UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 8 1997

OFFICE OF
AIR AND RADIATION

Steve Zappe
New Mexico Environment Department
Hazardous & Radioactive Materials Bureau
2044 Galisteo
P.O. Box 26110
Sante Fe, NM 87502

Dear Mr. Zappe:

The U.S. Environmental Protection Agency (EPA) is in the process of reviewing the Department of Energy's (DOE's) Compliance Certification Application for the Waste Isolation Pilot Plant (WIPP) and has identified several areas requiring additional information.

In order to keep you updated with the progress of EPA's WIPP certification process, I have enclosed the letter the Agency sent to the DOE identifying those information needs. If you have any questions about this or any other issue related to the certification process, please call me at (202) 233-9310.

Sincerely,

Frank Marcinowski, Director
Center for Waste Isolation
Pilot Program

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 19 1996

OFFICE OF
AIR AND RADIATION

Honorable Alvin L. Alm
Assistant Secretary
for Environmental Management
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

Dear Mr. Alm:

The U.S. Environmental Protection Agency (EPA) received the U.S. Department of Energy's (DOE) Compliance Certification Application (CCA) for the Waste Isolation Pilot Plant (WIPP) on October 29, 1996. The Agency immediately began its review of the CCA for completeness in accordance with its regulations at 40 C.F.R. §194.11. My staff has indicated that the content and logical flow of the CCA have improved since we reviewed earlier draft chapters this past summer. Notwithstanding the substantial improvement in the CCA from these earlier drafts, we have identified several areas where necessary supporting documentation is either not included in the CCA, or is unavailable for review. This information must be provided to the Agency prior to any completeness determination by the Administrator.

In addition, I would like to call to your attention some important issues regarding technical sufficiency that my staff has identified. I hope that this advance notification of the Agency's preliminary technical concerns will allow DOE to address these concerns early in EPA's rulemaking process to enable the Agency to certify whether or not the WIPP complies with the Agency's radioactive waste disposal regulations at Subparts B and C of 40 CFR Part 191.

My staff has identified three areas in particular where the CCA needs additional information. These areas, which are described in detail in Enclosure 1, include background documentation for computer codes, substantiation of models, and the general unavailability of records.

The Compliance Certification Criteria at 40 C.F.R. §194.23(b) requires DOE to document computer codes used to support the compliance certification application "in a manner that complies with the requirements of ASME NQA-2a-1990 addenda, part 2.7, to ASME NQA-2-1989 edition." The CCA does not document the computer codes, as required. Department staff have informed my staff that analysis documentation is being developed to fulfill the requirements of §194.23(b). The CCA must be supplemented with appropriate documentation before EPA can make its completeness determination.

The sensitivity analysis, which describes the effects of parameters (e.g., actinide retardation, borehole permeability) on the disposal system, is also required pursuant to §194.23, but has not yet been fully completed and included in the CCA. My staff understands that the Department is working to complete this analysis; however, the CCA cannot be deemed complete until EPA receives the final analysis.

Finally, the Records Center located at Sandia National Laboratory lacks certain records needed by my staff to verify technical information found in the CCA. It is important that all relevant information be made available at the Records Center so the Agency and the public can trace and validate documentation intended to support the Department's compliance analyses.

In addition to the documentation requirements that must be satisfied for completeness purposes, there are other aspects of the CCA that need to be addressed. Enclosure 2 describes areas of the CCA that must be clarified or enhanced before EPA can deem them technically sufficient to support a demonstration of compliance. The most important of these areas are peer review, institutional controls, and the use of magnesium oxide (MgO) as an engineered barrier.

The Department has peer-reviewed seven areas of the CCA: (1) engineered barriers; (2) natural barriers data qualification; (3) waste form/disposal room data qualification; (4) conceptual models; (5) engineered system data qualification; (6) waste characterization; and (7) passive institutional controls. While EPA has received the results of such peer reviews in the CCA submitted on October 29, 1996, my staff has learned that DOE has re-opened the latter four of these areas for further peer review. My staff attended some of the peer review meetings and observed that the re-activated peer review panels are directly addressing issues related to the technical sufficiency of certain aspects of the application. The Agency needs to receive the panels' new peer review findings as soon as possible.

Moreover, Section 194.27 imposes specific standards for the conduct of peer reviews and requires that peer reviews conducted prior to promulgation of the regulation, or that are in addition to the peer reviews required by the regulation, must provide substantiating documentation. Thus, DOE must document the substantive issues addressed by the new peer reviews and the process by which the peer reviews were accomplished as soon as possible.

The Compliance Certification Criteria at 40 C.F.R. §194.41 requires DOE to include "detailed descriptions of proposed active institutional controls, the controls' location, and the period of time the controls are proposed to remain active. Assumptions pertaining to active institutional controls and their effectiveness in terms of preventing or reducing radionuclide releases shall be supported by such descriptions." A plan for active institutional controls is included in the CCA; however, insufficient data and information are provided to support DOE's assumption that such controls will be 100 percent effective for 100 years after closure of the disposal system. DOE needs to submit documentation to justify any such assumptions as soon as possible.

Similarly, Section 194.43(a) requires DOE to include "detailed descriptions" of passive institutional controls. The passive institutional control plan included in the CCA appears to be only a conceptual design, which is insufficient as a description and clearly lacks justification for the nearly 100 percent effectiveness of the controls over a 700-year time frame. Thus, to meet its obligations under the regulations, DOE should submit additional information regarding implementation of passive institutional controls. Moreover, although Section 194.43(c) provides that EPA may allow DOE to assume passive institutional control credit, DOE must demonstrate that such credit is justified. DOE must submit the requisite justification for any credit assumed as soon as possible.

In accordance with Section 194.44, the Department has stated that it will use magnesium oxide (MgO) as an engineered barrier to prevent radionuclides from reaching the accessible environment. In its performance assessment, DOE has assumed that MgO will be 100 percent effective at mitigating the effects of gas generation. However, DOE has not provided substantiation as to why the assumed level of effectiveness is correct. The Agency requests that the Department justify (e.g., through the use of site-specific experiments and a final engineering design) and document as soon as practicable why DOE's MgO assumptions are valid.

The above requests for additional information and analyses, as well as a listing of further Agency concerns, are explained in detail in the enclosures to this letter. The comments are based on EPA's review of the CCA and are being provided to the Department, now, in order to facilitate the certification process. The Agency will continue to conduct its technical review. EPA will advise DOE if the results of our internal review, or public comments we receive, require that additional analyses, support or documentation be submitted.

Thank you for your cooperation during our review process. Should you have questions regarding this request, please contact E. Ramona Trovato at (202) 233-9320.

Sincerely yours,

Mary D. Nichols
Assistant Administrator
for Air and Radiation

Enclosures

cc: George Dials (DOE)

40 CFR Part 194 Requirements Identified By EPA As Requiring Additional Information in DOE's CCA Prior to Any Determination of Completeness by the Agency

<u>*Content of Compliance Certification Application*</u>

194.14(a)(2)
Part 194 requires that the CCA include for all geologic units within the disposal system the following general hydraulic characteristics:

- hydraulic conductivity;
- storage coefficient;
- transmissivity;
- permeability;
- thickness;
- matrix and fracture characteristics; and
- hydraulic gradients.

Section 2.2 of the CCA indicates that these characteristics have been evaluated for all geologic units in the disposal system. However, it is not apparent that all of the required information is presented.

What follows is an incomplete table which presents information extracted from Chapters 2 and 6 of the CCA and Room Q experiments (Domski et al., 1996) which DOE could revise to present the necessary information. This information should be provided (in the table or other form) as part of the analysis documentation.

