THE STATE OF MISSISSIPPI
ENERGY AND TRANSPORTATION BOARD

REVIEW COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RICHTON DOME SITE MISSISSIPPI

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Many individuals contributed to the preparation and review of this document. In particular, the staff of the Energy and Transportation Board of the State of Mississippi provided overall project direction. Significant comments and peer reviews were provided by the members of the Nuclear Waste Technical Review Committee. The Nuclear Waste Policy Advisory Council contributed valuable commentary and guidance in construction of the final document.

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1.0 INTRODUCTION

The State of Mississippi has compiled this comment document on the Draft Environmental Assessment for the Richton Dome site, which is being considered by the Department of Energy for a possible nuclear waste repository. The comments in this document are based on contributions from state officials and state agencies, private contractor organizations, other state institutions and members of the public. DOE has of course received additional comments from members of the public and others in the public hearings on the subject that have been held in the State. It is the State's position that, lawfully, Richton should not be considered as a potentially acceptable site as a result of the intent of the Nuclear Waste Policy Act (P.L. 97-425, 96 STAT 2201).

On the basis of a comparison with salt repositories in other geohydrologic settings, DOE has concluded in the Draft Environmental Assessment that Richton is not one of the three sites that should be nominated for detailed site characterization. We strongly contend that Richton Dome is not only unsuitable for detailed site characterization it is the official position of this State that this site may not be considered for any purpose under the Nuclear Waste Policy Act due to the proximity of the site to the town of Richton. This blatantly violates both the letter and the intent of the Act. A repository at Richton will never be acceptable to the State, or, in our view, licenseable under the regulations of the U. S. Nuclear Regulatory Commission and the U. S. Environmental Protection Agency.

We believe that the negative consequences resulting from a potential repository at Richton have not been adequately discussed in the Draft Environmental Assessment and we will therefore provide further discussion of such aspects throughout this document. We will also point out how the ranking system employed by DOE fails to take adequate account of such negative

features by diluting the most significant site selection factors by a number of others in which there is either no difference among sites or no difference that has an important effect on the suitability of the sites for a repository. The Richton Draft EA states that insufficient data is available to eliminate the dome...therefore the dome is recommended. This logic implies that the burden of proof is on the state to disprove a site rather than on the DOE to prove that a site is safe. This is in clear violation of the letter and intent of the Nuclear Waste Policy Act and the DOE Guidelines.

This document is organized as follows: We begin from the most general standpoint, mainly the ranking system used by DOE to make comparisons among various candidate sites. This discussion pertains primarily to Chapter 7 of the Draft Environmental Assessment. We both comment on and offer suggestions on the methods applied by DOE for sharpening the comparative evaluation so that the results are more meaningful. This comprises Chapter 2 of this comment document. In Chapter 3 we review eight categories of technical issues which pertain to the suitability of the Richton site. These include: hydrology; dissolution; geochemistry; dome geometry and stability; faulting, seismicity, and tectonics; geomechanical and geotechnical considerations; resource preemption and potential intrusions and performance assessment. Naturally there are overlaps among several of these sections, but nevertheless it has seemed useful to categorize the comments as far as possible. In Chapter 4 we consider a number of aspects of environmental impact of a repository, and in Chapter 5, we consider the potential socioeconomic impacts. These latter are extremely important were a repository located at Richton due to the fact that the town of Richton itself is adjacent to the site. Lastly, in Chapter 6, we include a number of additional comments that were not easily categorized but that also pertain to the environmental assessment and to the suitability of the Richton site for a repository.

