J3

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

WM DOCKET CONTROL CENTER

ER 85/123

APR 8 1985

'85 MAY 31 A11:02

WM Record File 106.2
WM Project 16
Docket No.
PDR ✓
LPDR ✓
Distribution:
R Johnson J Linehan
(Return to WM, 623-SS)
To: R Johnson

Comments—EA
U.S. Department of Energy
Attn: Comments-EA
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Sir:

The Department of the Interior has reviewed the environmental assessment for Vacherie Dome Site, Webster and Bienville Parishes, Louisiana.

Our detailed comments are in the enclosed statement.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

Enclosure

1075

General

The opportunity to comment on the draft Environmental Assessments (EAs), the nine candidate sites for the first repository for civilian high-level radioactive waste is appreciated. These large, complex reports represent a meaningful contribution in terms of effort and time. The effort of preparation was obviously large, and available time was short, which might very likely have contributed to some significant shortcomings of internal consistency in the reports. There apparently was little time or manpower devoted to the cross checking of values or descriptions within individual reports. Since the time available for review and comment was also short, research of the background reference documents was not possible. Thus our reviews are necessarily based on the knowledge and experience of individual reviewers, bureau experience and expertise, and the content of the draft Environmental Assessments. Also, our experience at each of the candidate sites is vastly uneven, and the review comments reflect this unavoidable variation.

Three related basic issues that became apparent during our review of the EAs are (1) the modeling of hydrologic systems, (2) the identification of failure modes and the most likely pathways of radionuclide release, and (3) conclusions reached in the EAs are not supported by the data base. In regard to modeling assumptions, reliability of data, and limitations of results of the modeling of hydrologic systems should be better described. Such descriptions might help explain apparently inconsistent ground-water travel times given in different sections of the salt-site EAs as is noted in the specific comments.

The failure modes addressed in the EAs are simplistic. We are particularly concerned that all available geotechnical information available for the various host rocks apparently has not been used to assess the mechanical and thermal responses of the geologic and hydrologic systems to the repository. This is particularly true with regard to the sites where the host rock lies below the water table. The possibility that a response of these systems to a repository might be the opening of vertical pathways for fluid circulation is dismissed either summarily or by means of a partial and theoretical analysis. Probable flow paths from the repository frequently are determined on the basis of inconclusive data on head gradients, on restrictive assumptions on the nature of water-bearing zones, and on flow directions through salt units determined by the unsupportable assumption of Darcian flow through a uniformly saturated and homogeneous porous medium. In general, the conclusions of the EAs as a body appear to go well beyond what the data base justifies. Confidence in the objectivity of the reports will be enhanced by conservation, and demonstrated by closer adherence to what the data base can support. Conclusions are supported with little data in many instances. For example, values for effective porosity and dispersion are necessary to calculate radionuclide transport. Field measurements of those parameters are rare, yet calculations are made as if sufficient data were in hand.

We recommend the EAs should contain a comprehensive discussion of the schedule for various activities related to characterization and nomination of a site. The reviewer must understand what activities will be undertaken concurrently; those activities that will be phased; how review of completed studies will be undertaken; a description of the intermediate decision points in the characterization phase; and how sites being characterized will be evaluated during this process. We believe this important information is needed in the final EA to ensure that sites with presently unknown flaws could be eliminated from further study during the characterization phase. The discussions in Section 4, Expected Effects of Site Characterization Activities, should incorporate this information.

To address chapter 7 adequately requires not only solid, broad-scope technical experience but also an awareness of the needs, goals, and guidelines applied to The Civilian Radioactive Waste Management Program. Chapter 7 is being reviewed here as a unique element since the same text for this chapter appears in each EA. The results are presented separately and not in site-specific terms.

We have two concerns about the ranking system used: (1) the comparison uses different kinds of data, different qualities of data, and different distributions of data, assembled and evaluated by different teams for different kinds of sites; and (2) the ranking scheme which treats all issues of equal value does not seem to be fully defensible, because all concerns are not truly equal in isolating high level radioactive waste.

