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PROJECT WM-10

MEMORANDUM FOR: Robert J. Wright  
 High-Level Waste Technical  
 Development Branch  
 Division of Waste Management

FROM: Mark Logsdon  
 High-Level Waste Technical  
 Development Branch  
 Division of Waste Management

SUBJECT: WRITTEN CLARIFICATION TO BWIP ON OPEN HYDROCHEMISTRY  
 CONCERNS IN DSCA

At the NRC/DOE meeting in Richland, Washington during the week of June 13, 1983, Dr. Tilak Verma of WMHT deferred clarification of several open hydrochemistry concerns in the DSCA until other members of the hydrology team could consider them. He told DOE/RHO that NRC staff would provide written clarification on these points. Attached is a set of NRC responses to points on hydrochemistry that BWIP indicated needed clarification.

**ORIGINAL SIGNED BY**

Mark J. Logsdon  
 High-Level Waste Technical  
 Development Branch  
 Division of Waste Management

Attachment:  
 NRC Responses

WM Record File  
 10/1

WM Project 10  
 Docket No. \_\_\_\_\_  
 PDR   
 LPDR

**Record Note:**

- Responses prepared by Logsdon
  - Draft reviewed by T. Verma, R. Wright, P. Justus
- All comments resolved

Distribution:

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TABLE 2

1.	<u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
	DSCA Section 3.4.3 p. 3-10 to 3-11	Geochemical Models, C-14	DOE requires clarification

NRC Response: The NRC comment addresses conceptual paleoclimatic and paleohydrologic models. In order to evaluate the origins and ages of groundwaters using the oxygen and deuterium isotopic data, the data must be analyzed in light of the paleoclimatic and paleohydrologic conditions that prevailed during recharge and in light of the locations of probable recharge areas. The integration of the oxygen and deuterium data within a suitable paleoclimatic and geographic framework was not presented in the SCR. The paleoclimatology of interest is that of the Quaternary Era (10 CFR 60.122).

The application of paleoclimatic and paleohydrologic models to the interpretation of stable isotope data has been well established in the technical literature. Numerous examples of integrated studies can be found in:

IAEA, "Interpretation of Environmental Isotope and Hydrochemical Data in Groundwater Hydrology," IAEA, Vienna, 1976.

IAEA, "Isotope Hydrology 1978, Vol. II," IAEA, Vienna, 1979.

The need for quantitative geochemical models that can correct the measured carbon-14 activity for both dissolution and precipitation of carbonate phases and for addition of carbon from organic sources also has been addressed in numerous publications, e.g.,

Barker, J. F., Fritz, P. and Brown, R. M., "Carbon-14 Measurements in aquifers with methane," in IAEA, Isotope Hydrology 1978, Vol. II, 1979.

Fontes, J. C. and Garnier, M. J., "Correction des activités apparentes en  $^{14}\text{C}$  du carbon dissous: estimation de la vitesse des eaux en nappes captives," C. R. Reunion Annu. Sci. Terre, Soc. Geol. Fr., 1976.

Plummer, L. N., "Defining reactions and mass transfer in part of the Floridan aquifer," Water Resources Research, Vol. 13, 1977.

Reardon, E. J., and Fritz, P., "Computer modeling of groundwater  $^{13}\text{C}$  and  $^{14}\text{C}$  isotope compositions," J. Hydrology, Vol. 36, 1978.

Wigley, T.M.L., "Effect of mineral precipitation on isotopic composition and  $^{14}\text{C}$  dating of groundwater," Nature, Vol. 262, 1976.

2.	<u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
	DSCA Section 3.5 p. 3-12, item 4	DOE notes need for matrix diffusion data	DOE requires clarification

NRC Response: Matrix diffusion can be expected to significantly retard radionuclides in a dual porosity groundwater flow system if the hydraulic conductivity is low (less than approximately  $10^{-8}$  m/s).

Diffusion coefficients for species of interest can be measured in the laboratory. The laboratory-derived values for selected tracers can be used to help analyze the results of dual-well tracer tests to evaluate the importance of matrix diffusion in the BWIP system.

TABLE 3

<u>3. Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
SCR Table 5-3	"Groundwater hydrochemistry" 5,7,15	Change title; move to section on conceptual models

NRC Response: The basis for the NRC comments is given in DSCA Appendix F. In particular, see p. F-11 to F-12 on carbon-14 age dating; p. F-8, paragraph 2 on "breaks" in isotopic data. A change in title with appropriate introduction in text may resolve NRC comments, if the changes reflect the generalized nature of the information in the table and the uncertainties expressed in DSCA Appendix F.

