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Mr. Robert Bills
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Dear Bob:

The following comments concern the November 15, 1994 draft position paper concerning gas generation. We were told at the meeting on December 8 that another draft of this paper will be forthcoming in a matter of weeks. Please provide a copy of the paper to all stakeholders and schedule a meeting to discuss its contents.

Plainly, a paper of the complexity of this document requires technical assistance for its analysis. We have requested grant funds from DOE but have not yet succeeded in obtaining funding.

At present our comments on the November 15 draft (the "draft") are as follows:

1. The draft terms the reaction-path model the "most defensible" and "more defensible" than the average-stoichiometry model for SPM purposes (at 2). How the judgment was made that one model is "most defensible" and is "more defensible" than another requires explanation. It was not apparent before this paper that the quality of "defensibility" for SPM purposes was a matter of degree; in other words, an approach has been viewed either as defensible or not so. Has this changed?

2. If the reaction-path model is the most defensible, how can the average-stoichiometry model be defensible also? Is the average-stoichiometry model defensible or not, and if it is please explain why.

3. As between the reaction-path model and the average-stoichiometry model, which leads to the greatest release of radionuclides or hazardous constituents? Please provide the data underlying any conclusions.

4. The first full paragraph on page 4 of the draft contains several statements about interrelated processes involving gas generation. No citation to data sources is given. Please provide data supporting the statements in this paragraph.

5. Please provide data support for the statements in the first paragraph on page 5 as to the effect on brine pH of reactions between brine and disposal room contents.

6. The draft notes that quantification of the effects of microbial action on H_2O content is essential to predict anoxic corrosion, brine radiolysis, and brine available for transport (at 8, lines 35-39). What actions are proposed to refine that figure?

7. The discussion of anoxic corrosion (at B-5) contains no firm explanation of the drop in corrosion rates as between 3 and 24 month runs. To rely on the lower 24-month rate is it not necessary to select an explanation? Is it not possible that the experiments cited introduced unintended factors in pretest preparation?

8. Whether anoxic corrosion generates $Fe(OH)_2$ or Fe_3O_4 "may be an important issue" (draft at B-6). What measures are proposed to deal with this uncertainty?

9. The last paragraph which starts on page B-10 raises several significant questions about microbial activity (presence of nutrients, microbial processes, gas production, H_2O production and consumption, effect of repository H_2O, effect on radionuclide behavior, survival of microorganisms). What is proposed to resolve these issues?

10. What "more details" are available on the issues mentioned in sections B.2.1.4, B.2.1.6, and B.2.1.7? What water availability, electron acceptors, and nutrients are projected to be present by the authors of the gas generation model?

11. There is a statement that aerobic microbial activity will be an insignificant process if current estimates of actinide solubilities and quantities of brine present are retained (draft at B-13). It would seem that both estimates are far from firm. What is proposed to narrow the uncertainties as to factors contributing to aerobic microbial activity?

12. Please furnish the discussion of the results from Francis et al. (1994) referred to at draft B-14.

13. The discussion of fermentation and methanogenesis starting at draft B-17 appears incomplete. Certainly, the discussion of anaerobic results from Francis et al. (1994),

referred to at draft B-18, is omitted. More generally, there is no discussion of the rates and potentials of gas production.

14. It is said that anaerobic microbial activity may produce H_2O even after accounting for H_2O consumption by radiolysis, and possible laboratory studies are mentioned (draft at B-19). What studies may provide the necessary information?

15. There is further mention in the first paragraph on page B-19 of the need to quantify net H_2O production from anaerobic microbial activity to establish (a) gas production from anoxic corrosion, (b) gas production from brine radiolysis, and (c) brine available for contaminant transport. How will net H_2O production be quantified?

16. Please provide the discussion of the results of Reed et al. (1976) referred to at draft B-19. What will be done to quantify O_2 production from radiolysis?

17. Does the project maintain that radiolysis of cellulosics, plastics, and rubbers will be insignificant? (p. B-19).

18. It is stated that the Lappin et al. (1989) estimates of anoxic corrosion omitted the contribution of RH TRU canisters and plugs (at C-4); presumably roof supports were also omitted. Omission of these factors creates a concern. What is planned to account for the contributions of these components in the average-stoichiometry and reaction-path models?