With regard to the first concern, it is unclear why sites, for which many geotechnical studies have been completed, have been compared to sites for which comparable studies do not exist. Generally, further investigation of a phenomenon, topic, region, etc., reveals increasing complexity over what had previously been described; also, even major new findings often accompany further studies. Therefore, in all likelihood, were the Richton, Deaf Smith, and Davis Canyon Sites as extensively studied as the Hanford and Yucca Mountain Sites, they might not appear as "favorable" in the analyses as the sparse data suggest. Accordingly, some ranking "penalty" probably should be assigned to these sites (Richton, Deaf Smith, and Davis Canyon) in both post and preclosure rankings prior to attempting a meaningful comparison with the Hanford and Yucca Mountain Sites. In addition, a) we wonder if the facts are accurate and complete as stated, b) whether the facts are correctly used and inferences based on them are correctly drawn, c) whether these facts and inferences are correct and fairly summarized and transferred from one chapter to another and into Chapter 7 in particular. We have noted many deficiencies during our review. Some of these deficiencies, such as unsupportable assumptions on ground-water flow provide key input for the rankings in Chapter 7. Accordingly, many of the rankings in Chapter 7 become questionable and may even be in error. Therefore we recommend Chapter 7 should discuss the effect of differences in the data bases among the sites in the comparable analysis. Such a discussion certainly is needed.

Furthermore, the EA's taken as a body are very uneven in treatment of available data. This is understandable to a degree, because each of the site EA's was prepared by a different team of experts describing sites that very considerably in physical characteristics. This unevenness introduces difficulties for the authors of Chapter 7 when using an "equal weight" decision process. There is a need to establish some common framework or operational procedure to obtain some comparability of facts for the sites. This may be approached by assignment of an "important factor" or a weighting to each of the elements of a site (such as elements of ground-water hydrology, tectonics, geochemistry).

Our second concern is that the comparative analysis in Chapter 7 does not adequately weight the favorable and potentially adverse conditions by their importance. Preclosure and postclosure factors are weighted virtually the same (49:51). Mistakes during construction and operation can, at least in principle, be corrected, but postclosure failures are unlikely to be remedied. Within each group of guidelines, the favorable and potentially adverse conditions are weighted equally. There is such a long list of different conditions that a condition of singular importance for one site receives no particular attention. The comparative analysis resolves into a vote-counting numbers game, as if each vote had the same importance, which is definitely not the case.

We recognize that a system of weighting is not easily created and the weights assigned to different conditions will be questioned. It is unclear whether any effort was made to evaluate an approach, as follows. For each of the sites determine an "importance factor" for each of the elements or characteristics of the site that must be used in the comparative analysis. These provide an initial basis for weighting the favorable and potentially adverse conditions individually for each site. As these weighting factors are necessarily judgmental, we recommend that various combinations of weighting factors be applied to determine if a consistent sequence of site rankings can be obtained. The use of Monte Carlo methods should be considered in this evaluation. If such a weighted evaluation process has not been attempted, we recommend that it be tried to determine whether or not the rankings remain stable when individual criteria are weighted. Another approach which would have merit in confirming the rankings would be to impanel a Delphi group. Both of these processes would tend to create a more defensible objective analysis of the sites, ultimately recognizing that subjective judgment is required to reach any ranking, no matter what method is employed. Therefore, we question the grades assigned in the Tables in Chapter 7 of each EA. We believe the addition of a U grade for unresolved would have better identified grey areas and urge this be considered in the preparation of final EAs. The following detailed comments on Chapter 7 point out examples where incorrect comparisons of site characteristics might have been made.

For example it is unclear how the "P" and "NP" scheme of table 7-1 furnish a basis for comparison. The data source for the table should be identified. We question the summaries entered into table 7-1 and others like it. For example, the trustworthiness values for some of the geohydrologic parameters for any of the sites based on preliminary results of studies to date should be presented. It is also unclear whether the benefits of the saturated versus the unsaturated zones have been compared.

Examples of concerns include Page 7-10, paragraph 1—On geohydrology, specifically on travel time to accessible environment, comparison for different sites: Very different data abundance, type of data (model, drill stem test, well data, etc.); different sites may have used different models and perhaps different factors for the margin of "conservative" safety allowance (this factor is cited as 10 for Hanford and Yucca Mountain for specific parameters, but may not be for others. We question whether a single PROSPECTOR type model can be used for all sites. For Richton Dome, travel time is apparently based on a stable and stationary salt dome. Possible diapir movement is covered under "favorable condition no. 2" of the comparison chart. For Richton Dome this criterion rates a P, favorable, but nothing is said about diapir movement.

Favorable condition no. 3 (page 7-12) is rated NP for five sites, but the treatment is much too brief. Here, with the admitted uncertainties, lie possible problems; the nature of the uncertainties and the likelihood of their resolution by preshaft studies and later shaft-based studies should be projected.

