WMEG AND WMGT DOCUMENT REVIEW SHEET

DOCUMENT: Basalt Waste Isolation Project Performance Assessment Plan

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SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This is an extremely important document for the NRC Waste Management Program because it describes the program plan, objectives, approaches and models for the pre-closure and post-closure assessment of the BWIP repository. It addresses the analyses to be performed by DOE to assess compliance with the following regulatory requirements:

A. Pre-closure Assessment
   1. 10CFR60 - Section 60.111 - limits specified in Part 20 (e.g. 500 mrem/yr. to individuals in unrestricted areas and 5 rem/yr whole body dose for occupational exposure.)
   2. Operational requirements in the draft EPA Standard - 25 mrems/yr - whole body, 75 mrems/yr - thyroid, 25 mrems/yr any other organ.
   3. 10CFR20 and draft EPA Standard - ALARA Principle

B. Post-closure Assessment
   1. 10CFR60 - Section 60.113
      a. Containment of HLW - 300 to 1,000 years.
      b. Release rate - 10^{-5} parts/year after 1,000 years.
      c. Groundwater travel time - at least 1,000 years.
   2. Draft 40CFR191 - integrated releases over 10,000 years - less than Table 2 in the draft EPA Standard.

NRC's review and evaluation of the performance assessment program is extremely important for the approval of the final safety analysis report and construction permit of the BWIP repository.

BRIEF SUMMARY OF DOCUMENTS:

This document outlines the approach to be used by DOE in their performance assessment activities at Hanford. The document describes both pre- and post-closure approaches to performance assessment. Pre-closure performance assessment topics discussed include (1) system description, (2) scenario selection and characterization, (3) consequence analysis.

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(4) preventive and mitigative measures, and (5) scheduling and interfacing. Post-closure performance assessment topics include (1) system description, (2) analysis methodology, (3) conceptual models and computer codes, (4) scenario selection, (5) code verification and benchmarking, (6) model validation and (7) scheduling and interfacing. The report also addresses sensitivity and uncertainty analyses. The former identifies the variables for which the results of the performance analysis are most sensitive. The latter quantifies the impact on the performance analysis due to uncertainties in the input parameters and computer codes.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

Post-closure Performance Assessment - General Comments

1. The report is lacking in sufficient detail to be able to get a complete understanding of the BWIP performance assessment methodology.

2. The report does not state clearly the data needs of the computer models for assessing compliance with the regulations. It does not discuss the amount and type of data required for demonstrating compliance with the major regulatory requirements in 10CFR60 and 40CFR191.

3. The report does not describe or reference the laboratory or in-situ tests required to obtain the data for the performance assessment. This interface is very important because it will allow NRC's staff to evaluate the adequacy of the methods and validity of the data before the submission of the licensing application.

4. The report does not describe or reference the laboratory or in-situ tests to be performed to validate the computer codes.

5. The report implies that the scenario selection and characterization (including uncertainties) will be based mainly on the DELPHI technique. It is realized that for some scenarios consensus of expert judgment may be the only alternative for selection and characterization of the scenario. However, for other scenarios, historical data, and/or modeling should also be considered.

6. The report seems to mix the 10CFR60 and EPA requirements in the key radionuclide identification process (Section 5.3.3). It is important that the report clearly indicate the technical basis for eliminating radionuclides from the analysis. It should also assure that the elimination of radionuclides will not impact the results of showing compliance with the 10CFR60 and 40CFR191 requirements (see specific comments).

7. The report does not indicate the methods or models to use in assessing scenarios such as volcanic activity and glaciation.

8. The report does not indicate the procedure, method or techniques to be used in determining the probability of the scenarios. The existing draft EPA Standard requires the probability of occurrence of the scenario to assess compliance with the standard.

9. The report does not provide adequate references to support some of the preliminary conclusions (e.g. Section 5.3.1).

10. Appendix E does not meet its objectives. It does not state what information is needed, why it is needed, and how it will be used to conduct the performance assessment (see specific comments).

Pre-closure Performance Assessment:

1. The report describes briefly and in general terms a generic methodology for the pre-closure performance assessment. The methodology seems adequate in principle. However, the report lacks specific information on the models and techniques to be used to quantify the (a) contaminant source terms, (b) transport mechanism and (c) radiological dose consequences.

2. The report does not discuss the data available and data needs for assessing compliance with the operational requirements. It does not address or reference in specific, how to obtain reliability data for components and human errors.

