices at WIPP. Other causes of subsidence may need to be considered, such as, subsidence of the overlying strata because of oil or gas production or subsidence due to casing or plug failure in or near brine injection wells.

EPA-221 RESPONSE

Each of these will be handled systematically in the scenario screening activity. The DOE has recently completed a more rigorous scenario screening process. The most current information can be referenced in the DCCA and the update.

EPA-222 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-12

EPA cautions the DOE's use of expert panels for estimating Kd values. The EPA suggests referring to guidance in the forthcoming 40 CFR Part 194 rule.

EPA-222 RESPONSE

Comment noted.

EPA-223 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-12

Has the DOE examined thermal characteristics of Remote Handled waste? The DOE needs to establish an enforceable waste acceptance criteria assuring that the thermal input of waste corresponds with their assumptions.

EPA-223 RESPONSE

The DOE has a thermal limit at WIPP of 10 kilowatts of thermal heat per acre. This limit will be reflected in both the WAC and the operating practices (emplacement criterion for RH waste).

EPA-224 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-16

What reason does the DOE have to state "examinations and evaluations will likely (emphasis added) demonstrate seals can meet required performance based criteria"?

EPA-224 RESPONSE

See the previous response with regard to the technical feasibility of long-term testing (EPA-128).

EPA-225 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-22

The issue of having developed a complete set of scenarios may not be resolved.

EPA-225 RESPONSE

The most current scenario development information can be referenced in the DCCA and the update.

EPA-226 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-23

EPA cautions against the DOE's use of expert panels for estimating solubility. The EPA suggests referring to guidance in the forthcoming 40 CFR Part 194 rule.

EPA-226 RESPONSE

Comment noted.

EPA-227 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-24

The focus on human intrusion should not be on passive controls, but should include evaluation of aspects of human intrusion that can be mitigated by engineered barriers and repository design.

EPA-227 RESPONSE

Because of the long time periods involved, the best approach, and the one taken by the DOE, is defense in depth. The DOE will rely on various levels of protection including markers, records dissemination, active controls, disposal system design, and engineering to prevent and mitigate the potential effects of human intrusion. The first line of defense is to prevent the intrusion from occurring. This involves three levels of defense which include ownership of the land, written records of the hazards, and markers and monuments. Additional depth will be added to the protection system by placing records in numerous locations around the area, throughout the United States, and around the world. In addition, passive markers will include a number of protective elements designed to be effective individually and to work in concert as a system. These elements range from

large scale berms and monuments to subsurface markers. The next level of defense is to take measures to inform a driller that he has intruded on the repository. The DOE is assessing the existing natural elements and currently planned elements of the protective system to determine whether or not additional protection is required in this area. Finally, if a determination is made that an additional level of defense is needed, engineered measures may be appropriate for mitigating the immediate effects of drilling.

EPA-228 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-28

Assumption of no groundwater uses is acceptable only if consistent with current practice and regulation in the Delaware Basin. Reliance on legal controls which are based specifically on the presence of WIPP cannot be used for more than 100 years.

EPA-228 RESPONSE

The assumption of no groundwater uses is based on the lack of sufficient quantities of potable groundwater in the area to qualify as an underground source of drinking water. This lack of water is unrelated to the existence of WIPP. While areas of useable groundwater occur in isolated perched lenses within the Dewey Lake, they do not appear to be of sufficient size to qualify.

EPA-229 COMMENT

CHAPTER 12.0 - COMPLIANCE SUMMARY

Page 12-29

If studies show that criticality is not a credible scenario, the compliance application must present those results.

EPA-229 RESPONSE

The results of any relevant studies will be used in developing the CCA.

EPA-230 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #4

If releases to the accessible environment do occur, this statement would be true only if the DOE uses the point on the boundary where the maximum dose would be expected to occur.

EPA-238 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #32

DOE must "make the case" to justify any credit for active institutional controls.

EPA-238 RESPONSE

The DOE implementation plan, WIPP Active Access Controls for Disposal Design Concept, Appendix to Chapter 7 of the DCCA, provides pertinent information relative to the effectiveness of the active institutional controls being considered in the PA process. The CCA will have adequate justification supporting any areas where such credit is taken.

EPA-239 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #33

Active institutional control should be used for as long as is practicable.

EPA-239 RESPONSE

Long-term active control measures will be maintained for as long as practicable. However, Performance assessment currently includes the assumption that active controls are only maintained for 100 years (i.e., no human intrusion is assumed to be possible prior to 100 years after closure). The Appendix to Chapter 7 of the DCCA, provides pertinent information relative to the effectiveness of these active institutional controls being considered in the PA process.