Aside from the technical commentary to be presented herein, the record of the State of Mississippi is to reflect many of the administrative problems encountered by the State in its attempts to completely review and provide

technically complete commentary on the Draft Environmental Assessments. While the State has made a good faith effort on its own part to comply with the Department of Energy requirement to provide commentary on the Draft Environmental Asessments by March 20, 1985, the Department of Energy has hindered those efforts significantly by allowing a period of but 90 days for the states to review and provide comments on nine separate documents, each of which is in excess of 1000 pages. To compound the problem, the Department provided only a limited number of copies of the Draft Environmental Assessments for review and provided them during the week prior to the 1984 Christmas and New Year's Holiday Season, thus depriving the State of approximately 10 days of comment and review time. The State was further hampered by the Department due to the fact that the State had but limited funding with which to enlist the services of a qualified technical contractor and was able to do so only after having to abbreviate, through a phased process, the scope of the contract. Additional financial assistance was not awarded until late in February, 1985. The efforts of the State were further thwarted by the Department by its failure to provide vitally necessary reference documents in a timely fashion. To be sure, the State has yet to receive a completed set of the referenced documents.

Due to this demonstrated bad faith on the part of the Department, the State finds it impossible to compile all of its comments on the Draft EA's prior to the March 20, 1985, deadline. This arbitrary deadline has had an unacceptably adverse effect on the State's ability to comment fully as required by the Act and the guidelines on the serious nature of this program and the controversy it has engendered in the State. The State will be submitting additional comments after March 20, 1985, which we hope will receive serious consideration. Heretofore, the State has produced and submitted to the DOE for the record additional commentary on various documents directly related to the Department's repository siting program. Those comments are and shall continue to remain in effect and are not waived by the State. If necessary and upon request by DOE, the comments can be resubmitted even though they have been previously submitted to DOE.

DOE evaluations of the Permian Salt Bed sites strongly indicate that all of the Gulf Interior Region Salt Dome sites, including Richton, are vastly inferior to those bedded salt sites in Deaf Smith and Swisher Counties, respectively. Therefore, it is the position of the State of Mississippi that should either the Hanford site or the Yucca Mountain site (or a site in the Paradox Basin should the Davis Canyon site be recommended for site characterization) be disqualified, the Swisher County site must take preference over the Richton site or any other site in the Gulf Interior Region for consideration for further site characterization activities.

The Draft EA's developed by the Department of Energy failed wholly to take into account many intangibles, particularly those having to do with overall sentiment of the public and political sector regarding the construction and operation of a repository within the borders of the State of Mississippi. As noted heretofore, a repository at Richton or any other site in the State of Mississippi will never be acceptable. To enforce that postion, citizen's groups, public interest groups, professional organizations, municipal and county governments, the Mississippi Energy & Transportation Board and the Mississippi Legislature have all adopted formal resolutions and/or positions in which that sentiment of opposition is succinctly and inequivocally expressed. Evidence of such sentiment is the position of the State of Mississippi, formally adopted by the Mississippi Energy & Transportation Board in December, 1984, as shown on pages 1-5 and 1-6.

The policy was developed and prepared by the Nuclear Waste Policy Advisory Council, which in turn held public hearings on the position statements. It is the position of the State that the Draft EA's must include direct consideration of the official State position statement, and that this position must be directly reflected in the ranking of the sites. It is obvious that the current draft of the two Mississippi site's Draft EA's wholly ignore the adopted position of the State.

POLICY OF THE STATE OF MISSISSIPPI

I. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT NUCLEAR WASTE NOT BE STORED IN ANY GEOLOGIC FORMATION IN THE STATE OF MISSISSIPPI.

II. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT THERE BE STRICT COMPLIANCE WITH ALL STATE LAW, INCLUDING BUT NOT LIMITED TO ALL PERMITTING RULES AND ANY OTHER REGULATORY REQUIREMENTS.

III. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT, PURSUANT TO THE GOVERNOR'S MORATORIUM AND THE FEDERAL POLICY OF CONSULTATION AND COOPERATION, A CESSATION OF FIELD WORK IN MISSISSIPPI BY DOE SHOULD CONTINUE UNTIL SUCH TIME AS ALL DOCUMENTATION RELATIVE TO THE NUCLEAR WASTE PROGRAM IN MISSISSIPPI HAS BEEN PROVIDED AND REVIEWED TO THE SATISFACTION OF THE GOVERNOR.

