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MEMORANDUM FOR: Robert L. Johnson, Project Manager
Salt Repository Projects Branch
Division of Waste Management

FROM: Timothy C. Johnson, Section Leader
Materials Engineering Section
Engineering Branch
Division of Waste Management

SUBJECT: SALT EA MAJOR COMMENTS CONCERNING WASTE PACKAGE DESIGN AND PERFORMANCE ASSESSMENT

Pursuant to your request for information concerning EA review preparation in the area of waste package design and performance assessment, we have prepared that following comments. The subject areas are as indicated in the the guidance notes you distributed at the Salt Team meeting on October 10, 1984.

A. Identification of Major Comments

Attached are some draft "specific comments" pertaining to our review of waste package design and performance prediction as such matters are addressed in Chapter 6 of draft 4 of the Salt EA's. You will note that the attached comments do not necessarily apply solely to matters requiring resolution in the EA's, but also address major concerns of longer range significance to licensing. Based upon a conversation between you and M. Tokar on October 11, 1984, it is our current understanding that these comments can be grouped under System Guideline 960.4-1.

B. New Potential Licensing Issues

We have identified no new licensing issues related to waste package design and performance assessment.

C. Status Summary on EA Review Preparations

As directed, we have tabulated (see attached Table I), the percentage completion of EA Review Plan Section 5.0 review preparation activities. With regard to plans for completion, see the footnotes to Tasks 2, 6, and 8 in Table I.

OFC	:WMEG	:WMEG	:WMEG	:WMEG	:	:	:
NAME	:MTokar:gh	:CPeterson	:JVoglewede	:TJohnson	:	:	:
DATE	:10/23/84	:10/24/84	:10/23/84	:10/24/84	:	:	:

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D. Preparation of 10-15 Minute Oral Presentation

We anticipate no problem with this. If you have any questions, please contact me (X74088) or M. Tokar (x74748).

Original Signed by

Timothy C. Johnson, Section Leader
Materials Engineering Section
Engineering Branch
Division of Waste Management

cc: TVerma
TJungling
KChang
EWick

Attachments (2)
Table I
Vacherie Draft Comments

OFC	WMEG	WMEG	WMEG	WMEG			
NAME	MTokar:gh	CPeterson	JVoglewede	TJohnson			
DATE	10/ /84	10/ /84	10/ /84	10/ /84			

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TABLE I/MT

Attachment

Table I

Status of EA Review Preparation Activities*

1. Understanding siting guidelines: 100%(a)
2. Obtaining familiarity with available documents and data: 100%(b)
3. Developing key scenarios and conceptual models: N.A.
4. Conducting sensitivity analyses: N.A.
5. Developing preliminary issues: 100%(C)
6. Reviewing key documents: 30%(d)
7. Reviewing on-site data: N.A.
8. Conducting scoping review of preliminary EA drafts: 70%(e)

*NOTES:
N.A. = Not Applicable to the waste package review.

(a) With the realization and acknowledgement that the guidelines are always subject to re-interpretation, this task is essentially complete.

(b) This task can never (by definition) be 100% complete. However, with regard to the EA pre-review effort, we (through our BNL consultants) have completed a document review, and BNL has issued a final report summarizing that effort. With regard to future activity, a data/document review effort is called out as a major task in our FIN A3164 program at BNL for FY85.

(c) We have issued a draft STP for Salt and thus consider this task to be completed.

(d) There is one "key" document on Salt waste package performance (the Jansen report). We just received a draft of this document on 10/9/84. Considering the fact that Chapter 6 of the Salt EA draft 4 is an abridged, "Reader's Digest" version of the Jansen report, we consider this task to be ~ 30% complete.

(e) We are well into this task and are perhaps 1 to 2 months ahead of the game in that we generated 1st cut draft specific comments over 2 months ago. However, we need to (1) review the Jansen report in detail and (2) recast our specific comments to fit them into the WMRP "concern categories" format.

VACHERIE DRAFT COMMENTS
08/02/84

Comment Number	Comments
6 - 1	Section 6.4.2.1.3 - Corrosion Inadequate Consideration of Available Data and Uncertainties In this section the modeling of waste package corrosion and failure is described. It is assumed that the waste package overpack will fail when the allowance (2.5 to 5.0 cm) for uniform corrosion is exceeded. Pitting corrosion, stress/corrosion cracking (SCC), etc. are said to be not expected, but "local penetration ratios" (e.g., pitting factors) are applied to determine failure times under "unexpected conditions," which include potential pitting or stress/corrosion cracking failure modes. For such unexpected conditions, failure (breaching) of the overpack is predicted in 300 years (Table 6.4-14), while for expected uniform corrosion conditions the waste package is predicted to remain intact for greater than 10,000 years. There are fundamental problems with this approach. The corrosion wastage allowance approach works reasonably well for uniform corrosion, but it is more difficult to apply to other mechanisms such as pitting, SCC, and hydrogen embrittlement. The current state of knowledge is such that these materials alternative degradation mechanisms can not be ruled out, or quantified. Therefore, consideration of the uncertainties involving alternative failure modes and their potential impact on waste package performance should be part of the analysis. A fallback position should be presented that deals with the fact that further R & D may show that the current low-carbon steel, corrosion allowance reference design is inadequate. This relates to Post-closure System Guideline 960.4-1.