If only one of the four subconditions for favorable condition no. 4 is rated positive, the entire condition no. 4 is rated positive. It is unclear whether the four subconditions are of equal weight. We believe the rankings may not be the same for different types of host rock and hydraulic conditions. We recommend the expected flux be a factor in assessing the sites not withstanding the footnote on page 7-15. The assessments should address these issue.

By summarizing and ranking subcategories, such as geohydrology, possible interaction among the major factors (such as hydrology vs. geochemistry) is not considered. This problem must be addressed in the final assessment.

Geochemistry—Favorable condition no. 1—Concerning redox conditions of the sites—again we are faced with disparate bases of data and different uncertainties. The presence of methane and pyrite, etc., may not be pervasive, for instance.

Favorable condition no. 2—Discussion for Hanford concerns reducing conditions but for the other sites the condition is for sorptive properties of the matrix material. Sorptive property of host rock at Hanford is low. We do not understand how these distinct properties can be equated. Once rated, the basis becomes obscured and the reader/user is apt to accept the ratings as on a basis of commonality.

Favorable condition no. 3—Again, the same problem of how to (1) evaluate the individual factors, (2) rate their role for each site, and (3) compare among the sites, remain significant.

Favorable condition no. 4—Limiting release to less than 0.001 percent per year—is rated P for all sites. The bases are different—for all but Hanford it is the absence of water at the waste package; for Hanford it is the presence of reducing condition; high pH, and reduced corrosion of metal overpack (page 7-20). These are different factors, with different reliability. We also recommend the assessments investigate the availability of geochemically compatible and feasible backfills for different kinds of media.

Rock Characteristics (postclosure)—This factor should be prefaced by a statement of the expected magnitude of the thermal pulse for proper evaluation. This important consideration has been omitted. Possible changes in the geologic framework and hydrologic system as a result of the heat load from the emplaced waste should be given intensive attention in future studies. Attendant uncertainties should be explicitly explained in the final assessments. In particular, possible changes in ground water circulation and flowpaths, fracture development, aperature changes of existing fractures, hydrothermal alteration of rock, and vertical and horizontal movement of the rock and land surface should be addressed.

Not just the geohydrology but other properties, specifically postclosure rock characteristics, vary directly as the result of differences between saturated and unsaturated zones. Yet other than in the section on Geohydrology, the differences for these two types of sites are not clearly spelled out (an exception is the recognition of sealing by ductility, page 7-25).

Potentially adverse condition no. 1—It is unclear how the possible stability problem at Hanford is not expected to affect the containment capability. The document states this on page 7-25 without citing the basis for the conclusion.

In the ranking summary section, the possible importance of "potentially adverse condition no. 2" is not given thorough treatment. The possible brine migration effect is allowed in the discussion under that heading, but without apparent justification other than the statement that "these phenomena are not expected to have significant effects at any of the sites," dismissed in the summary discussion. Further, the report states that the salt sites are rated higher because of lack of significant adverse properties. Both statements directly contradict the earlier, more specific discussions. This discrepancy must be investigated and supported.

As stated earlier, the question of developing weighting factors cannot be overemphasized. The almost unmanageable list of different conditions (favorable, potentially adverse, etc.) almost dictates that any single item on the list runs the risk of being forgotten. Thus it appears to become a numbers game with vote counting, as if each vote has the same importance. However, this is manifestly not so. An adverse condition on brine migration in salt should have overwhelming importance if it is present; a corresponding overwhelming factor for basalt might be the postclosure hydrology. The present report completely overlooks these partly judgmental factors. As a result, we believe the rankings might be unrealistic.

Potentially adverse condition no. 1—We question whether the following factor is worth worrying about. If precipitation and runoff rise significantly in the next 100,000 years, could new perched aquifers be created in what is now the unsaturated zone? If so, and if the repository shaft passes through this new aquifer, that could be a cause for concern.

Erosion—Favorable condition no. 3 is readily the important one. As long as the waste is unlikely to be exposed, the primary function of the repository will be fulfilled, thus the other two are insignificant. They merely help to ensure that condition no. 3 is fulfilled in the absence of more direct data. The three conditions are not equal and should not be so listed or compared.

Favorable condition no. 1—Could be rated NP (as is the case for NTS), but if the site is one of depositional aggradation, then it should not pose a problem (may pose one in case of rapid deposition, if a particular horizon is thereby pushed down into the underlying water table; if this should be a topic of concern, it isn't discussed).