EPA-240 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #36

Expected performance includes disruptive events.

EPA-240 RESPONSE

Comment noted.

EPA-241 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #46

For any credit to be given for passive institutional controls, those controls would have to be identified and the credit demonstrated in the compliance application.

EPA-241 RESPONSE

Comment noted.

EPA-242 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #48

True but controlled area used in compliance application may be smaller if the DOE does not, in fact, control the entire "maximum controlled area".

EPA-242 RESPONSE

Comment noted.

EPA-243 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #53

Future expectations of resource use should not be used.

EPA-243 RESPONSE

Under the current regulatory framework the implementing agency is required to make certain assumptions regarding future resource use.

EPA-244 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #54

The DOE should demonstrate that compliance can be achieved despite the presence and lure of resources.

EPA-244 RESPONSE

The resource issue will be considered in PA. The most recent information on these topics can be referenced in the DCCA and the update.

EPA-245 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #55

The DOE should have a plan to demonstrate that removal is possible.

EPA-245 RESPONSE

Such a plan has since been prepared and submitted. See the appendices to section 7 of the DCCA.

EPA-246 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #59

Wells should be assumed to be located at the point, outside the controlled area where the total dose to an individual, including water use, is expected to be the highest.

EPA-246 RESPONSE

Interpretation 59 does not preclude consideration of wells in the manner proposed by the comment.

EPA-247 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Item #65

The DOE should not use the guidance in 40 CFR Part 191 to estimate human intrusion rates. The EPA is developing criteria for consideration of human intrusion in the forthcoming compliance criteria.

EPA-247 RESPONSE

Your comment on intrusion rates is respectfully noted. However, the Agency should bear in mind that such a concept is in direct conflict with the technical basis used by EPA in development of the containment requirements that exist in the 40 CFR 191 standard today. Revised technical bases would require new containment requirements. Otherwise, measuring a prediction of repository performance (PA results) through comparison to performance measures (existing containment requirements) that were developed with different fundamental assumptions in mind would provide a meaningless result.

EPA-248 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR PART 191

Items #63-66

DOE may want to reevaluate these assumptions based on review of 40 CFR 194.

EPA-248 RESPONSE

At the time that the EPA promulgates criteria that specifically supersede the guidance set forth in Part 191, The DOE's program will be modified accordingly.

EPA-249 COMMENT

APPENDIX A: REGULATORY INTERPRETATIONS, 40 CFR SUBPART 268.6

Item #35

The statement that groundwater will not be monitored during the post decommissioning phase (post-closure) appears to conflict with previous plans and statements of intent in this document and others (draft Test Phase Part B Application). Provide detailed justification for this decision.

EPA-249 RESPONSE

A detailed discussion of the monitoring plan is provided in the Appendices to section 7 of the DCCA.

NEW MEXICO ENVIRONMENT DEPARTMENT
COMMENTS ON THE COMPLIANCE STATUS REPORT FOR THE WIPP
(DOE/WIPP 94-019, Rev.0)

NMED-1 COMMENT

REGULATORY FRAMEWORK

Section 1.3, Page 1-8

This Section should contain a reference that the permitting and Post Closure standards are found in HWMR-7 Sections 264 and 270.

NMED-1 RESPONSE

The CSR was written with the intent to establish the project's status with respect to 40 CFR 191 and 40 CFR 268. The DOE will address the requirements of 20 NMAC 4.1 (formerly HWMR-7), including those found in Sections 264 and 270, in future DOE documents. In particular, the submittal of the permit application will contain information to address these regulations.

NMED-2 COMMENT

HAZARDOUS WASTE DISPOSAL STANDARDS

Section 1.3.1, Page 1-8

Some discussion of how 40 CFR 268.6 and other operational RCRA regulations may be synergistic or may differ is warranted (e.g. ground water monitoring requirements and unit boundary). Throughout the whole report various discussions on waste characterization and monitoring leave this reviewer confused on how DOE proposed to satisfy overlapping issues addressed by both programs.

NMED-2 RESPONSE

The DOE recognizes that there are various RCRA regulations that apply to the disposal of waste at WIPP and that these regulations overlap in certain areas. However, the CSR was written with the intent to address only those requirements in 40 CFR 191 and 40 CFR 268. The requirements of other RCRA regulations were addressed in the RCRA permit application Rev. 5.