COMPLETENESS DETERMINATION TABLE FOR 194.14(a)(2)

Unit		Hydraulic Conductivity	Storage Coefficient	Transmissivity	Permeability	Thickness	Matrix * and Fracture Char.	Hydraulic Gradients
Santa Rosa		--	Specific capacity 0.029 to 0.041 liters/sec/meters (2.2.1.4.2.2)	--	10^{-10} m^2 (Table 6-24)	0 to 91 m (2.2.1.4.2.2) 0.6 to 78 m (2.1.3.7)	--	--
Dewey Lake		10^{-8} m/s (2.2.1.4.2.1)	--	--	5.01 x 10^{-17} m^2 (Table 6-23)	149.3 m (Table 6-23) 152 m (2.1.3.6)	2.2.1.4.2.1 and 2.1.3.6	--
Rustler	Forty-niner	--	--	8 x 10^{-8} to 3 x 10^{-9} m^2/s (Table 2-4 and 2.2.1.4.1.5)	0 m^2 (6.4.6.5)	17.3 m (6.4.6.5) 13 to 23 m (Table 2-4 and 2.1.3.5.5)	--	--
Rustler	Magenta	--	--	4 x 10^{-4} to 1 x 10^{-9} m^2/s (Table 2-4 and 2.2.1.4.1.4)	6.31 x 10^{-16} m^2 (Table 6-22)	7.9 m (2.2.1.4.2) 7 to 8.5 m (Table 2-4, 2.1.3.5.4 and Table 6-22)	--	3 to 6 m/km (2.2.1.4.1.4)
Rustler	Tamarisk	--	--	<2.7 x 10^{-11} m^2/s (Table 2-4)	0 m^2 (6.4.6.3)	24.8 m (6.4.6.3) 26 to 56 m (Table 2-4 and 2.3.5.3)	--	--
Rustler	Culebra	--	--	1 x 10^{-3} to 1 x 10^{-9} m^2/s (Table 2-4 and 2.2.1.4.1.2)	2.1 x 10^{-14} m^2 (Table 6-18)	4 to 11.6 m (Table 2-4) 7.7 m (Table 6-18) 11 m (2.1.3.5.2)	2.1.3.5.2 and 2.2.1.4.1.2	--
Rustler	unnamed lower member	6 x 10^{-15} to 1 x 10^{-13} m/s (2.2.1.4.1.1) 1.5 x 10^{-11} to 1.2 x 10^{-11} m/s (basal interval) (2.2.1.4.1.1)	--	2.9 x 10^{-10} to 2.2 x 10^{-13} m^2/s (Table 2-4) 2.9 x 10^{-10} to 2.4 x 10^{-10} m^2/s (basal interval) (2.2.1.4.1.1)	0 m^2 (6.4.6.1)	29 to 38 m (Table 2-4 and 2.1.3.5.1)	--	--

COMPLETENESS DETERMINATION TABLE FOR 194.14(a)(2)								
Unit		**Hydraulic Conductivity**	**Storage Coefficient**	**Transmissivity**	**Permeability**	**Thickness**	**Matrix * and Fracture Char.**	**Hydraulic Gradients**
Rustler-Salado Contact Zone		--	--	3.2×10^{-11} to 5.4×10^{-8} m^2/s (Table 2-4) 3.2×10^{-11} to 8.6×10^{-6} m^2/s (2.2.1.5.2)	--	3 to 18 m (Table 2-4) 2.4 to 33 m (2.2.1.5.2)	--	0.27 to 7.4 m/km (2.2.1.5.2)
Salado	Impure Halite	2.7×10^{-22} m/s (Domski et al. 1996, Room Q)	Storativity 2.1×10^{-6} Spec. Storage 2.5×10^{-6} m^{-1} (Domski et al. 1996, Room Q)	1.3×10^{-15} m^2/s (Domski et al. 1996, Room Q)	2.3×10^{-22} m^3 (permeability-thickness) (Domski et al. 1996, Room Q) 1×10^{-23} to 4×10^{-18} m^2 (2.2.1.3) 10^{-21} to 10^{-24} m^2 (Table 6-14)	up to 600 m (2.1.3.4)	--	
	Anhydrite	4.3×10^{-13} m/s (Domski et al. 1996, Room Q)	Storativity 2×10^{-7} Spec. Storage 3.3×10^{-6} m^{-1} (Domski et al. 1996, Room Q)	2.6×10^{-14} m^2/s (Domski et al. 1996, Room Q)	4.5×10^{-21} m^3 (permeability-thickness) (Domski et al. 1996, Room Q) 2×10^{-20} to 7×10^{-18} m^2 (2.2.1.3) 7.94×10^{-18} to 10^{-21} m^2 (Table 6-15)	Fig. 2-8	Table 6-16	
	Marker Bed 139	3.4×10^{-13} (Domski et al. 1996, Room Q)	Storativity 6.6×10^{-8} Spec. Storage 4.4×10^{-7} m^{-1} (Domski et al. 1996, Room Q)	5.1×10^{-14} m^2/s (Domski et al. 1996, Room Q)	7.94×10^{-18} to 10^{-21} m^2 (Table 6-15) 8.9×10^{-21} m^3 (permeability-thickness) (Domski et al. 1996, Room Q)	0.85 m Fig. 2-8	Table 6-16	
Disturbed Rock Zone		--	--	--	10^{-15} m^2 (Table 6-17)	--	--	

COMPLETENESS DETERMINATION TABLE FOR 194.14(a)(2)								
Unit		**Hydraulic Conductivity**	**Storage Coefficient**	**Transmissivity**	**Permeability**	**Thickness**	**Matrix * and Fracture Char.**	**Hydraulic Gradients**
Castile	Brine Pockets	--	--	--	2×10^{-15} to 1.58×10^{-10} m^2 (Table 6-26)	--	2.1.3.3 and 6.4.8	
	Castile	--	--	--	--	301 m (2.1.3.3)	2.1.3.3	
Bell Canyon		1.7×10^{-7} to 3.5×10^{-12} m/s (2.2.1.2.1)	--	--	--	1,000 ft (2.2.1.2.1)	--	25 to 40 ft/mile (2.2.1.2.1)

-- Information needs to be provided in the CCA.

* Aspects of matrix characteristics are often considered in discussions in the text. The section reference, or lack of a section reference, in this column refers to fracture characteristics.

194.14(a)(2)
Part 194 requires a description of the geology, geophysics, hydrogeology, hydrology, and geochemistry of the disposal system and its vicinity and how these conditions are expected to change and interact over time.

The CCA does not include updated information obtained from recent site investigation-related studies. The CCA states that "these recent studies... provide detailed information necessary to construct the conceptual models," but does not summarize what these studies entailed and how they impact the understanding of site characteristics relative to older data. The CCA implies, on page 2-9, Section 2.1, that these data are included in Chapter 6 and associated appendices.

The CCA should include more detailed information pertaining to the more recent studies so that an understanding of the site conditions and linkages of this information with the conceptual model development can be achieved. In addition, the CCA should provide a discussion of newly acquired site-specific information (i.e., information on Culebra and retardation studies presented at the 10/11/96 meeting between DOE and State of New Mexico representatives), and discuss how this information impacts site conceptual model development.

194.14(a)(3)
Part 194 states that the CCA must provide the presence and characteristics of potential pathways for transport of waste from the disposal system to the accessible environment including, but not limited to: existing boreholes, solution features, breccia pipes, and other potentially permeable features, such as interbeds.

The CCA includes information pertaining to the Salado Formation marker bed presence and briefly describes these features in Chapter 3, GCR, and HYDRO. However the presence of pre-existing fractures within the marker beds is not addressed in sufficient detail to gain an understanding of the in-situ (i.e., pre -WIPP) fracture conditions within marker beds, from a geologic basis. CCA Section 6.4.5.2 addresses how the interbeds are "managed" in the PA, indicating, for example, that marker beds contain previous fractures that may be partially healed (Appendix MASS13.3 and PAR-36). However, the density, nature, and extent of fractures within marker beds, pertinent test results, etc., should be discussed in greater detail.

The CCA should be revised to include a more detailed discussion regarding the nature, extent, geologic characteristics, etc., of pre-existing fractures within Salado Formation marker beds.

Quality Assurance

194.22(a)(2)(iii)
Part 194 states that the CCA shall contain information on the QA program applied to meteorologic characteristics.

CCA Chapter 5 does not contain information on the QA program applied to meteorological characteristics.