<u>4. Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
SCR 5.1-74 para. 1	Basis of restrictive criterion?	Cites Hem, 1970

NRC Response: The basis for the NRC comment is given in DSCA Appendix F, p. F-4 to F-5. A criterion of <10% is commonly used in hydrochemical studies; the more restrictive criterion used at BWIP results in loss of potentially useful data.

<u>5. Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
SCR 5.1-87	Chemistry in unconfined aquifer	Please clarify

NRC Response: We are concerned with the chemistry along the flow path. If a portion of the probable flow path has been contaminated by artificial recharge of waste water, DOE should consider a more detailed presentation of data that distinguishes between the hydrochemistry of the natural system and the hydrochemistry of the disturbed system. Combining both data sets into single tables produces a "data set" that can be related to neither condition.

<u>6. Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
SCR 5.1-98 para. 4	Bacterial reduction of $SO_4^{2-}$	Statement out of context

NRC Response: Agree. NRC withdraws comment.

<u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
7. SCR Figure 5-53	15 (incomplete data base)	Need clarification

NRC Response: Hydraulic continuity must be demonstrated before data base can be considered complete for purposes of defining flow paths. To date, there is no demonstration of hydraulic continuity in any unit.

<u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
8. SCR 5.1-108 para. 2	inconsistent with 5.1-98 para. 4	Disagree

NRC Response: Agree; the relevant discussion is in paragraph 5. NRC withdraws the comment on paragraph 2 of 5.1-108.

<u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
9. SCR Table 5-26	3, 10, 16 - alt. units suggested	Need clarification

NRC Response: The NRC staff considers that dissolved gases could provide important information on the origin and evolution of the groundwaters, and this deserves fuller discussion than was presented in the SCR. In particular, a discussion of sampling procedures is needed to evaluate the data on dissolved gases: Were the samples collected at depth or were they pumped to the surface? In either case, was the pressure at the point of collection the same as the pressure at depth? If not, what steps were taken to mitigate degassing and/or contamination by atmospheric gases? How were the gases transferred from the water sample to the analytical apparatus? What was the method of analysis? It is assumed that this is data collected by the BWIP (no reference is given), but information on methods and procedures must be available to assess the data. The written comment is meant to suggest that the gas data in various tables be in a consistent set of units, preferably mole % with a note to the table giving the yield of gas at STP (compare Table 5-19, 5-26). The most important point is to use consistent units.

<u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
10. SCR Table 5-28	K content is significant w.r.t. montmorillinite	Need clarification

altering to illite

NRC Response: The difference in cation exchange capacity between smectites and illite is potentially significant for radionuclide transport. At elevated temperature in the presence of high concentrations of K<sup>+</sup>, smectites could alter to illite. This item notes, for consideration by DOE/RHO, the relatively high concentration of K<sup>+</sup>.

<u>11. Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
SCR 5.1-132 para. 2	Relative concentrations of methane - 9,10	Need clarification

NRC Response: As with Item 9 above, we are not familiar with any documentation by DOE/RHO of the sampling and analytical techniques used for methane. This documentation is needed for independent assessment by the NRC staff.

<u>12. Item Reference</u>	<u>Statement of item comment</u>	<u>BWIP Disposition</u>
SCR 5.1-158, para. 1	Deviations from slope of +8 -1	Disagrees. Pasco Basin is semi-arid.

NRC Response: The current climatic conditions of the Pasco Basin are not the issue, unless BWIP wishes to hypothesize that the groundwater represents the infiltration of modern meteoric water and that the recharge points are in the Pasco Basin. Both of these points contradict positions on age of the groundwater and location of recharge points made in numerous statements in the SCR. This response relates to Item 1, the application of conceptual models of paleoclimatology to interpretation of stable isotope data. It is the climatic regime at the time and location of recharge that determines the oxygen and hydrogen isotopic composition of groundwater at low temperatures.

<u>12. Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP Disposition</u>
SCR 5.1-167 para. 1	Use of tracers to evaluate representativeness - 16	Simple statement of fact

NRC Response: We are not familiar with any documentation by DOE/RHO of the methods and procedures implied nor of the criteria used to determine "representativeness." This documentation is needed for independent assessment by the NRC.

13. <u>Item Reference</u>	<u>Statement of item-comment</u>	<u>BWIP</u> <u>Disposition</u>
SCR 5.1-187	Correction of C-14 for methane - 1,3	Needs clarification
<u>NRC Response:</u> See response to Item <u>1</u> .		