NMED-3 COMMENT

PERFORMANCE-BASED WASTE ENVELOPES

Section 4.2.1, Page 4-22

Waste parameters shown to have little or no impact on repository performance will be candidates for reduced characterization. Later in the Waste Characterization Section 4.3 (Page 4-40) the CSR states definitively that physical waste forms not affecting compliance will be excluded from future waste characterization programs. Section 4.3 (Page 40) should reflect Section 4.2.1 (Page 4-22) on the need to consult the State and EPA before changes are made.

NMED-3 RESPONSE

It is understood and implicit in the RCRA permitting process that the State and the EPA will be consulted prior to any such changes in the method(s) that are utilized for compliance.

NMED-4 COMMENT

PROGRAM SUMMARY

Section 4.3.1, Page 4-39

This section states that there are two objectives to the waste characterization program: 40 CFR 191 and 194; and 40 CFR 268.6. This section needs to discuss the overlap between 40 CFR 268.6 and 40 CFR 264, and emphasize that the State RCRA program must also be satisfied.

NMED-4 RESPONSE

The CSR was intended to provide the outline of the approach that WIPP was going to use for the development of the NMVP and the CCA. Specific waste characterization information for the RCRA Part B Application will be included in chapter C, The Waste Analysis Plan which will be incorporated into the NMVP, as appropriate. The state RCRA program will therefore be the driver.

NMED-5 COMMENT

PROCESS KNOWLEDGE INFORMATION

Page 4-43

DOE will have to quantify and qualify specific criterion to support the use of any process knowledge. HWMR-7, section 264.13(a) will be enforced.

NMED-5 RESPONSE

Process knowledge will be verified and documented for use in waste characterization programs. The adequacy of the knowledge, the verification, and the documentation will be determined by the applicable regulators. Wastes shipped to WIPP will have the requisite level of waste characterization.

NMED-6 COMMENT

MONITORING

Page 5-1

Monitoring is required by HWMR-7, Section 264.

NMED-6 RESPONSE

The DOE recognizes that the requirements of 20 NMAC 4.1 (formerly HWMR-7), Section 264 will need to be addressed. However, the CSR was written with the intent to address only those requirements found in 40 CFR 191 and 40 CFR 268. Monitoring and other requirements found in 20 NMAC 4.1 will be addressed in the RCRA permit application.

NMED-7 COMMENT

CONFIRMATORY MONITORING

Page 5-6 (P2)

NMED/WIPP staff are unaware and have confirmed that no program exists for hydrogen, methane, or hazardous gas monitoring as described in this section. This should be confirmed that such a statement is not made in the RCRA Part B application.

NMED-7 RESPONSE

This will be confirmed and future submittals will reflect the situation accurately, as appropriate.

NMED-8 COMMENT

40 CFR 191.15

Section 8.1.5.2, Page 8-27

It is unclear what is meant by the statement, "the regulatory performance measures...are health-based soil concentration level allowable for specified hazardous constituents as proposed in 40 CFR 264 Subpart S." On the contrary 268.6 provides a methodology and requirements for petitions to allow land disposal of prohibited wastes. The statement in question is highly oversimplified.

NMED-8 RESPONSE

The most current information on this topic can be referenced in the draft NMVP and the RCRA permit application rev. 5.

NMED-9 COMMENT

CONTAINMENT OF RELEASES

Section 9.1, Page 9-1

Section 9.1.2 40 CFR 268.6. This section discussed VOC monitoring system. It should be consistent with that required under the RCRA Part B permit.

NMED-9 RESPONSE

The most current information on this topic can be referenced in the draft NMVP and the RCRA permit application rev. 5.

NMED-10 COMMENT

40 CFR 268.6

Section 9.2.2, Page 9-6

The discussion on this page is DOE Interpretation of the applicability of the Test Phase no-migration petition to the disposal phase petition. While wording may have indicated in the no-migration determination

that "RCRA relies on Institutional controls" to restrict access to hazardous waste disposal sites, the agency did not specifically review or address possible releases form (sic) human-intrusion. NMED/WIPP staff have suggested that because the disposal phase decision and 40 CFR 191 decision will be handled simultaneously, the two conceptual models for releases should be consistent (e.g. include human intrusion).

NMED-10 RESPONSE

The conceptual models used for compliance with 40 CFR 191 and 40 CFR 268 will be consistent for the undisturbed scenario including the treatment of brine inflow, gas generation, potential gas and brine migration (i.e. potential releases of gas and brine from the repository), salt creep, and waste compaction. The analysis of human intrusion required by 40 CFR 191 does not change the underlying conceptual model used in the performance assessment model.