IV. AT THE BEGINNING OF ANY FIELD WORK, BY ANY AGENCY, ORGANIZATION, OR ENTITY OTHER THAN THAT OF THE STATE OF MISSISSIPPI, THERE MUST BE IN PLACE A NEGOTIATED AGREEMENT DETAILING IN WRITING AT A MINIMUM THOSE PROVISIONS REQUIRED UNDER STATE LAW AND INCLUDING SUCH OTHER PROVISIONS AS MAY BE NECESSARY IN ORDER TO PROTECT PUBLIC INTEREST, HEALTH, SAFETY, AND WELFARE OF THE CITIZENS OF THIS STATE.

V. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT THE ENERGY AND TRANSPORTATION BOARD SHALL SERVE AS THE INITIAL AGENCY IN THIS STATE TO BE CONTACTED BY THE FEDERAL DEPARTMENT OF ENERGY OR ANY OTHER FEDERAL AGENCY ON ANY MATTER RELATED TO THE LONG-TERM OR TEMPORARY STORAGE AND/OR PERMANENT DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE OR TRANSURANIC WASTE. THE BOARD SHALL SERVE AS THE INITIAL AGENCY IN THIS STATE TO RECEIVE ANY REPORT, STUDY, DOCUMENT, INFORMATION OR NOTIFICATION OF PROPOSED PLANS FROM THE FEDERAL DEPARTMENT OF ENERGY OR ANY OTHER FEDERAL AGENCY ON ANY MATTER RELATED TO THE LONG-TERM OR TEMPORARY STORAGE AND/OR PERMANENT DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE OR TRANSURANIC WASTE. NOTIFICATION OF PROPOSED PLANS INCLUDE NOTIFICATION OF PROPOSALS TO CONDUCT FIELD WORK, ON-SITE EVALUATION, ON-SITE TESTING OR ANY OTHER RELATED STUDIES. THE BOARD SHALL DISSEMINATE OR ARRANGE WITH THE FEDERAL DEPARTMENT OF ENERGY OR OTHER FEDERAL AGENCY TO DISSEMINATE INFORMATION RECEIVED TO THE COUNCIL, THE COMMITTEE, APPROPRIATE STATE AGENCIES, APPROPRIATE LOCAL UNITS OF GOVERNMENT AND INTERESTED CITIZEN GROUPS.

VI. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT ANY INFORMATION OFFICES ESTABLISHED IN MISSISSIPPI SHOULD PROVIDE FACTUAL AND SCIENTIFIC INFORMATION AND EFFORT SHOULD BE MADE TO DIRECTLY ANSWER QUESTIONS RELATIVE TO NUCLEAR WASTE SITING POSED BY MEMBERS OF THE PUBLIC. THE BOARD OF ENERGY AND TRANSPORTATION, INSOFAR AS FUNDS, PERSONNEL AND BUDGET ARE AVAILABLE, SHOULD COMPILE INFORMATION THAT IS AVAILABLE TO THE BOARD FOR DISTRIBUTION TO THE GENERAL PUBLIC.

VII. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT REPRESENTATIVES OF OTHER STATES, THE FEDERAL GOVERNMENT, AND THE SCIENTIFIC COMMUNITY SHOULD BE CONSULTED WITH AND PERTINENT INFORMATION OBTAINED SO THAT THOSE RESPONSIBLE FOR THE HEALTH, SAFETY, AND WELFARE OF THE PEOPLE OF THE STATE OF MISSISSIPPI WITH RESPECT TO THE NUCLEAR WASTE PROGRAM MAY BE MORE FULLY INFORMED SO THAT THE BEST POSSIBLE DECISIONS REGARDING THE PROGRAM MAY BE MADE.

VIII. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT ALL DECISIONS, EXCEPT DECISIONS RELATIVE TO POSSIBLE LITIGATION, SHALL BE MADE IN OPEN MEETINGS WITH THE FULL PARTICIPATION OF THOSE RESPONSIBLE FOR THE NUCLEAR WASTE PROGRAM AND OF THE PUBLIC OF THE STATE OF MISSISSIPPI AND INFORMATION UPON WHICH DECISIONS ARE MADE SHOULD BE AVAILABLE TO THE PUBLIC.