3. The report does not address adequately the retrievability issue.

4. The report does not address the verification, benchmarking and validation of computer codes used for pre-closure assessment. Even though most of the codes to be used are existing codes, it is not clear that they have been adequately verified and validated. Also, the chemical and physical environment caused by different scenarios in the repository may be different than the environment in which the codes have been tested previously.

5. The report shall indicate explicitly that the components and systems important to safety will be clearly identified. This will help NRC's staff to focus their attention on the most important components and systems during the review of the preliminary and final safety analysis report.

Specific Comments

1. Page 14, Table 1. The table should be updated to reflect the latest version of 10CFR60 (e.g. containment of high-level waste package 300 to 1,000 yrs).

2. Pages 15 and 16, Figure 1. The pre-closure section of the performance assessment logic diagram seems to be incomplete. It does not address the pre-closure codes input requirements and the verification, benchmarking and validation. It is realized that most of the codes and techniques to be used already exist. However, it is not clear that the codes have been properly verified, benchmarked and validated. Some studies indicate a lack of data and models to quantify the source terms, potential human errors and reliability of components under repository environments. It is also recommended that an additional block be added for documentation of codes used in the pre-closure assessment (assuming that existing code documentation may not be adequate). Additional blocks should be added also after blocks 4.4 and 5.7 to compare the results of the performance assessment with the regulatory requirements. These blocks should also include a description of the rational (or technical basis) for concluding that the regulatory requirements have been met with reasonable assurance.

3. Page 17, Section 3.12. This section shall indicate that the components and systems important to safety will be identified clearly. This will help NRC's staff to focus their attention on the most important components and systems during the review of the preliminary and final safety analysis report.

4. Page 21, last paragraph. The rule (10CFR60) is not a draft.

5. Page 24, Figure 2. This figure seems to be incomplete. The second paragraph in page 23 indicates that quantitative risk assessment will be used (see also sections 4.3 and 4.4), however, Figure 2 does not show consideration of probabilities to perform a risk assessment. The figure shall include also a block identifying the components and systems most important to safety.

6. Page 25, Section 4.3, bottom of the paragraph. The criteria to select credible accident scenarios are very important for NRC, since the compliance or no compliance with the regulations will be affected by the selection of scenarios. Therefore, BWIP shall include in this report and shall provide to NRC for review the criteria and rationale for scenario selection.

7. Page 25 and 26, Section 4.4.1. This section does not discuss the models and codes to be used in the consequence of analysis. It also lacks discussion on available data and data needs. For example, it is not clear that sufficient information is available to determine the fraction of waste inventory and size distribution of the releases due to potential accidents such as fire and explosion. This is also an example, where close coordination among performance assessment data needs and laboratory and in-situ testing is required.

8. Page 26, Section 4.4.2, Second Paragraph. The establishment of threshold criteria for safety risk above which preventive or mitigative measures will be employed are very important for NRC. Therefore, BWIP shall include in this report and shall provide to NRC for review the threshold criteria and technical rationale. This section should address the areas of human errors and human-systems interaction.

9. Page 28, Section 4.5.3, This section should have more information in the content of the Safety Assessment Report.

10. Page 30, Section 5.0. The phrase <u>postulated geologic conditions</u> does not seem broad enough; the prediction of the long term behavior of the repository shall consider hydrologic, climatic, human-induced, and repository-induced conditions.

11. Page 32, Section 5.2, first paragraph. This section seems to indicate that the Delphi method will be used for scenario selection and detailed parametric analysis. We agree in principle that the use of the Delphi method for opinion solicitation from experts could be very useful for scenario selection (expert opinion may be the only available alternative for some scenarios). However, for other scenarios, the use of historical data and model analysis may be more appropriate for scenario selection and parametric analysis.

12. Pages 32-33, top of page 33. We agree in principle with performing a consequence analysis first, before attempting to estimate probablility of occurrence of all scenarios. However, if it is determined that the scenario has the potential for significant consequence then the probability of occurrence must be determined. This section does not indicate the procedure, techniques or methods to estimate the probability of occurrence of the scenario. This area is extremely important because the existing draft EPA Standard requires calculation of the probability of occurrence of the scenario to assess compliance with the standard.

13. Page 33, second paragraph. The list of plausible scenarios shall include repository-induced phenomena (e.g. heat effects).

14. Pages 33 and 34 Section 5.3.1. The report shall reference the modeling studies from which the preliminary conclusions were obtained. It is not clear that the conclusions in the very near-field and near-field modeling studies have taken into consideration the uncertainty in the models and input data. Therefore, we questioned the validity of these conclusions at this time, until additional evidence is provided.