The CCA needs to include meteorological information or state why a QA program was not applied to meteorological characteristics.

Models and Computer Codes
Part 194 requires that the CCA include a description of conceptual models and scenario construction used to support the CCA. In addition, Part 194 states that documentation of all models and computer codes must be included.

There is a significant problem with the completeness of the CCA documentation that deals with the CCDF formalism and the codes that implement it. While the current versions of the formalism and codes may be doing exactly what is required of them, and while those intended activities may be what is needed for the PA, it is often difficult and sometimes impossible to determine what it is, exactly, that they *are* doing, and to *verify* that this is all happening as intended. The documentation is, in places, too sparse to enable a reviewer to acquire a comprehensive understanding of the current form of the formalism and codes.

DOE needs to provide documentation for the CCDF formalism and for the codes that implement it. Specific examples are provided below.

194.23(a)(1)
Part 194 requires a description of the conceptual models and scenario construction used to support the CCA.

No discussion is provided in the NUTS User's Manual of the numerical implementation of precipitation, or on colloidal preferential solubility.

The CCA needs to include(in the NUTS User's Manual) numerical implementation of precipitation, and colloidal preferential solubility information.

194.23(a)(2)
Part 194 requires a description of plausible, alternative conceptual model(s) seriously considered but not used, and an explanation of the reason(s) why such model(s) was not deemed to accurately portray performance of the disposal system.

(1) While the application describes the conceptual models used for cuttings, cavings, and spallings, there is little discussion of any alternative models that may have been evaluated.

The CCA needs to provide a more complete discussion of alternative models seriously considered. This comment also applies to all model conceptualization in the CCA PA. If there are no other plausible, alternative models, this should be stated clearly in the CCA.

(2) The Culebra is described as having heterogeneous transmissivity (CCA page 6-124, line 2-3) and uniform porosity (CCA page 6-129, line 20-26). Given the fact that flow in the Culebra is conceptualized as being predominantly in fractures, the porosity should vary with hydraulic conductivity (and transmissivity since the thickness is constant).

Future changes in the Culebra transmissivity due to dissolution need to be discussed, or reasons need to be given for discounting this alternative conceptualization of the Culebra.

194.23(a)(3)(i)
Part 194 requires that documentation be provided to substantiate that conceptual models and scenarios reasonably represent possible future states of the disposal system.

In the Design Document specification for Appendix CCDFGF, the map of 144 specific locations to model for intrusions implies that location-specific probabilities were used to ascertain whether brine would be encountered at each of these locations. Yet, the documentation in Appendix MASS implies that a fixed value near 8% was used for all locations.

The CCA needs to clarify the inconsistency between site-specific brine information and the fixed 8% value.

194.23(a)(3)(ii)
Part 194 requires that mathematical models incorporate equations and boundary conditions which reasonably represent the mathematical formulation of the conceptual models.

The Design Document in Appendix CCDFGF includes a discussion of entity EN2 which does not reveal how release estimates are calculated or how interpolation is used. It also lacks detailed explanations of the equations which assign releases to cases with multiple E1, multiple E2 and multiple E1E2 type intrusions. In addition, the Design Document discussions of cuttings, blowout, and spallings releases provide insufficient information about how the actual releases are calculated. Only thumbnail sketches of how releases *could be* calculated are provided. It is not sufficient to list variables with no text discussion as to their derivation, meaning and limitations.

The CCA needs to provide pertinent documentation to support mathematical assumptions made.

194.23(a)(3)(iii)
Part 194 requires that numerical models provide numerical schemes which enable the mathematical models to obtain stable solutions.

The NUTS User's Manual contains numerous errors and omissions in the derivation of equations. Until these errors are corrected by a careful analysis of the source code for the computer program, a thorough determination of technical adequacy will not be possible.

The user's manual should be updated to include more complete equations. The following errors and omissions should be corrected:

- *Page 29, Section 4.3.8, equations 4.37 - 4.39 are incorrect.*
- *Page 38, Section 4.4.1, last paragraph: states that "we will discretize the equations in general ..." when, in fact, the equations are written for a fully implicit case only.*
- *Page 40, equation 4.79: ξ_{fi} is never defined. Further, the equation seems like it is written only for linear adsorption unless ξ_{fi} takes on a more complex meaning.*
- *Page 54, Section 4.5.1, this section defers details of colloid transport to ALGEBRA calculations and then states that maximum concentrations of colloid particulates are added to dissolved concentrations to estimate net mobilization. Equations are required here, detailing colloidal transport from generally accepted theories and noting the assumptions made to reduce it into the form being solved by NUTS, which should also be presented.*

194.23(a)(3)(iv)
Part 194 requires that computer codes accurately implement the numerical models; i.e., computer codes must be free of coding errors and must produce stable solutions.

(1) There is not enough information to evaluate the testing of the SECOTP2D analytical solution developed for DOE (page 60 of the SECO User's Manual). In addition, the application is missing the FORTRAN code used by DOE to implement this analytical solution.

The CCA needs to provide this code, as well as documentation that the code has been tested.

(2) The CCA documentation does not provide sufficient information to verify that the grid geometry used in the BRAGFLO calculations produce stable and accurate results.

The DOE needs to perform and document a grid convergence evaluation to verify that BRAGFLO and NUTS (NUTS uses the same grid to transport actinides) calculate accurate and stable results. The grid convergence evaluation should halve the grid spacing in BRAGFLO, and use a flow field with fast velocities to analyze particle transport calculated in NUTS.

194.23(c)
Part 194 requires documentation of all models and computer codes used in performance assessment calculations to be included in the application.

No testing or documentation was presented for the computer code SECO3D, the three dimensional version of the SECO code.

The CCA needs to provide testing documentation related to this code, since this code was used to develop the regional flow model that supports the use of a 2D model, as well as used in the FEP selection process to decide that the SECO two dimensional code is adequate for the CCA calculations.

194.23(c)(2)
Part 194 requires that the CCA include *detailed* instructions for executing the computer codes, including hardware and software requirements, input and output formats, listings of input and output files from a sample computer run, etc.

(1) Only brief file descriptions are provided in the SECO User's Manual.

These files must be thoroughly documented in order for EPA to perform independent testing of the SECOFL2D and SECOTP2D codes.

(2) Many of the input variables for NUTS are not adequately described in the NUTS User's Manual or in the derivation of equations in CCA Section 4. Poorly documented input variables include the following:

- *Page 82, ADSEXPCOEFF: Not clearly defined. Is it* ξ *of equation 4.91? Is it* X_2 *of equation 4.28?*
- *Page 86, MAT_WASTE: Is input on line 12 as well as 13?*
- *Page 88: Entire page on solubility input parameters is not comprehensible, since this topic is not discussed earlier. What relations are input to the table? How is it used?*
- *Page 89: "Correlation Polynomial" [input at Line 11] is not discussed earlier.*
- *Page 89: "Contact handled inventory, remote handled inventory" [input at Line 12] is not discussed earlier. How is this implemented in the formulation and the code?*
- *Page 89: "Gas-liquid equilibrium line" [input at line 13] is not discussed earlier in the formulation.*
- *Page 99, top of page: Input on normalization factors is not discussed earlier.*
- *Page 106: Input on normalization factors not discussed earlier.*
- *Page 108: "Velocity scaling" for colloidal transport not discussed earlier, and no formulation is supplied.*

(3) Many of the input and output variables for NUTS are not adequately described in the NUTS RD/VVP or in the derivation of equations. Examples of poorly documented input variables include the following:

- *Page 51: What is* R_d*? It is not defined anywhere.*
- *Page 147: In the output file, CSRC and MVCPG need to be explained.*

(4) NUTS/RD/VVP Test Case #5 needs a figure depicting the conceptual model that is being simulated.

Titles for the columns need to be provided on CCA page 361.

(5) CCA page 374: Is this a mass conserved simulation? How were the two 1-D analytical solutions linked?

Please discuss. A conceptual figure is also needed.

(6) NUTS Validation Document, page 1205: oscillations in the concentration profile need explanation.

Please discuss the physical reason for these oscillations.