IX. IT IS THE POLICY OF THE STATE OF MISSISSIPPI THAT THE STATE, ITS AGENCIES, SUBDIVISONS, OFFICIALS, AND EMPLOYEES SHOULD BE ABSOLVED FROM ANY LIABILITY WHATSOEVER SUFFERED AS A RESULT OF THE NUCLEAR WASTE DISPOSAL PROGRAM IN THE STATE OF MISSISSIPPI.

X. ANY VIOLATION OF POLICY AS SET FORTH IN THIS DOCUMENT SHOULD BE REPORTED TO THE NUCLEAR WASTE POLICY ADVISORY COUNCIL FOR THEIR RECOMMENDATIONS FOR APPROPRIATE ACTION BY THE ENERGY AND TRANSPORTATION BOARD.

2. COMPARISONS AMONG SITES

2.1 METHODOLOGY

2.1.1 BACKGROUND

The Department of Energy (DOE) published Final General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories, December 1984 (10 CFR 960). These final guidelines have never been accepted by the State of Mississippi. Evaluations of individual sites and comparisons between and among sites are based on post-closure and pre-closure guidelines. The Guidelines state that evaluations must place primary significance on the post-closure guidelines and secondary significance on the pre-closure guidelines, with each set of guidelines considered collectively for such purposes. Within the pre-closure guidelines, 11 technical guidelines are separated into three groups that represent, in decreasing order of importance, 1) pre-closure radiological safety; 2) environment, socioeconomics, and transportation; and 3) ease and cost of siting, construction, operation, and closure.

A Draft Environmental Assessment has been prepared for each of the potential sites. Chapter 7 of the Draft Environmental Assessment presents a comparative evaluation of sites proposed for nomination. This evaluation purports to be based upon the ranking scheme established in the Final General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories as described above. DOE has fashioned this Draft EA on the basis of complying with the EPA Guidelines. The State is being forced to comment on an EA based on guidelines that we have never accepted and that we contend have not been adequately complied with by DOE.

2.1.2 SUMMARY OF FINDINGS

Of the three ranking methods used by DOE, the utility estimation method is the only method which even presumes to encompass the multitude of variables involved in this complex analysis. The averaging method and the pair-wise

comparison method do not recognize the extent that one site is better or worse than other sites; the only consideration is that one site is better or worse than another. This results in a significant reduction in the utilization of available data.

The rankings produced by the utility estimation method are questionable in validity because the weights applied to the various groups of guidelines are subjective and not necessarily consistent with provisions of the guidelines. For example, the weights assigned to the three pre-closure groups by DOE are essentially equal although the guidelines specify that the radiological safety group should weigh more than the environmental/socioeconomic group, and that group more than the site implementation/cost group.

The technical guidelines are interdependent and in some cases appear in both pre- and post-closure groups. This results in double counting of the same data. For example, pre-closure rankings for all sites on tectonics are the same as post-closure rankings. Thus, the differential between two sites on tectonics is weighed twice as much as their differential on population, which only appears in the pre-closure group. For example, Richton's low position with respect to population is greatly diluted by its high rankings on tectonics, rock characteristics and site ownership, all of which are double counted.

Richton's overall ranking is sensitive to the weight applied to the post- and pre-closure guidelines and to individual guidelines within those groups. For example, putting a preponderence of weight on the population guideline within the radiological safety group, with all other weights unchanged from the DOE weights, moves Richton from 4th to 5th.

2.1.3 OUTLINE OF APPROACH

This assessment of the site ranking model is divided into four subsections: 1) problems with the theory of the site ranking model, 2) problems with specific portions of the guidelines, 3) major concerns with the Richton dome

site, and 4) areas requiring additional investigation. In the analysis of the site ranking model, emphasis was placed on an analysis of the utility estimation method of aggregation. Our evaluation is based on Chapter 7 of the Draft Environmental Assessment and the Final General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories (10 CFR 960).