15. Page 35, Section 5.3.3. The following statement is not clear: "It is assumed, a priori, that the total system will satisfy appropriate regulatory criteria and, futhermore, that a methodology can be identified to allocate subsystem performance requirements." We disagree with making the above statement a priori. The BWIP shall demonstrate that the above statement is correct instead of assuming it "a priori."

16. Page 36, Section 5.3.4, second paragraph. This paragraph implies that a sensitivity analysis method may be "to vary each parameter or group of parameters and then evaluate its effect on the solution." In the application of this method BWIP staff shall be aware that some parameters are correlated (e.g. hydraulic conductivity and porosity), therefore they should not be varied independently without taking into account existing correlations.

17. Page 37, Figure 4. This figure shall have a line connecting the bottom block with the second block (document) from the top. This will make clear to the reader that the process is iterative.

18. Page 38, Figure 5. This figure is very confusing. It is not clear why the comparison with the EPA limit is used at this level to eliminate nuclides and perform engineered barrier allocation. If the intent is to identify the key radionuclides that could have a significant impact in violating the engineered barrier requirements, then the comparisons shall be with the 10^{-5} parts/year limit instead of the EPA limit. It is also important to realize that the key radionuclides could be a function of time, scenario and performance criterion. Therefore the key radionuclide identification process may need to be repeated for each performance criterion and each important scenario.

19. Pages 40-41, Section 5.4. BWIP shall provide a list with the expected dates of completion for documentation of the verification, benchmarking and validation of each code. This will help NRC in plannning the review of each document.

20. Page 42, Section 5.6, third paragraph. This paragraph indicates: "validation of the repository systems code will be performed in situ in conjunction with exploratory shaft operations. BWIP shall clearly identify or reference the in-situ tests required for validation of the computer codes. This information is essential for a proper interface with the in-situ experimentation program. It is also very important for the NRC's staff evaluation of the codes validation program.

21. Page 48, Table 4. Item 5 indicates that the selection of disruptive scenarios is scheduled for completion on 8/31/83. Is it completed? Can NRC get a copy of the report?

22. Page 51, Appendix A. This appendix does not describe codes or procedures to analyze scenarios such as volcanic activity or glaciation. Has BWIP concluded that the above scenarios are not important? Where is the documentation of the technical basis to eliminate some of the scenarios?

23. Pages 53-56, Figures A-2 to A-5. These figures imply that the groundwater flow in the very near-field and near-field can be represented with two dimensional codes. It is not clear that the above assumptions are correct for all scenarios. There may be scenarios which require a three dimensional representation. BWIP shall justify the use of 2-D codes in the very near-field and near-field.

24. Page 56, Figure A-5. This figure implies that daughter products will be neglected in the far field. It is not clear at this point, based on the uncertainties in predicting the geochemical environment and important scenarios, that the daughter products could be ignored in the far field. BWIP shall provide the basis for the above assumption.

25. Page 110; first paragraph. Has BWIP made estimates of the potential frequency of occurrence of volcanic activity (over the next 10,000 years) that could impact the site? Please, reference the document containing the basis for neglecting the volcanic activity scenario.

26. Page 112, fifth paragraph. This paragraph states that calculation of groundwater velocity in an equivalent porous medium also requires definition of the effective porosity. This section does not discuss the number of measurements required of effective porosity to establish with reasonable assurance that the groundwater travel time requirement is met. If the uncertainties methods described in Section 5.3.5 are going to be used additional data on effective porosity and the correlation between effective porosity and hydraulic conductivity is needed. However, this section does not discuss what information is needed and how it will be used to assess compliance with

the performance requirements. This is the major problem with Appendix E, it does not meet the objectives stated in Section E.1. According to section E.1, the emphasis of Appendix E shall be on "what information is needed, why it is needed, and how it will be used to conduct a performance assessment." Appendix E, in general, does not satisfy the above objective.

The purpose of this appendix is to state what is needed (what), why it is needed (why), and how it is to be used (how).

E.2 Geologic Characteristics

lists what features
no statement of why needed
no statement how to be used

E.3 Waste Emplacement Characteristics

has what, very general, no specific properties
no why
no how

E.4 Waste-Related Effects
(listed in paragraph 1 of E.3, so should be part of E.3)

has what, general
has why, very general
no how

E.5 Hydrogeologic characteristics

Ground-water occurrence

kind of a passing comment

Ground-water flow patterns

no what
no why
no how

Hydraulic Characteristics of basalt

states what info: general, no values, not complete
sort of states why for hydraulic conductivity,
no statement of why for effective porosity
no how

Repository related processes

has what info: no values
has why
no how

Ground-water velocity and travel time

General statement