Favorable condition no. 2—Wording could, in combination with condition no. 1, be construed to mean that erosion at Hanford during the next 10,000 years could amount to 450 m.

Potentially adverse condition no. 1, page 7-35—This reference to deposition during the last glacial period implies changes in hydrologic conditions resulting from climate effect. Under the latter heading, the only reference (page 7-31) refers to "changes" without any specifics. Taking these two entries together, could imply there's more to the story, for instance infiltration of ground water and resultant changes in permeability, sorptive properties (due to different material in fractures), flux, etc.

Qualifying conditions—The reason for making the qualitative distinction between Hanford and the other sites is not obvious; this point accents the concern about the basis for comparison among the sites.

Dissolution—Potentially adverse conditions and favorable conditions—the presence of breccia pipes, etc., at the three salt sites being conceded, the important task should be to ascertain the age of these activities. Right now the responses given to the two issues above for the three salt sites are not consistent.

Tectonics (postclosure)—Potentially adverse condition no. 1. Diapirism was included in the listing, but no evaluation was given for the salt sites. This might affect the ranking.

Human Interference—No more than passing mention of artificial markers. Are there any site-specific factors affecting the use of artificial markers?

Potentially adverse condition no. 1—What are considered as resources today may not be what people will seek in 5,000 years. Think of oil or coal in the pre-Marco Polo western world, or rutile, or uranium, or bauxite (or, in the foreseeable future, anorthosite). Our present conception of resources is no reliable guide for future explorers. Also, we believe the proximity to a National Park is a significant factor that should be considered under this heading.

Postclosure Systems Guidelines, Pages 7-53 and 7-54—No mention is made of whether the same waste form is assumed for all the sites, or whether waste forms and waste packages are tailored to the sites. We believe one should assume that the decision made in 1984 on the once-through uranium cycle, without reprocessing, will be valid in 20 years. Assessment of the qualifications of sites for use sometime in the 21st century probably should include the option of disposal of reprocessing waste, both hot and cool. Therefore, the assessment is thus quite uncertain and the site comparison may be prejudiced. Page 7-54 states that the waste packages are expected to last "indefinitely." This assumes a dry repository. Possible brine migration or possible electrolytic reaction of waste with water has not been considered. In the EA report for Davis Canyon, the authors mention (pages 6-92 and 6-93) 25 and 8 liters of brine accumulation per emplacement for cooled high-level radioactive waste and for spent fuel rods, respectively, in 100 years, and conceded that "...the presence of brine is expected to cause some corrosion of the waste cannister." Surely, such factors could and should be given thorough consideration and not merely be counted as a vote.

Radiological Hazards, Favorable condition no. 1, population density should address transient populations. For example, this factor might affect the density for Davis Canyon.

Site Ownership and Control—The rankings seem highly artificial to us. Other than top-ranking Hanford, we cannot agree with the priorities. An Act of Congress is required to transfer lands controlled by this Department. We question the success of a process of eminent domain.

Meteorology—This discussion is an example of the comparison (admitted by the authors of the report) of different kinds of data or absence thereof. The sites cannot be ranked on this basis.

Cost—It is not clear whether the cost includes the construction of transportation facilities to the sites and special transportation vehicles. This cost category is not listed under either "construction" or "operation." Transportation costs may vary greatly among the sites.

Format

Topics are difficult to follow because data and interpretations commonly found grouped in a technical report by discipline are scattered throughout several chapters. This is especially notable for geologic and hydrologic matters. Summaries of individual disciplines should be presented thus facilitating a more complete understanding of what is known and what must still be discovered. Alternatively, a detailed index in the final EA could help alleviate the problem. One or the other is necessary for a meaningful exposition of what is known.

As a basis upon which to develop some perspective on the overall quality of presentation, one report, Swisher site, was scanned intentially for internal consistency. This exercise revealed literally hundreds of inconsistencies and contradictions. If this report is representative of the entire group, the Environmental Assessments need a greal deal of hard work before final release. Details of this scanning effort are not provided. But they could be made available upon request should they be considered of value later.

Salt storage piles—A potential environmental impact at each of the salt sites is the presence of extensive salt storage piles. The assessments assert that any deleterious effects at these piles can be mitigated, but this conclusion is not based on in-depth analysis. Important to the conclusion is the assumption that a crust will form at the surface of the salt and provide protection from dissolution and erosion. Operating experience and/or theoretical studies should be cited to demonstrate that such a crust will form and would be effective under the specific climate conditions at the various salt sites.