19. What is the scientific justification for assigning a uniform distribution between 0 and 1 to parameter x in the formula for anoxic corrosion in the average-stoichiometry model (draft at C-5)?

20. It is stated that pH, CO_2, and H_2S may affect corrosion of Fe-base materials significantly and that Brush (1991) attempts to take some such factors into account (draft at C-6, lines 16-18). Is the proposed approach to such factors defensible under SPM standards, and what is the defense?

21. In calculating microbial gas production it is also stated that a parameter x is sampled from a uniform distribution of between 0 and 1 (draft at C-7, top of page). Please provide the scientific justification for this range, which is said to neglect reaction B.13.

22. It is stated that factors such as the number and types of microbes, concentrations of nutrients and electron acceptors, pH, and concentrations of partial pressures of byproduct

gases may significantly affect microbial activity (draft at C-7, lines 29-34). Is the proposed approach to such factors defensible under SPM standards, and what is the defense?

23. It is assumed for the 1991 and 1992 PA's that microbial activity has no effect on the water content of the repository (draft at C-7, lines 36-39). Is this position defensible, and what is the defense?

24. The corrosion rates assumed for the purposes of SPM-2 are said to be supported by Appendix E. The best estimate inundated rate (explained at draft E-8 et seq.) is reduced from the 1991-92 estimates based on 24 month data. What is the basis to assume that the 24 month rate will prevail over extended periods?

25. The draft "arbitrarily" assumes that the corrosion rate seen in one reaction applies to other reactions (draft at E-9). This does not appear to be a defensible assumption. At any rate, it has not yet been defended. Please comment.

26. There is a minimum estimate of a zero corrosion rate, loosely attributed to passivation (draft at E-9, E-10). This conclusion is stated despite (a) the fact that higher pressures call for additional CO_2 to bring about passivation, (b) the speculative nature of predictions of additional passivation mechanisms, (c) the evidence of depassivation. Please explain why the minimum figure is justified.

27. The maximum anoxic corrosion estimate of 20 $mol/m^2/yr$ is derived by accounting for pH and pressure (draft at E-10, E-11). Is the pressure adjustment (4x) sufficiently justified, based only on data using a N_2 partial pressure of 73 atm? Since these are maximum figures, should they not be rounded up instead of down?

28. The temperature adjustment likewise results in a rounding down. (draft at E-12). Should the figure not be rounded up?

29. The humid corrosion rates are also "arbitrarily" stated or adjusted (draft at E-12). Please justify the figures used.

30. Are the proposed rates for microbial degradation adequately based, since they are derived from data involving cellulosic degradation only and do not consider degradation of rubber or plastics (draft at E-13)?

31. It is stated that certain simplified formulas for aerobic microbial degradation are adequate for the average-

stoichiometry model but may not be for the reaction-path model (draft at E-14). How can such simplifications be deemed defensible?

32. Insufficient information is provided in the draft concerning the data underlying estimates of the rate of anaerobic microbial reactions (draft at E-15). The estimates are therefore not defensible.

33. Similarly, the projections of humid microbial action are not supported by data and are said to be arbitrary (draft at E-15, E-16).

34. The proposed radiolysis rates are based only on data involving dissolved Pu239, and given the questionable nature of actinide solubility data in general, can they be defended? It is stated that if the inventory and dissolved concentrations of Pu239 are high enough, gas production may locally exceed those from corrosion or microbial degradation (draft at E-19).

35. The draft says that it "may be more difficult to defend estimates of the maximum rates of gas production from brine radiolysis." (draft at E-20). Given the stated uncertainties, the figures do not appear to be defensible. It is not possible, for instance, to justify use of the same probability distribution used by the expert panel for Pu(V) solubilities, since that expert panel's judgments have been correctly deemed indefensible in the draft (at E-20). Why are the figures stated in the carryover paragraph on page E-21 not appropriate as defensible maxima?

36. In any case, the draft does not explain the derivation of the radiolysis estimates contained in Table 2 (at E-31). Please explain why these figures are defensible.

Thank you for considering these comments.

Very truly yours,

Lindsay

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