(7) GRASP-INV User's Manual: It is unclear whether pilot points were treated as noise-free.

If the pilot points were not treated as noise-free, then the User's Manual and CCA need to document how the standard deviation of the noise was computed. In addition, the rationale for determination of the values of kriged estimate errors at pilot point locations needs to be documented.

194.23(c)(4)
Part 194 requires detailed descriptions of data collection procedures, sources of data, data reduction and analysis, and code input parameter development.

(1) With respect to the flow and transport properties of the Culebra the CCA states, "The more recent tracer test program consisted of single-well injection-withdrawal tests and multi-well convergent flow tests." However, no references to this work are provided. In addition, the statement on CCA page 3 of Attachment 15-1 indicates that detailed descriptions of distribution coefficient laboratory studies and complete test results would appear in SNL reports by the time of submission of the CCA.

Since the results of these tests are used to support critical components of the conceptual model (e.g., matrix diffusion), it is not possible to evaluate the technical adequacy of the conceptual model without reviewing the actual test analysis. The CCA needs to identify where the field tracer and laboratory tests have been analyzed, including the analyses that justify the cross correlations for the Culebra transport parameters.

(2) Appendix MASS (Attachment 13-2) discusses the symmetry of intact rock properties and the orientation of possible gas pressure-induced fracture properties around the WIPP. However, there is insufficient information submitted in the CCA to support the assumption of radial **uniform** fracturing. Radial uniform fracturing will tend to minimize the potential transport distances and, since fracturing is only assumed to occur in the anhydrite marker beds, there is no chance that intercommunication of overlying units will occur by vertically extending fractures.

The CCA needs to include documentation to support the assumption of radical uniform fracturing.

(3) It appears that the anhydrite fracture model is simulated using a matrix porosity formulation instead of a classic fracture formulation. The use of the matrix porosity formulation inherently

assumes a high fracture density; however, there appears to be no field fracture data to support the DOE approach.

The CCA needs to provide information which demonstrates that DOE's implementation of the anhydrite fracture conceptual model is appropriate.

(4) None of the references pertaining to the fracturing of the anhydrite marker beds describe how the actual data values were derived.

The CCA needs to include a quantitative argument as to why a highly simplified conceptual model is sufficient to model fracturing of the anhydrite marker beds. In addition, a detailed description of the actual data pertaining to the fracture properties (e.g., how was the data were obtained, uncertainties, limitations, etc.) is need.

(5) Appendix TFIELD: The calibrated fit to the head data is not clear and appears questionable in some cases. Only averages of residuals are presented for steady state head data, and transient data plots give no indication of the expected measurement errors. Also, a number of explanations regarding transient data mismatches need clarification: shafts were modeled as a pressure boundary instead of a flux boundary; not all pump tests were included in the fit; and Storativity is not constant across the site as modeled.

The CCA needs to discuss in detail and clarify the head residuals. More than averages for steady state are needed, and the size of the residuals should be assessed relative to the expected statistical error. The physical explanations for residual mismatches should be explained.

194.23(c)(6)
Part 194 requires an explanation of the manner in which models and computer codes incorporate the effects of parameter correlation.

Appendix MASS identifies the Culebra dolomite as an equivalent homogeneous fractured media "with no parameter cross-correlations."

The CCA needs to provide information to support the claim of no parameter correlations, including the lack of no correlation between fracture spacing and surface area. In addition, Figure 1 needs to include corresponding parameter values and a listing of where each data value and associated analysis can be located in supporting references.

<u>*Waste Characterization*</u>

194.24(a)
Part 194 requires DOE to provide information on the chemical, radiological and physical composition of waste proposed disposal at WIPP. The information must include waste components and their approximate quantities in the waste.

(1) The CCA does not provide data on the inventory of the organic compounds, phosphate, acetate, citrate, oxalate, or EDTA. DOE has indicated that these components are "negligible" or "not used" in performance assessment (Tables WCA-3 and WCA-4), implying that identification of these materials is not necessary. Nevertheless, this determination was made based upon assumed quantities and reactions, which would appear to necessitate an understanding of the quantities of these waste components present in the waste inventory.

The CCA needs to provide information pertaining to the estimated inventory of organic compounds, phosphate, and potential organic ligand.

(2) The CCA omits data concerning radionuclides Iodine 129, Technetium 99 and Tin 126, as well as data on total alpha activity.

These radionuclides were identified as important in 40 CFR 191 Appendix A; therefore, the inventory should be addressed in the CCA.

(3) TWBIR states that stored radionuclide inventories for Argonne National Laboratory-East, Argonne National Laboratory-West and Teledyne-Brown Engineering were not reported.

Provide the inventory data for Argonne National Laboratory-East and West, and Teledyne-Brown Engineering.

194.24(c)
Part 194 requires DOE to provide information on the limiting values for individual waste components identified in 194.24(b)(2), and the associated uncertainty for each limiting value, of the total inventory of waste proposed for disposal in WIPP.

It is not clear from Appendix WCL which waste components are being limited. Further, the waste components seem to be screened out solely because of insignificant quantity in the inventory.

The CCA needs to provide consistent reporting of waste limits and their associated uncertainties. In addition, WCL should specify actual inventory values for each waste component.

194.24(c)(l)
Part 194 requires DOE to demonstrate that for the total inventory of waste proposed for disposal, the WIPP complies with the numeric requirements of section 194.34 for the waste component limits previously identified, and for the plausible combinations of upper and lower limits of such waste components that could result in the greatest release.

While CCA Section 4.2.2 states "This following discussion is responsive to the criteria at 40 CFR 194.24(c)(1)..." it does not address the requirements of 194(c)(1).

The CCA should include a description of:

- *the plausible combinations of upper and lower limits of waste and their associated uncertainties; .*
- *a rationale for the selection of these combinations;*
- *the results of the modeling run of the code using values to input parameters corresponding to values of waste components fixed at the limiting values;*
- *a demonstration that the results of the analysis show that the disposal system complies with the numeric requirements under these conditions; and*
- *documentation that the combination of these selected limits results in the greatest estimated release.*

194.24(c)(3)
Part 194 requires DOE to provide information that demonstrates that the use of process knowledge to quantify components in the waste proposed for disposal conforms with QA requirements in section 194.22.

The CCA discusses "acceptable knowledge" in lieu of process knowledge, and refers several times to the Appendix WAP for the acceptable knowledge waste characterization details. However, the Appendix WAP, Appendix C9, does not specifically address acceptable knowledge waste characterization for radiological parameters.

The CCA should provide detailed documentation that specifically addresses waste characterization via acceptable knowledge for radiological parameters. DOE should ensure that all major elements presented in Appendix WAP and Appendix C9 are addressed.

194.24(c)(4)
Part 194 requires DOE to provide information that demonstrates that a system of controls has been and will be continue to be implemented to confirm that the total amount of each waste components will not exceed established limits under 194.24(c).

(1) Although the CCA briefly discusses the WIPP Waste Information System (WWIS), additional information is requested.

The CCA should provide information on the status and implementation of the WWIS, as well as information on "automatic limit, range, and QA checks; automatic report generation...," database security, mending database integrity and making changes to the data.

(2) Although the CCA briefly addresses the general aspects (i.e., QAPD, QAPP, QAPjP, audits, surveillances, SOPs, PDPs) of the systems for maintaining centralized control over the waste characterization activities and the authorization of grants to generator sites to characterize and ship waste to WIPP, some of the systems discussed do not address radiological waste characterization activities. For example, Page 4-48, Paragraph 3, discusses waste stream profile forms (WSPF) which do not include radiological waste characterization elements.

The CCA needs to provide information on systems for maintaining centralized control over the waste characterization activities which fully address radiological waste characterization activities.

(3) The CCA does not include any discussion on maintaining chain of custody over the waste and waste records from the point of characterization to the point of disposal.

The CCA should provide a discussion on maintaining chain of custody over the waste and waste records from the point of characterization to the point of disposal.

(4) The CCA does not include a discussion on the control procedures for the receipt of waste, which includes provisions for records and shipment surveys, acceptance and emplacement of waste, and provisions for dealing with non-conforming waste and waste records.