A liner beneath the salt pile will be relied upon to provide long-term protection for ground water. A review of past and ongoing experiences where such liners have been used, including an evaluation of their effectiveness and the length of their useful life, should be conducted. We are not aware of any practical experience with such liners for the time periods of decades involved here. Any leachate through the liner is assumed to have total dissolved solids (TDS) of 35,000 parts per million (ppm). However, concentrations 10 times this value seem entirely possible.

Caprock—It is assumed that caprock is virtually impermeable and serves as a barrier against salt dissolution at salt domes. In our opinion this is not a valid assumption. Water is known to occur in fractures and solution openings in the consolidated caprock and is present in the unconsolidated anhydrite sands at the top of each salt stock being considered as is indicated by the test drilling conducted as a part of this program. Further indication of fracture and solution porosity in caprock is the zones of lost circulation encountered in drilling caprock. Also the presence of gypsum stringers which are common in the anhydrite caprock indicates that hydration of the anhydrite caprock along fractures is a common feature. Hydration of anhydrite requires water of low ionic strength to permit gypsum to form. Whether the source of the water is water of low ionic strength in units adjacent to or overlying the caprock, somewhat more saline water from formations at depth, or a combination of these sources has not been determined. In any event the available evidence strongly indicates that caprock is characterized by fracture and solution porosity and is capable of transmitting water. It follows that the hydrology of the caprock is an important factor concerning both potential radionuclide migration and salt dissolution at each salt dome and will require careful characterization at each site.

Near dome hydrology—The ground-water hydrology near any of the domes is virtually unknown. Knowledge of the near dome ground-water hydrology is necessary to define the probable pathways of radionuclide movement and to determine dissolution rates at the dome. Pathways described in the EAs indicate lateral movement away from the dome through aquifers at repository depths. Given a vertical head gradient, porous and permeable caprock on the dome, it would appear that nuclides upon arrival at the margins of the salt stock could move vertically as well as horizontally, and this vertical pathway might dominate nuclide transport.

Fluid movements in salt—Darcian flow through salt units is assumed for purposes of ground-water travel time calculations, determination of most likely flow paths to the accessible environment, and performance modeling. Hydraulic gradients in salt units are calculated in the environmental assessments as if hydraulic heads in adjacent hydrologic units were dissipated across the salt units. Flow velocities through the salt units are calculated using permeabilities inferred from regional ground-water flow models or measured on core samples.

Because salt is a plastic medium, the assumption of Darcian flow is unreasonable. Other driving forces such as rock stress and temperature are more likely to produce fluid movement. Hydraulic heads in hydrologic units separated by a salt unit cannot be related through a hydraulic gradient across the salt, as if the salt were a porous medium. Permeability estimates of salt units from the gross regional ground-water flow models are suspect, as are laboratory permeability measurements made on core samples that were subject to in situ conditions not duplicated in subsequent handling and analyses.

We acknowledge that the assumption of Darcian flow through salt is a conservative analysis as far as calculating the magnitude of flow velocities in the salt. However, inherent in this assumption is the concept that ground-water gradients define the direction of the most probable pathway of radionuclide transport through the salt. On the contrary, pathways through the salt are most likely to be determined by differential stress, both in situ and resulting from effects of the repository, temperature, and other possible failure modes.

It appears from the Environmental Assessment that development of the site could have significant adverse impacts on wetlands. The Department of Energy (DOE) provided conflicting discussion as to whether wetlands were, or were not, present on the site. The DOE should determine the areal extent of the wetland acreage, and quantify the impacts of site development and design measures to compensate for wetland loss. Any costs for acquisition or operation and maintenance associated with compensation should be borne by the DOE for the period the site is in operation.

Specific Comments

Page 1, Executive Summary, listing at bottom of page - Item 6 is listed as Vacherie Dome County, Texas (bedded salt). This obviously should be the Swisher County Site.

Page 10, figure 3 - The section shows Cook Mountain Formation at the salt dome. The nearest Cook Mountain Formation is 6 or 8 mi away. The Sparta is not shown, yet Cook Mountain would imply the full thickness of the Sparta is at the dome. Actually, the full thickness of the Sparta occurs about 6 mi to the north of the dome and about 9 mi to the east. Figure 3 is not in good agreement with figure 3-10. Figure 3-24 also lacks consistency with figures 10 and 3-10.