2.1.4 EVALUATION - ANALYSIS AND DISCUSSION

2.1.4.1 Site Ranking Model Theory

The five sites were ranked based on an evaluation of post-closure and pre-closure guidelines. The guidelines contain both technical and system guidelines. The technical guidelines address the specific characteristics of the site that are considered to have a bearing on the pre-closure and the post-closure performance of the repository. The system guidelines address the expected performance of the total system, including its engineered components; their objective is to protect public health and safety and to preserve the quality of the environment. For each of the post-closure guidelines and the three major groups of pre-closure guidelines, a relative ranking of sites was established. This ranking is based on favorable, potentially adverse, disqualifying and qualifying conditions for each guideline. The results are then integrated to develop rankings of groups and sets of technical guidelines and an overall ranking of the sites proposed for nomination. The data were aggregated by three different methods: averaging, pair-wise comparison, and utility estimation. The following weights were used by DOE: post-closure - 51%; pre-closure - 49%. The components that make up the pre-closure grouping are weighted as follows: radiological safety/environment (35%), socioeconomics and transportation (33%), ease and cost of siting, construction, operation, and closure (32%). As will be further addressed hereinafter, we contend that the selection of the weightings is both arbitrary and wholly inconsistent with the DOE Guidelines, and therefore, the Nuclear Waste Policy Act.

The following are some of our concerns with the site ranking model theory.

2.1.4.1.1 System Guidelines Versus Technical Criteria

The guidelines state "Comparisons between and among sites shall be based on the system guidelines, to the extent practicable and in accordance with the levels of relative significance specified above for the post-closure and pre-closure guidelines. Such comparisons are intended to allow comparative evaluations of sites in terms of the capabilities of the natural barriers for waste isolation and to identify innate deficiencies that could jeopardize compliance with such requirements. If the evidence for the sites is not adequate to substantiate such comparisons, then the comparisons shall be based on the groups of technical guidelines under the post-closure and the pre-closure guidelines considering the levels of relative significance appropriate to the post-closure and the pre-closure guidelines and the order of importance appropriate to the subordinate groups within the pre-closure guidelines." Ostensibly, the ranking of the five sites was based totally on technical guidelines. Careful analysis of both the ranking methodology and results raises grave doubts that such is truly the case. DOE even admitted that sufficient data did not exist to evaluate the systems criteria for any of the post-closure or pre-closure guidelines (p. 7-120, Richton Dome Draft EA).

2.1.4.1.2 Analysis of Individual Conditions

For each of the conditions within each guideline, an analysis of present/non-present (p/np) was provided. It is not clear, however, how the subjective present/non-present evaluation was translated to an actual score and site ranking for each guideline. There apparently is no weighting of the individual conditions within each guideline. If there were, it is essential that it be further documented by DOE.

2.1.4.1.3 Weighting of Guidelines

The weighting scheme is wholly subjective. Although the DOE Guidelines dictate that post-closure shall have primary significance over pre-closure guidelines, the DOE decision to give them nearly equal weight (51/49%) merely makes a mockery of this critical requirement. Moreover, and amazingly, nearly equal weight is given to the three pre-closure guideline groups (35/33/32%).

Within the pre-closure guidelines, the 11 technical guidelines are separated into three groups. Within each group, equal weight is given to each technical guideline. For instance, within the first group, radiological safety, DOE assigns equal weight to the four technical guidelines that make up this group:

Population
Site ownership
Meteorology
Off-site installations

Population, and therefore considerations of public health, safety and welfare is a far more effective discriminant and thus must be weighted much more heavily than the others. The population criterion for Richton is vastly more sensitive relative to the other sites, and by weighting population more heavily, the ultimate ranking of Richton to the other sites will shift dramatically.

2.1.4.1.4 Aggregation Methods

After a ranking of sites for each of the technical guidelines was established, the rankings were combined or aggregated to derive for each site: 1) a ranking for the set of post-closure guidelines, 2) ranking for each of the three subordinate groups of pre-closure guidelines, 3) a ranking for the entire set of pre-closure guidelines, and 4) an overall ranking for all of the guidelines. Since the rankings assigned to sites might depend on the method of ranking, three different methods were used to perform the aggregation: averaging, pair-wise comparisons, and utility estimation.