The CCA should provide a discussion on the controls currently in place for receipt of waste which include provisions for records and shipment surveys, acceptance and emplacement of waste, and provisions for dealing with non-conforming waste and waste records.

(5) The CCA does not provide evidence which substantiates that waste components for which inventory limits were set are monitored, controlled and accounted for in a systematic and traceable manner.

The CCA should provide evidence that substantiates that waste components for which inventory limits were set are monitored, controlled and accounted for in a systematic and traceable manner.

194.24(g)
Part 194 requires DOE to provide information that demonstrates that the inventory of waste emplaced in the disposal system complies with the limitation on transuranic waste described in the WIPP LWA.

The CCA describes the limits imposed by the LWA, but the data in the CCA do not support a determination of whether the waste inventory meets these limits. There is no information in the CCA describing the RH waste surface dose rate.

The CCA should provide information on how DOE is addressing all limitations specified in the LWA.

Future State Assumptions

194.25 (b)(1)

Part 194 requires DOE to consider futures states, and document the effects of potential future hydrogeologic, geologic, and climatic conditions on the disposal system over the regulatory time frame.

The CCA includes the impact assessment of increasing precipitation in the Culebra member. However, Dewey Lake Formation has not been assessed.

DOE should provide the impact assessment on the effects of the potential changes to hydrogeologic conditions on the Dewey Lake Formation. The potential changes on precipitation, recharge, hydraulic gradient, and characteristics needs to be included.

Scope of Performance Assessments

194.32(a)

Part 194 states that performance assessments shall consider deep drilling that may affect the disposal system during the regulatory time frame.

The connection of a Castile brine reservoir with repository waste panels has long been recognized as one of the most severe challenges to performance assessment. Scenarios concerning brine reservoirs are included in the CCA but their assumed characteristics are much different than those observed at WIPP-12, located less than 2,000 meters north of the waste panels. The principal difference is the size of brine reservoirs assumed. WIPP-12 has an estimated volume of $2.7 \times 10^6 m^3$, while brine reservoir volumes used in the CCA ranged from 1.6×10^5 m^3 to 3.2×10^4 m^3, with a median of 8×10^4 m^3. DOE's rationale in the CCA for using smaller reservoirs is that larger ones would be depleted by multiple intrusion boreholes that do not strike waste. The median pore compressibility value used in the CCA (1.15×10^{-8} Pa^{-1}) is similar to the constant value used for WIPP-12 (1.45×10^{-8} Pa^{-1}). The volume of brine that would flow to the surface from a brine reservoir is:

$$\frac{\text{Volume to Surface}}{\text{Pressure Drop}} = \text{Reservoir Volume} \times \text{Pore Compressibility}$$

For WIPP-12 the volume to the surface and pressure drop were known from field observations and thus the volume of the reservoir times the pore compressibility could be calculated to be 3.92×10^{-2} m^3 Pa^{-1}. For the median values used in the CCA, this product is only 9.2×10^{-4} (2.3% of the value for WIPP-12). The assumptions used in the CCA lead to a maximum release to the surface from an E1E2 scenario (1,000 year time for first intrusion) of about 21 m^3 (see Fig.

SA-20 in Appendix SA).

The CCA needs to provide:

- *A detailed, quantitative argument justifying the conclusion that larger depressurized reservoirs are less of a problem than smaller, fully pressurized ones.*

- *A detailed, quantitative argument supporting the reservoir depletion assumptions used;*

- *Justification for the probabilities selected for the different reservoir volumes used.*

In addition, the computer models and specific modeling assumptions used to calculate the results obtained need to be made available in a usable form for reviewers.

194.32(c)
Part 194 states that performance assessments need to include an analysis of the effects on the disposal system of any activities that occur in the vicinity of the disposal system prior to disposal and are expected to occur in the vicinity of the disposal system soon after disposal. Such activities may include existing boreholes and the development of any existing leases that can be reasonably expected to be developed in the near future, including boreholes and leases that may be used for fluid injection activities.

CCA Table 6-6 (Section 6.3.1) indicates a FEP "effects of explosions" to which it refers to Section 6.4.5.3 for explanation. Section 6.4.5.3 does not explain this FEP.

The CCA needs to provide information on the "effects of explosions" FEP.

194.32(e)
Part 194 states that the CCA needs to include information that identifies all potential processes, events or sequences and combinations of processes and events that may occur during the regulatory time frame and may affect the disposal system.

(1) The CCA indicates that panel seals will prevent brine flow and radionuclide transport between panels, but fails to justify such effectiveness.

The CCA needs to include documentation that justifies the effectiveness of the panel seals in preventing brine flow and radionuclide transport between panels.

(2) CCA Section SCR 3.3.1: Neither the CCA nor the referenced FEP screening package in the Sandia Records Center (as of December 3, 1996) include a referenced study by Stoelzel and O'Brien (1996) (reference #611) which details modeling performed to assess the salt water disposal and water flooding activities outside of the WIPP LWA area.

DOE needs to provide this report.

Results of Performance Assessments

194.34(b)
Part 194 requires that probability distributions for uncertain disposal system parameter values used in performance assessments shall be developed and documented in any compliance application.

Many of the distribution functions describing the parameters used in the WIPP PA (Appendix PAR) are assumed to be uniform (*i.e.*, have equal probability for occurrence of each value of the parameter within the range between the minimum and maximum values for the parameter). DOE has employed uniform distributions for some parameter sets, as shown in the Table below, where such a selection may not be warranted. This is particularly true for the distribution coefficients (Kd's) of Am, Pu, Th, and U. Typically, distribution coefficients are reported as log uniform distributions because of the large range in their values. Use of uniform distributions, by contrast, results in relatively high mean Kd values which, in turn, would lead to under-estimations of releases of radionuclides reaching the accessible environment. For those parameter sets where the range is large (*i.e.*, where max value/min value > 10), the appropriateness of adopting a uniform distribution should be demonstrated.

The following are parameters for which DOE needs to provide justification for the selection of uniform parameter distributions:

ID	*MAT/L*	*PARAMETER*
541	*Salado Halite*	*COMP RCK*
3246	*Blowout*	*PART DIA*
2254	*Borehole*	*TAUFAIL*
3914	*Culebra*	*MINP FAC*
3487	*Culebra*	*APOROS*
3475	*U(VI)*	*MKD U*
3479	*U(IV)*	*MKD U*
3480	*PU(III)*	*MKD PU*
3481	*PU(IV)*	*MKD PU*
3478	*TH(IV)*	*MKD TH*
3482	*AM(III)*	*MKD AM*
3246	*Blowout*	*PART DIA*

As a particular example of the need to explain the basis for selecting parameter distributions, page PAR 118, lines 4-6, describes the basis for the parameter TAUFAIL as professional judgment. The CCA does not provide any information supporting the acceptability of this distribution or the range selected. In fact, use of a uniform distribution for this range of values (0.05-10) may be inappropriate. Page PAR 8 (lines 9-10) in Appendix PAR states that "use of the loguniform distribution is appropriate when all that is known about a parameter is its range (a,b), and B/A>>10; that is, the range (a,b) spans many orders of magnitude." In this case, B/A = 200.

DOE needs to provide an explanation as to why a uniform distribution was selected when the guidance suggests that a loguniform distribution is more appropriate.

Active Institutional Controls

194.41(a)
Part 194 states that the CCA should include detailed descriptions of proposed active institutional controls, the controls' location, and the period of time the controls are proposed to remain active. Assumptions pertaining to active institutional controls and their effectiveness in terms of preventing or reducing radionuclide releases should be supported by such descriptions.

The implementation time line and the description of active institutional controls do not outline the process for implementing and maintaining AICs.

The CCA should include a list or time line that outlines the major AIC milestones and actions that will taken to protect the repository in the pre- and post-closure phases. The CCA should describe how long each individual measure will continue to be effective, how it will be actively maintained, and cite empirical evidence which supports the periods of times asserted for effectiveness. For instance, when the Department asserts that a perimeter fence will be maintained for a minimum of 100 years, the Department should also identify minimum requirements for fence performance, how this will be inspected/determined, and how often and by what mechanism maintenance or replacement will be performed.