Page 3-17, figure 3-8 - Used Recent in Quaternary rather than Holocene as used in figure 3-3 (p. 3-6). Under lithology (1) Glauconitic sand has not been observed in the Carrizo in USGS test holes; (2) the Cook Mountain contains glauconitic sands in some areas; (3) Cockfield sands are dominantly nonglauconitic; and (4) in most areas in Louisiana the Midway does not contain sand. Perhaps very fine glauconitic sand could be found at the transition to Wilcox.

Page 3-24, section 3.2.3.2.3, Caprock and Salt Stock Stratigraphy - The sharp and tightly cemented caprock-salt contact from the DOE-Smith No. 1 borehole is described. This could be misleading in the context of the paragraph because the reader could imply that this described the contact for the whole dome. Well LSU V-7, located approximately 2,500 feet (ft) west of the DOE-Smith No. 1 borehole, screens a permeable "anhydrite sand" at the salt-caprock contact. In addition, the section does not adequately describe the caprock. During the drilling of well LSU V-6, located approximately 5,000 ft southeast of the DOE-Smith No. 1 borehole, a very permeable zone (probably solution cavities) was encountered in the caprock. Drilling fluid was lost, and drilling had to cease because all attempts to stop the fluid loss failed.

Page 3-26, section 3.2.5.1, paragraph 2, last sentence - The outcrop pattern around the dome and the section on figure 3-10 indicate that the Claiborne (Eocene) has been displaced by upward movement of the salt. As the dome was active during the Eocene, salt movement in the anticlinal salt structures cannot be ruled out. Faulting would accompany such movement. Faults in the Carrizo, Cane River, and Sparta in the general area may be related to salt movement. Radial faults (next paragraph) at either end of the dome imply salt movement. On page 3-31 (section 3.2.5.5., paragraph 3) the statement is made that salt movement continued throughout the Tertiary. Describe how could this occur without new faulting or continued movement along existing faults.

Page 3-29, section 3.2.5.4 - Uplift and Subsidence—Evidence exists that suggests that regional subsidence is occurring in northeast and perhaps north-central Louisiana. The subsidence may be related to ground-water withdrawals from the Sparta aquifer. More information can be obtained from the Louisiana District Office, U.S. Geological Survey (USGS), Water Resources Division, Baton Rouge, Louisiana.

Page 3-30, figure 3-13 - The Balcones fault system is shown to the east of the Mexia-Talco fault zone. The Balcones system is to the west.

Page 3-35, paragraph 6 - The age of the "anomalous sand" is given as Pliocene or Quaternary on this page. On page 3-19 (section 3.2.3.2.2, paragraph 2) Kolb is quoted as identifying the age as Pliocene or Miocene. As the same reference source is used, these ages should be consistent.

Page 3-38, section 3.2.6.1.1 - After discussing the anomalous sand in the preceding section, no mention is made of it in this section or in table 3-4.

Page 3-45, section 3.2.6.3, Natural Radiation - The following statement is made, "Natural radiation levels in ground water and surface waters have not been determined." The USGS in Louisiana has collected and analyzed numerous ground-water and surface-water samples for radioactive element concentrations as part of the USGS participation in the nuclear waste studies in Louisiana. The analyses can be found in the following references:

Ryals, G. N., and Hosman, R. L., 1980, Selected hydrologic data from the vicinity of Rayburns and Vacherie salt domes, northern Louisiana saltdome basin: USGS Open-File Report 80-217, 17 pp.

Ryals, G. N., 1982, Regional geohydrology of the northern Louisiana salt-dome basin, part I, conceptual model and data needs: USGS Open-File Report 82-343, 23 pp.

It should be noted that the Water Resources Division Office, USGS in Louisiana will complete a project this year that provides a statewide assessment of background radioactivity in ground water.

Page 3-45, section 3.2.7.1, paragraph 2 - The Cockfield may be part of the upper aquifer in a regional sense but nowhere is it shown to be at the dome. Table 3-18 indicates the units are in the vicinity of Vacherie Dome which is a more acceptable statement.

Page 3-47, table 3-9 - The Cockfield and Cook Mountain formations are not adjacent to the Dome except in a regional sense. This has not been made clear in the report. A change in title of the table is needed.

Page 3-49, section 3.2.7.3, paragraph 3 - "...salinity is observed to increase with depth." The Nacatoch at one site had TDS of 217,830 milligrams per liter (mg/l) and the Austin had a TDS of 125,570 mg/l. Only two sites were sampled for the Austin and three for the Nacatoch. With so little data and some of them conflicting, the statement cannot be supported.