Comment Number	Comment
6-2	Section 6.4.2.1 Performance of Engineered Barriers Paragraph 6.4.2.1.3 Boundary Condition Uncertainties in the Near Field Condition Due to the Presence of the Waste Package The interaction between the waste package and its immediate environment determines the lifetime of the containment barrier and the rate of nuclide release from the engineered barrier system (EBS). The Environment Assessment (EA) reports for a repository located in salt assume several factors which, if the uncertainties are large, would drastically affect the containment time and releases from the EBS. While no site-specific relevant evidence is presented to support these assumptions, it is argued in the EAs that reducing conditions prevail, brine transport and accumulation is limited, radiation effects are minimal and temperatures are maintained low enough to avoid fracturing, dehydration of other minerals and decrepitation of the salt. During the pre-closure period of approximately 50 years there is a potential for high temperature oxic conditions to occur. During post-closure, temperature and radiation effects can alter the nature of the repository waters (brine) and can result in changes in Eh and pH of the brines. Alpha radiolysis of brines could potentially lead to very oxidizing conditions (Pederson, L. R., 1984). There appear to be unresolved uncertainties in the temperature and radiation levels associated with the waste package (Comments 6- and 6-). These uncertainties not only affect the chemical characteristics of the brine but also lead to uncertainties in the brine migration rates, the total accumulated brine, and the chemical and physical properties of the surrounding salt (development of fractures, radiation induced brittleness, decrepitation of the salt, formation of colloidal sodium). Several studies have indicated those areas where uncertainties in near-field properties can influence

package behavior. Radiation damage to the salt can result in the formation of colloidal sodium (Levy, P. W., 1984) which on reacting with brines can result in pH values ranging from acidic to basic (Pederson, L. R., 1984; Panno, S. V., 1983). There is uncertainty as to the fate of chlorine formed during irradiation.

The degree to which radiation will influence the properties of the immediate host rock environment depends on the salt composition, the dose rate, the temperature and the degree of crystallinity. Salts containing large amounts of impurities exhibit a higher resistance to radiation effects (Levy, P. W., 1984). Lower dose rates appear to result in faster rates of colloidal sodium formation although dose rates as low as those predicted in the EA or within the range of present uncertainty (2 to 10^3 R/h) have not been used to examine the effects of radiation on salt.

The uncertainty in the temperatures as a function of time affects not only the water chemistry but also the rate at which brine migrates, the total accumulated brine, the potential for salt decrepitation and magnitude of the effects of irradiation on salt. Levy (1984) reports a maximum temperature (100-150°C) for the rate of formation of sodium colloids. However, Levy also notes that samples irradiated at room temperature which did not exhibit the presence of colloids immediately following irradiation, do exhibit colloids at three to six months following irradiation. Saturated brines irradiated in the presence of rock salt (125°C) become acidic while brines made from adjacent rock salt are more basic (Panno, S. V., 1983). Even thermal annealing of unirradiated salt produces an increase in brine alkalinity (Panno, S. V., 1983) and may be accompanied by the release of HCl (Jockwer, N., 1984) especially under the added influence of irradiation.

In general, the presently available data indicate that there are uncertainties in the near field environment of a waste package caused by the presence of the waste package and which will be magnified as uncertainties in the performance of the containment barrier and the magnitude of release from the EBS.

These uncertainties should be recognized and an evaluation of their potential impact on package performance addressed. This relates to Post-closure System Guideline 960.4-1.

Comment Number	Comment
6-3	Section 6.4.2.1 Performance of Engineered Barriers Paragraph 6.4.2.1.4 Solubility Inadequate Consideration of Available Data This section purports to examine potential radionuclide release from CHLW and SFPWR packages. Only the 14 named radionuclides listed in 40 CFR Part 191 are discussed, even though limits are provided by EPA for all other radionculides that may be present. Further, the entries in the tables covering NRC limits are not obvious and the column headings are not explained in the text. It is necessary to check potential releases for all radionuclides that may be present, particularly because some of the limits may be less than one picogram/year. DOE should prepare complete listings of all radionuclides present for each type of waste (CHLW, DHLW, SF2) and compare the amounts present with both NRC and EPA limits. This relates to Post-closure System Guideline 960.4-1.
6-4	Section 6.4.2.1 Performance of Engineered Barriers Paragraph 6.4.2.1.4 - Solubility Inadequate consideration of uncertainties in data Four tables are offered in which solubilities for 14 radionuclides were given. The chemical species are not identified and only one solubility for each is given, even though it is well known that solubility for many of the radionuclides of interest depends strongly on pH and oxygen content of the solvent water. Other factors may also create oxidizing/reducing conditions. This relates to Post-closure System Guideline 960.4.-1. Evaluation of the conclusions drawn by DOE is impossible without this information. The solubility error may be as much as 10 orders of magnitude and the uncertainty is the quantity of brine available is at least a factor of two. Full disclosure of the basis for the tabular entries plus discussion of the uncertainties is needed.