Monitoring

194.42(a)
Part 194 requires DOE to conduct an analysis of the effects of disposal system parameters on the containment of waste in the disposal system. The results of this analysis should be used to develop pre-closure and post-closure monitoring plans.

The CCA provides a list of parameters that were analyzed for their effects on the containment of waste and on the verification of performance assessment predictions. This analysis ranks the parameters as having high, medium or low effect on the containment of waste and the verification of performance assessment predictions. The CCA provides no explanation or documentation regarding the methodology for assigning the high, medium and low designations to the various disposal system parameters analyzed.

The Department needs to provide the methodology by which the various disposal system parameters were designated as having high, medium or low effects on the containment of waste and the verification of performance assessment predictions.

<u>*Consideration of Underground Source of Drinking Water*</u>

Part 194 states that DOE should consider all underground sources of drinking water in the accessible environment that are expected to be affected by the disposal system over the regulatory time frame. Part 194 goes on to say "In determining whether underground sources of drinking water are expected to be affected by the disposal system, underground interconnections among bodies of surface water, ground water, and underground sources of drinking water shall be considered."

CCA Chapter 8 and Appendix USDW do not show the location of USDWs.

The CCA needs to include appropriate maps of USDWs using plan views with information such as township, range, and estimated latitude and longitude of the center of the USDW.

Items Identified By EPA As Not Being Sufficiently Addressed in the CCA and Requiring Additional Information

Content of Compliance Certification Application

194.14(a)(2)
Section 194.14(a)(2) requires that a description be provided of the "...geochemistry of the disposal system and its vicinity and how these conditions are expected to change and interact over the regulatory time frame."

Section 6.4.3.4 &.5 of the Compliance Certification Application (CCA) provides solubility values for dissolved actinides in Castile and Salado brine. Both plutonium and americium are much more soluble in Salado brine than in Castile brine. The assumption is made that, in any scenario involving a Castile brine reservoir, all of the brine in the waste panel will be Castile brine.

DOE needs to provide a justification of this assumption.

194.14(a)(2)
Section 194.14(a)(2) also requires "a description of the...hydrology...of the disposal system and its vicinity and how these conditions are expected to change and interact over the regulatory time frame." This is to include the estimated vertical flow of groundwater for each geological unit expected to transmit radionuclides to the accessible environment during the regulatory time frame.

Section 2.2.1.1 of the CCA discusses the conceptual model for regional groundwater flow around the WIPP. However, estimated vertical flow of groundwater into and between these transmissive units is not provided. This estimation of vertical flow includes estimates of infiltration at the surface and into immediate underlying geologic units.

DOE needs to include: 1) the estimated infiltration at the surface and to the Dewey Lake; and 2) the estimated vertical flow of groundwater into other transmissive units within the area surrounding the WIPP.

Models and Computer Codes

194.23(a)(1)
Section 194.23(a)(1) requires a description of the conceptual models and scenario construction.

While Appendix MASS: Attachments 15-2, 15-8 and 15-9 describe the transport of colloids in the Culebra, more information is required to justify the assumptions made regarding these transport mechanisms. Specifically, Attachment 15-2 concludes with the following, "In summary, a particular colloid will be modeled in one of two ways depending on the colloids dominant retardation mechanism. If sorption is the dominant mechanism, the colloid will be treated nearly the same as a dissolved actinide, see Table 1. However, if filtration is the dominant retardation mechanism, matrix diffusion will be disabled and the decay constant will be used to filter out colloids. Of course other combinations are possible should a particular colloid require special consideration." This approach appears to treat the migration of colloids in the same manner as other radionuclides and does not address the special concerns related to the facilitative transport associated with colloids (e.g., colloids can move faster than the bulk velocity of the groundwater).

The Department needs to provide information to justify treating the transport of colloids and radionuclides in the same manner. In addition, the information on filtration versus sorption needs to be clarified, specifically how the filtration properties of crushed dolomite compare with fractures in the Culebra, or how the effects of filtration were separated from those of sorption.

194.23(a)(1) & 194.23(a)(2)

Sections 194.23(a)(1) and 194.23(a)(2) require a description of the conceptual models and alternative plausible conceptual models and an explanation of the reason why such alternative models were not deemed accurate.

Appendix MASS states "The conceptual model used in performance assessment for groundwater flow in the Culebra treats the Culebra as a confined two-dimensional aquifer with constant thickness and spatially varying transmissivity." The treatment of the Culebra as a fully confined system is contradictory to the modeling results presented by Corbett and Knupp (CCA Reference No. 147) which indicate on Page 5 that "Vertical leakage may contribute as little as 5 % or more than 50% of the total inflow to the portion of the Culebra that lies within the WIPP-site boundary."

The Department needs to provide additional support for the use of a fully confined system for the conceptual model, including information on why the Culebra should not be treated as unconfined (an alternative conceptualization) in certain areas.

194.23(a)(3)(I)

Section 194.23(a)(3)(I) requires that "conceptual models and scenarios reasonably represent possible future states of the disposal system."

As an essential component of the conceptual models, DOE has introduced MgO as a chemical additive to buffer the chemistry of the radionuclides so as to lower the pH and thus their solubility, and thereby limit transport. The Department states in Appendix BACK that approximately two times the amount of MgO needed to absorb the maximum expected CO_2 generated will be emplaced in the disposal rooms. The Department, however, has not provided documentation in the CCA verifying that the expected chemical reaction will in fact progress as expected and completely absorb the CO_2 generated.

The Department needs to provide experimental evidence to support these assumptions.

194.23(a)(3)(I)
Section 194.23(a)(3)(I) requires documentation that "the conceptual models and scenarios reasonably represent possible future states of the disposal system."

In Appendix BACK, the Department states that bags of cellulose or plastic will protect the MgO from premature exposure to the atmosphere without providing supporting evidence.

The Department needs to provide evidence that CO_2 will not diffuse through or otherwise penetrate the bags during the operational phase and reduce the post-closure capability of the MgO.

194.23(a)(3)(ii)
Section 194.23(a)(3)(ii) requires documentation that the "mathematical models incorporate equations and boundary conditions which represent that mathematical formulation of the conceptual models."

The BRAGFLO User's Manual is unclear on how the effects of wicking are integrated into the mathematical model.

The Department needs to clarify the incorporation of wicking into the mathematical model.

194.23(a)(3)(iv)
Section 194.23(a)(3)(iv) requires documentation that the "...computer codes are free of coding errors and produce stable results."

One feature of the SECOFL2D computer code (SECO User's Manual) that was not tested was that the code implements the transition from a regional grid to a local grid.

The Department needs to devise a test of this key component and document the accuracy of the bilinear interpolation scheme for both boundaries and properties.

194.23(a)(3)(iv)
Section 194.23(a)(3)(iv) requires "computer models accurately implement the numerical models" and are free of coding errors and produce stable results.

Appendix PAR identifies the assigned values for both longitudinal and transverse dispersivity in the Culebra as 0.0. Although this value would appear to lead to conservative results by reducing the amount of surface area available for matrix diffusion, there is insufficient evidence presented in the CCA that the SECOTP code will provide stable solutions at such low dispersivities. In fact, in a letter from James McCord to James Ramsey (Sandia National Lab), provided as an attachment to the Parameter Record Package for non-Salado longitudinal dispersivity, Dr. McCord states "Assuming that the numerical codes used correctly solve the governing partial differential equations, simulations using local dispersivities less than or equal to 2 m will yield results consistent with field scale dispersive spreading observations as reported by Gelhar et al. (1992)."

The Department needs to provide evidence that the numerical solver method implemented in the SECOTP code correctly solves the partial differential equations at dispersivities of 0.0 over the range of Courant numbers used in the CCA.

194.23(a)(3)(iv)
Section 194.23(a)(3)(iv) requires "computer models accurately implement the numerical models."