Page 3-49, section 3.2.7.3, last paragraph – The Wilcox and Sparta crop out (in part at least) at the Dome. The units are recharged on the outcrop. Water levels tend to conform this. The terrace and alluvial deposits of Bashaway Creek receive all of their recharge locally. The paragraph does not adequately state conditions at the dome.

Page 3-50, table 3-10 – There are difficulties with the choice of analyses and the aquifers represented.

1. Upper Aquifer – Describe if any of the terrace samples are from the terrace over Vacherie dome.

2. Upper Aquifer – The Red River alluvium is a distinct linear aquifer some distance from Vacherie dome. Water quality in this aquifer has virtually no bearing on what is expected at the dome site.

3. Upper Aquifer – Describe where the alluvial samples are from e.g. the dome area, or near the dome.

4. Upper Aquifer – Cockfield was included on table 3-18 and table 3-9. If the Cockfield is too distant to include analyses, the Red River alluvium is also.

Page 3-51, section 3.2.7.4, Aqueous Geochemistry of Caprock and Salt Stock – The following statement is made, "Water samples from the caprock or the caprock-salt stock interface of Vacherie Dome have not been obtained." The Institute for Environmental Studies, Louisiana State University, has analyzed and reported the results of water samples obtained from wells LSU V-7 (screens caprock-salt stock interface) and LSU V-6 (screens part of caprock). Ryals (1980, see citation under comments for section 3.2.6.3) reports an analysis of water from well LSU V-6.

Page 3-58, paragraph 2 – The paragraph probably should mention that Bashaway Creek goes dry—probably annually, except for the wettest years.

Page 3-61, paragraph 1 – 2 year, 7-day, low flow values represent ground-water discharge, but do not indicate total ground-water discharge. The 2-year, 7-day, low flow value for Bashaway Creek may be 0 but ground-water outflow occurs. The final EA should address this issue.

Page 3-63, table 3-17 – The upper limit of TDS for Bashaway Creek (near Heflin) should be 67.0 ppm not 670 ppm.

Page 3-64, section 3.3.2.1.1., paragraph 3 – Table 3-18 shows the Cockfield as part of the Upper Aquifer. However, figure 3-22 (explanation) does not show the Cockfield as being part of Te_2 —but it is.

Page 3-64, section 3.3.2.1.1., Geohydrologic Units – Hosman (1978, p. 10) does not address any unit as the Upper Aquifer. ONWI has apparently designated the terrace and alluvial deposits and the Cockfield Formation as comprising the Upper Aquifer (table 3-18). Figure 3-23 shows the head distribution concerning the figure and discussions of the Upper Aquifer.

1. As contoured on figure 3-23, (page 3-64) the Upper Aquifer would consist of the terrace and alluvial deposits, outcrop of the Cockfield aquifer unit, outcrop of the Cook Mountain confining unit, outcrop of Wilcon-Carrizo aquifer unit, and perhaps the Vicksburg-Jackson confining unit and Miocene aquifers.

2. Relating these various units as one unit on one map with smooth contours is not very realistic. Thus the usefulness of the map is limited.

3. There are probably not enough data, especially in the outcrop areas of the confining units, to construct contours.

4. The figure is extremely misleading. The report identifies the upper aquifer as terrace, alluvium, and Cockfield. However, in about half of the area shown on figure 3-23 the Sparta, Cook Mountain, or other Tertiary deposits crop out. Therefore, flow arrows are being shown for areas where the aquifer does not exist.

The following report should aid in the understanding of the geohydrologic relationships of the Tertiary units:

Ryals, G. N., 1983, Regional geohydrology of the northern Louisiana salt-dome basin, part II, geohydrologic maps of the tertiary aquifers and related confining layers: USGS Water-Resources Investigations 83-4135, 6 pp.

Page 3-67, table 3-18 - The accuracy of transmissivity and hydraulic conductivity values should be verified. The low end of horizontal hydraulic conductance for the Sparta is questionable. In fact, the thickness range for the units and K versus T values do not appear to match. Thickness, K, or T appear to be in error or else are not adequately presented. For example, with one conductivity and a range of thickness presented, more than one T can be presented for the Austin. Or for the Sparta-multiplying the lowest K (0.6) by the thinnest interval (91m.) results in a T value of 54.6—more than twice the low T reported. The minimum conductivity for the Sparta should be no lower than for the Cockfield. The low value of K for the Wilcox is much lower than determined from numerous tests of the fresh-water bearing zone.