Section 9.2.2 summarizes information provided by EPA in the WIPP no-migration determination regarding human intrusion. DOE has not received any additional guidance from EPA related to this topic. EPA has stated, with regard to this and other topics, that the Agency must be consistent in its interpretation and application of RCRA regulations at all hazardous waste facilities. To date, DOE believes that the use of institutional controls to render human intrusion events unlikely is consistent with EPA's interpretation and application of the RCRA regulations.

The EPA has provided an extended discussion of the role of passive controls in protecting RCRA permitted locations in the April 6, 1990 proposed NMD, (see 55 FR 13068).

NMED-11 COMMENT

<u>40 CFR 268.6 - (RCRA)</u>

<u>Section 9.6.1 (S2), Page 9-14</u>

EPA is quoted as saying that the air pathway is only credible release prior to closure. While this may be the case, the EPA decision was clearly limited to the Test Phase, which involved only a limited amount of waste and had stringent requirements on allowed waste form, double containment etc.

NMED-11 RESPONSE

The EPA concluded, based on the absence of a credible mechanism for migration of contaminants into the Salado Formation prior to the repository closure, that the air was the only viable pathway for migration. The logic should hold true without regard to source material (waste quantity). This same logic will be the basis for DOE disposal operations NMVP.

NMED-12 COMMENT

WASTE ACCEPTANCE/WASTE COMPLIANCE (RCRA)

Section 9.9, Page 9-15

"The final waste acceptance criteria will include criteria from the PA models as well as possible conditions which may be imposed as part of the compliance application process". This should emphasize what those relevant applications are (e.g. RCRA Part B).

NMED-12 RESPONSE

The CSR was written with the intent to establish the project's status with respect to 40 CFR 191 and 40 CFR 268. However, the DOE recognizes that there are requirements associated with other regulations and applications such as the RCRA permit application. These requirements will be addressed in future DOE documents that are relevant to those other regulations (e.g., the Part B of the permit application).

NMED-13 COMMENT

WASTE ACCEPTANCE/WASTE COMPLIANCE (RCRA)

Page 9-16

The ultimate goal of Waste characterization is to reduce the level and frequency of sampling and analysis required during the disposal phase. This should emphasize that this strategy will have to comply with not only 40 CFR 268.6 but also RCRA Part B.

NMED-13 RESPONSE

The DOE recognizes that there are requirements associated with other regulations, including 40 CFR Parts 264 and 270. DOE has established a waste characterization program that is designed to address

all regulatory requirements associated with waste characterization, including the waste analysis requirements specified under 40 CFR §264.13.

NMED-14 COMMENT

OTHER FEDERAL LAWS

Section 11.9, Page 11-8

The third bullet should be 40 CFR 264 not 40 CFR 265.

NMED-14 RESPONSE

Your comment is noted.

NMED-15 COMMENT

APPENDIX A

Bullet 5, page A-2

The hazardous wastes as defined in 40 CFR 264.10 are subject to regulations under the New Mexico Hazardous Waste Act not to RCRA.

NMED-15 RESPONSE

While the hazardous wastes are subject to regulation under the New Mexico Hazardous Waste Act, they are also subject to regulation under RCRA.

NMED-16 COMMENT

APPENDIX A

(3) and (4)

Unit boundaries described should not be confused by miscellaneous unit boundary, as defined in this regulatory interpretation section.

NMED-16 RESPONSE

The unit boundary described in the interpretation is one previously set by the EPA.

NMED-17 COMMENT

APPENDIX A

Bullet 35, Page A-19

NMED will decide through the permit issuance process and subsequent closure plan review on any vadose zone or groundwater monitoring requirements to be conducted during the post-closure care period.

NMED-17 RESPONSE

Agree, however DOE believes that vadose zone or groundwater monitoring should not be conducted during the Post-Decommissioning Phase because the results of such monitoring would not be meaningful. The location of such monitoring systems within the unit boundary would create a pathway for the migration of hazardous constituents.

NMED-18 COMMENT

GLOSSARY

Page G-9

Hazardous Waste Management Units, Waste Management Units, RCRA Units, Miscellaneous Units and disposal units need to be defined and/or differentiated in the report and the glossary.

NMED-18 RESPONSE

The future compliance documents will provide the needed definitions.