In regard to the BRAGFLO computer code, Appendix MASS states "Approximating convergent and divergent flow around the intrusion borehole and the shaft creates two narrow necks in the otherwise fairly uniform width grid in the region representing the repository. In the undisturbed performance scenario and under certain conditions in other scenarios, flow in the repository may pass laterally through these necks. In reality, these necks do not exist. Their presence in the model is expected to have a negligible or conservative impact on model predictions compared to predictions that would result from use of a more realistic model geometry." The text further states that "The time scale involved and the permeability contrast between the repository and surrounding rock are sufficient that lateral flow that may occur in the repository is restricted by the rate at which liquid gets into or out of the repository, rather than the rate at which it flows through the repository." To support this contention, a grid study comparing a two-dimensional and three-dimensional model was performed and included as MASS Attachment 4-1. The results of this analysis indicate that under undisturbed performance the grids would provide similar answers. However, the models were parameterized such that, in both cases, brine did not flow up the borehole following an intrusion and therefore, the adequacy of the grid under disturbed conditions cannot be evaluated.

The Department needs to provide a similar analysis that is representative of an intrusion scenario in which brine reaches the Culebra. That is, the pressures in the repository have to be high enough so brine from the repository reaches the Culebra.

194.23(c)(2)
Section 194.23(c)(2) requires, among other things, "...reports on code verification, benchmarking, validation, and quality assurance procedures."

The Requirements Document and the Verification and Validation Plan for the NUTS computer code establishes the criterion that "the integrated sum of releases passing any point of interest should be less than the integrated release from the repository." However, this does not prove that mass is being conserved, nor is evidence of mass balance provided elsewhere in the documentation.

The Department needs to perform a mass balance analysis on the NUTS computer code.

194.23(c)(2)
Section 194.23(c)(2) requires, among other things, "...reports on code verification, benchmarking, validation, and quality assurance procedures."

Regarding the GRASP-INV computer code, the CCA does not demonstrate that the incorporation of categorical simulation into GRASP-INV produces statistically valid unbiased transmissivity fields. As a result it is possible that the categorical simulation produces a statistical bias in favor of long Culebra travel times. The existing functional requirements and tests address many of the ancillary functions needed by the performance assessment, but the actual validity of the transmissivity fields to provide the statistical distributions of model predictions needed by the performance assessment is not tested.

An end-to-end requirement and test is particularly important in view of a recent change to GRASP-INV. The INTERA pilot point method (PPM) used to produce calibrated transmissivity fields was recently changed by adding a categorical simulation front end. This was done because of the outcome of the work of the geostatistics expert panel (GXG), applying different methods to four test problems.

Beyond questions about categorical simulation, it is important to have an end-to-end requirement and test for the pilot point method itself. A paper by Keidser and Rosbjerg is referenced in the GRASP-INV User's Manual in support of the pilot point method. The User's Manual states that the comparison that Keidser and Rosbjerg did of four inverse methods for determining transmissivity showed that the pilot point method is the best at reproducing large local heterogeneities. However, Keidser and Rosbjerg also say that the pilot point method is not the best for future predictions and did not perform well in the presence of measurement and model errors. They say it is "flexible enough to fit the observed short-time migration of the plume, but the continued simulation of the plume is more exposed to distortion when based on these local-scale corrections". But it is the statistical distribution of model predictions that the CCA really needs from GRASP-INV.

The Department needs to develop a code requirement and test the end-to-end statistical validity of the simulated transmissivity fields to provide the probabilistic inputs for the performance assessment.

194.23(c)(2)
Section 194.23(c)(2) requires, among other things, "...reports on code verification, benchmarking, validation, and quality assurance procedures."

The GRASP_INV computer code user's manual describes a number of test problem computer runs. However, none of the test runs is similar to the way in which the code is implemented in the performance assessment. It is also never stated in the documentation that the GRASP-INV code has been tested in a manner in which it will be implemented in the performance assessment.

The Department needs to provide evidence that the GRASP-INV code was tested in a manner in which it will be implemented in the performance assessment, and provide a sample computer run that corresponds to the CCA results.

194.23(c)(4)
Section 194.23(c)(4) requires "detailed descriptions of data collection procedures, sources of data, data reduction and analysis, and code input parameter development."

A low transmissivity region appears consistently in the calibrated transmissivity fields in the eastern portion of the site where there are limited data (Appendix TFIELD). From the histogram of Culebra transmissivity data, the P-18 data point could be argued to be a statistical outlier. Given the large variation of transmissivity data over the wider region, the P-18 data point could also be valid. If the low transmissivity region is an artifact, then it will bias some travel times high.

The Department needs to determine whether there are any physical explanations for an artificially low transmissivity data point at P-18, and provide evidence to explain how one data point can produce low transmissivity in a region far separated from that data point. The transmissivity fields need to be calibrated with the P-18 data point removed to verify that the low transmissivity region is due to the single data point at P-18.

Waste Characterization

194.24(a)
This section requires DOE to provide information on the chemical, radiological and physical composition of waste proposed for disposal at WIPP. The information shall include waste components and their approximate quantities in the waste.

The Transuranic Waste Baseline Inventory Report (BIR) contains an estimate of complexing agents, nitrates, sulfates, phosphates, and cement. However, this inventory of complexing agents (important to the solubility of actinides) is based on uncertain plans that Idaho National Engineering Laboratory (INEL) will vitrify the waste destined for WIPP, therefore, reducing the quantity of complexing agents and other waste components. This is inconsistent with the assumptions for waste form in the performance assessment, which assumes no vitrification or other waste form modification.

The Department needs to rectify this inconsistency between the BIR and the assumptions regarding waste form in the performance assessment.

Scope of Performance Assessment

194.32(a)
Section 194.32(a) states that "Performance assessments shall consider..., deep drilling,... that may affect the disposal system during the regulatory time frame."

Section 6.4.7.1 of the CCA indicates that all E1 and E2 intrusions that drill through waste rooms will also drill through Marker Bed-139 (MB-139) which is located 1.38 meters beneath the waste rooms. Models predict that MB-139 will contain brine that has drained from the waste rooms and is presumably contaminated (see CCA, page 9-97). Also, Appendix SCR, page SCR-114 states that there are 0.13 EPA units of radioactivity expected in MB-139. However, the contribution of direct releases from cuttings or brine in MB-139 releases would be additive to all other direct releases (cutting/cavings, spallation, direct brine release) for each realization. Values that are a fraction of an EPA unit could be an important contributor to repository releases.

DOE needs to provide justification of the impact of brine contamination expected in MB-139 and determine if this source needs to be added to the performance assessment.

194.32(e)(3)
Section 194.32(e)(3) requires the compliance application to include information which documents why any process, event, or sequence and combinations of processes and events identified pursuant to paragraph 194.32(e)(1) were not included in the performance assessment results provided in the compliance application.

The DOE has provided rationales and justification for the decisions concerning the elimination or retention of features, events and processes (FEPs) in the screening process described in Appendix SCR. The arguments presented in Appendix SCR are based on numerical assessments of low probability of occurrence of the process or event during the regulatory time frame or quantitative estimates of consequences that are then argued to be insignificant to performance of the disposal system as a whole or to a subpart of the system. In lieu of quantitative evaluations, DOE often presents qualitative arguments (sometimes called "reasoned arguments") to eliminate events and processes from consideration in performance assessments.

The Department needs to provide additional documentation for the quantitative and qualitative arguments in Appendix SCR for the following:

Natural FEPs - Regional Uplift
Page SCR-6 identifies a regional uplift over ten thousand years of approximately 1 meter.

The Department needs to provide a reference for that number.

Natural FEPs - Deformation
Page SCR-7 dismisses deformation on the basis of low probability based on the results of rock mechanics studies described in Appendix DEF without citing any quantitative data

of estimated deformation rates in the text.

The Department needs to provide some quantitative assessment of rates developed from the rock mechanics studies referenced in Appendix SCR to support the low probability decision.