Page 3-70, paragraph 2 - It should be made clear that the Wilcox-Carrizo is not confined by the Cane River throughout the region. The Wilcox crops out at the dome and only a few miles to the west of the dome the unit either crops out or subcrops under terrace deposits. On page 3-73, paragraph 3, the report states that no continuous confining unit overlies the Wilcox-Carrizo at Vacherie dome.

Page 3-73, paragraph 3 - In a southwesterly direction from Vachier dome, the Wilcox is not overlain by Cane River or Sparta in most of the area. Discharge is at the Red River Valley and discharge is directly from the Wilcox into the Red River Alluvium. Any water movement through clay would be through clay in the Wilcox.

Page 3-87, paragraph 1 - No mention is made that Bashaway Creek is dry for part of most years.

Page 4-15, section 4.1.1.1.1, paragraph 4- Figure 3-18 does not show the area within which surface-water characterization will be done. Perhaps, figure 3-19 should have been refined.

Page 4-15, section 4.1.1.1.3 - The term Upper Aquifer test well is highly undesirable because in Chapter 3 the Upper Aquifer is defined as alluvium, terrace, and Cockfield. Here Upper Aquifer is Sparta according to figure 4-3. The document should identify the aquifer to be tested by name.

Page 4-15 - More than one major sand may occur in the Sparta or Wilcox. Therefore, more than one series of tests may be desired for each aquifer to show intra-aquifer potential.

Page 4-17 - The location illustrated by figure 4-4 is over Vacherie dome. Illustrations in Chapter 3 indicate that the Sparta does not occur over much of the dome and possibly does not occur at the site illustrated in figure 4-4. Yet the Upper Aquifer is referred to as Sparta.

Page 4-104, section 4.2.1.4.2, paragraph 2 - In this paragraph the term Upper Aquifer is used as defined in Chapter 3 and not as used earlier in Chapter 4. This is a potential source of confusion.

Page 5-45, section 5.2.2.2.1, paragraph 1, page 5-124, table 5-26, item 4, paragraph 1 - The statement is made that the potentiometric levels of the Sparta will be lowered. Yet the statement is made that water will be produced without stressing the aquifer. Describe how this is possible. It requires a stress (pumping) to produce water.

Page 5-46, paragraph 2 - Boundary conditions may have a significant impact on pumping levels. The location is not many miles from the updip limit of the Sparta on the east flank of the Sabine uplift. The Sparta water levels are declining in downdip areas east of the dome, perhaps 1 foot per year. However, in the outcrop, decline is much less—possibly one third as much, or even less.

Chapter 6 - Throughout the chapter the statement is made that should radionuclides migrate from the salt stock, they would probably enter the Austin Unit. Virtually nothing is known about whether the complex salt stock and adjacent formations could provide a conduit to other formations (some containing freshwater).

Page 6-86, paragraph 5 - If there is no experimental data to support the existence of hydraulic gradients in domal salt (lines 4 and 5), then any travel-time values derived from calculations which include hydraulic gradient values in domal salts are scientifically unsupportable, and no conclusion is justified. Such values should not be used to suggest that travel times within the salt stock greatly exceed regulatory requirements (lines 6 and 7). This paragraph should be revised as should statements and conclusions made elsewhere in the document which are based on the same line of reasoning.

Page 6-87, section 6.3.1.1.2, last paragraph - Caprock, according to figure 3-10, drapes the sides of the dome to the proposed repository level. If caprock with fracture and solution porosity occurs on the flanks similar to that reported on the top of the dome, than an additional path for movement is possible once the radioactive waste leaves the salt. According to figure 3-10, the repository level is above the Austin.

Page 6-89, last paragraph - If the dome is nonporous and dry, state how there can be a downward component of flow in the dome.

Pages 6-122, table 6-11, Favorable Conditions, item 4 - The finding for item 4 was favorable yet items (i), (ii), (iii), and (iv) under item 4 (p. 6-123) were all "...favorable condition is not present." This is contradictory.

Page 6-124, table 6-11, item 2 - The answer presumes that the migrating waste remains in the Austin. If the waste can move that far, alternate paths should be evaluated. Alternate paths to other hydrogeologic units could occur by movement through the caprock on the flanks of the dome.