Natural FEPs - Deep Dissolution

The discussion on pages SCR-15 and SCR-16 regarding deep dissolution presents abbreviated summaries of contrasting geologic interpretations of these features by a number of investigators without definitively settling the issue in favor of one over the other. The statement that subsidence at the San Simon Sink (20 miles from the site) has occurred in historic times and has been attributed to deep dissolution appears to leave the possibility open for active deep dissolution. Comments by Anderson on DOE/WIPP 94-019, the Compliance Status Report (Docket entry A93-02, IID-22, 7/14/94 Anderson to Lovejoy), point out dissolution features not mentioned in the CCA. Additional descriptive information in the text is used to link dissolution features to the Capitan Reef and a conclusion is presented that deep dissolution is eliminated on the basis of low probability.

The Department needs documentation to explain how the deep dissolution rate was estimated; how it was used to demonstrate that the probability of affecting the controlled zone (or the repository) is well below the probability cut-off; and address the dissolution features mentioned in the Anderson communication.

Natural FEPs - Climate Change

Page SCR-30 states that the effects of climate change are accounted for in performance assessments by increases in recharge of the Culebra. Anderson has commented extensively on the development of karst dissolution and linked it to climatic fluctuations, along with estimates of expected continued development and consequent salt dissolution effects (comments on DOE/WIPP 94-019, the Compliance Status Report, Docket entry A93-02, IID-22, 7/14/94 Anderson to Lovejoy). The alternative karst development has implications for the fundamental flow mechanisms in the Culebra (the nature and extent of fracture flow).

The Department needs to address Anderson's hypotheses specifically to discount them with more thorough analyses or data, or the results of modeling to show the proposed effects are bounded by the CCA assessments.

<u>*Consideration of Drilling Events in Performance Assessments*</u>

194.33(c)(1)

Section 194.33(c)(1) on future drilling practices requires that "...such future drilling practices shall include, but shall not be limited to: ...the fraction of such boreholes that are sealed by humans..."

Section 6.4.7.2 of the CCA provides this information as the fraction of recently drilled (since 1988) boreholes that had been declared by the owners to be shut-in or temporarily abandoned that were eventually plugged. A survey indicated that 100% were plugged. However, there has been a recognized problem in recent years in the Delaware Basin of inactive wells that have never been declared as shut-in or temporarily abandoned by their owners. Appendix DEL (page DEL-45) recognizes one category of such wells (orphan wells whose owners cannot be located). Also, Table DEL-2 indicates an increase in active wells in southeastern New Mexico (since 1971) that is 7,428 wells less than the number of wells drilled minus the number abandoned. Assumptions about the existence, location, and effectiveness of borehole plugs drastically affect calculated amounts of Castile or Culebra brines in the repository as well as their movement toward the accessible environment.

The Department needs to provide detailed information about the large number of unaccounted for wells (e.g. the 7,428 wells in Table DEL-2). The effect of non-plugged boreholes needs to be included in intrusion scenarios.

194.33(c)(1)
Section 194.33(c)(1) requires that future drilling practices remain consistent with present practices in the Delaware Basin. These practices include borehole plugs or seals.

Section 6.4.7.2 assumes that all intrusion borehole plugs were effectively emplaced (i.e., the boreholes are completely sealed). No evidence is provided in Appendix DEL or it's attachments to support this assumption. Only about one-half of plugging operations on Bureau of Land Management (BLM) land are inspected by BLM during plugging and there is no indication of follow-up studies to determine effectiveness of emplaced plugs. This assumption is potentially important because defective 2-plug or 3-plug configurations could result in increased flows between Castile brine reservoirs, the repository, and the Culebra aquifer.

The Department needs to provide documentation on the percentage of plugs that are assumed to be effectively emplaced and the basis for the assumption.

194.34©
Section 194.34© requires documentation of computational techniques used in generating complementary, cumulative distribution functions.

Although the general approach to sampling of parameters is described briefly in Chapter 6, the User's Manual for Latin Hypercube Sampling (LHS), and Appendix PAR, no detailed discussion of the LHS procedure is included. The User's Manual contains a brief discussion of the advantages of this approach, but it does not clearly describe the implementation of the method.

The Department needs to provide a detailed discussion of the LHS procedure and its implementation.

Passive Institutional Controls

194.43(a)
Section 194.43(a) requires "Any compliance shall include detailed descriptions of the measures that will be employed to preserve knowledge about the location, design, and contents of the disposal system."

DOE may assume only that the passive institutional control (PIC) design as proposed will satisfy the compliance criteria, not that the design as it is constructed 100 years in the future will do so. Chapter 7 of the CCA and related appendices leave open the possibility that the conceptual design that is finally implemented could be radically different from anything that might be approved by EPA during the period of its regulatory authority. For instance, Appendix PIC states, "It should be noted that the illustrations used to support this conceptual design report are not intended to represent the final configurations. Rather they are for the purpose of representing the type of configurations which are intended to be used in the final design." [Page 4] The explanation of DOE's schedule for implementation does not allow EPA to evaluate the proposed design as a final design. As a result, DOE's commitment to a specific design and the Department's ability to implement the design as proposed are rendered ambiguous.

EPA acknowledges that, if the WIPP is certified, the conceptual design as proposed in the initial application is likely to undergo substantial modification over the course of several decades as our knowledge and technical capabilities expand. Nevertheless, EPA cannot certify an undefined "final design" as it may exist 100 years in the future. EPA considers it more appropriate to assume for the purpose of certification that the conceptual design that is proposed is the same one that will be implemented.

The Department must provide more explicit information in support of its proposed design and schedule for implementation of PICs. At a minimum, this information should include:

- *which steps DOE can and cannot accomplish during the operational period and the reasons why;*
- *the rationale behind the timing of the various stages of implementation;*
- *specific actions that DOE will take to test PICs, when those actions will occur, and what DOE expects to learn by testing -- especially in terms of how testing could lead to substantial modifications to the conceptual design; and*
- *evidence that DOE, in proposing the design as practicable, gave serious consideration to the amount of time, human effort, and money likely to be required to implement the major aspects of the design.*

For example, the statement that "this design concept will be revisited over the operational lifetime of the WIPP" lacks explication (Section 7.3, Par. 2). The process of re-certification offers an obvious opportunity for DOE to notify EPA of improvements to the conceptual design throughout the 35-year period of disposal and decommissioning. Yet "revisitation" during the operational period is not accounted for in the chapter. In fact, it appears from the time line *represented in Figure 7-16 (Page 7-83) that most of the work that will inform any revisions to the design will be conducted after the operational period. The areas in which DOE anticipates modifying the conceptual design during the operational period are not clearly identified.*

Engineered Barriers

194.44

Section 194.44 requires that the disposal system incorporate engineer barriers designed to prevent or substantially delay the movement of radionuclides toward the accessible environment.

While the inclusion magnesium oxide (MgO) as a backfill material will improve repository performance, the Department must provide an engineering design which supports the assertions about the performance of MgO. The evidence must support the assumptions used in PA.

The Department must provide an engineering design which provides the method of placement and quantity emplaced such that the MgO will be distributed as assumed in the conceptual models to support the reaction of MgO to be as predicted in the expected WIPP repository environment. The Department must also provide information which demonstrates that the excess volume proposed to be emplaced can actually be accommodated and whether it covers the uncertainties in the actual geochemical processes.

Consideration of Protected Individual

194.51

Section 194.51 requires, among other things, that exposure from all sources of radionuclide release from the disposal system to the accessible environment be examined.

Chapter 8 of the CCA provides a bounding analysis to demonstrate compliance with 40 CFR 191.15. However, the analysis only assumes exposure via consumption of potable water. It does not explicitly include the analysis of doses posed by other potential exposure pathways such as stock consumption or irrigation.

The Department needs to provide documentation which discusses why pathways other than consumption of potable water are not considered.

Consideration of Underground Sources of Drinking Water

194.53

Section 194.53 requires that all underground sources of drinking water in the accessible environment to be affected by the disposal system over the regulatory time frame be analyzed.

Section USDW3.31 of the CCA indicates that the Capitan Aquifer has been determined by DOE not to be a USDW that could be affected by the disposal system.

The Department needs to justify why the Capitan Aquifer cannot be affected by the disposal system over the regulatory time frame.