The averaging method leads to a dilution of information. Although DOE admits scale differences - for instance, for each guideline it is mentioned that the difference between site 1 and site 2 is greater than between site 2 and site 3 - the averaging method does not take this into account. Although the averaging method is the simplest, it is too great a reduction of the data. It does not take into account factors of comparison admittedly important. The

pair-wise comparison is equally weak. Within the guideline sets, no weights are assigned. While this type of aggregation method might be appropriate for a random event in scientific experimentation, the ranking of sites is judgmental - not random. Significant data input is lost through the reduction analysis of this method. The utility estimation method contains significantly more information, and, thus increased subjectivity. Whereas the previous two methods provided no weighting within the guideline sets, the utility estimation method weights the site on a scale from 1 to 10 for each of the individual guidelines. The scores are summed, weights assigned for the post-closure, pre-closure groupings and for the three groups of pre-closure criteria, and a total number is calculated. Notwithstanding the suggested advantages of this method over the others, there are a number of problems:

1. In the example provided on the Richton Dome Draft EA, pages B-7, B-8, the weighted division for the pre-closure guideline groups was 35:33:32 providing essentially equal weight for each of the groups. Our position is that this arbitrary choice is inconsistent with the DOE Guidelines and, therefore, the Nuclear Waste Policy Act as well.

2. As discussed previously, although the utility estimation method provides weighting within each technical guideline (scale of 1-10) and provides group weighting, there is no weighting assigned to the individual technical guidelines. For instance, within the post-closure guidelines, all nine technical guidelines are given equal weight. Some of these nine factors have greater significance than others and should be weighted to reflect this.

3. The weighting for each of the technical guidelines (scale 1-10) is on a linear scale. Greater sensitivity would be provided if a non-linear scale were used to rank each technical guideline with the function based on the relative risk of each variable.

2.1.4.1.5 Subjectivity of Issues

The site ranking model is flawed because of the subjectivity of issues included. Many of the "technical criteria" are easily influenced by biases. For instance, within the site ownership and control guideline of the pre-closure guidelines, sites with private landholdings are given a higher ranking than sites owned by federal agencies other than DOE. This implies that it would be preferable to take land from private holders than through agency transfers of title. This is a very subjective, if not bizarre, judgment.

2.1.4.1.6 Environmental Hazards Versus Ease of Implementation

Because of both the equal weighting given to the three groups of guidelines within the pre-closure guidelines and the lack of weighting among the technical guidelines of the post-closure and pre-closure groups, the site ranking model results in equating the facility of cost and implementation factors with environmental hazard and personal safety considerations. As a matter of public policy such a suggestion reflects a rank insensitivity to basic human and environmental values.

2.1.4.2 Problems with Specific Guidelines

Following are a few examples of specific problems found in the DOE Guidelines.

1. Within the post-closure guidelines, the sites could not be differentiated for three of the individual technical guidelines: climatic changes, erosion, and site ownership and control. Depending on the weighting scheme and aggregation method utilized, the inclusion of these three guidelines can make a difference in the overall ranking of sites. By including these three factors, the weight assigned to the six other technical guidelines is reduced. This is especially true in the utility estimation method.

2. Within the post-closure set of guidelines, there is no consideration of effects on future area growth. Impacts on the region's future as far as population, market areas, tourism, and other long term impacts should have been addressed, as should an analysis of viable alternative uses.

3. Within the transportation guideline, an analysis of lengths and costs of road and rail access is included. It is inappropriate to include cost factors in this part of the site ranking model. Implementation and cost factors should be minor factors on site selection relative to environmental hazard and personal safety.

   Also, there is considerable difference in ranking depending on whether road or rail access is considered. It is not clear how the ranking for the transportation guideline was established since the assessment involves a complex mix of access route analysis, cost, and environmental risks (life cycle costs).

4. The pre-closure guideline of site ownership is also questionable. As mentioned previously, sites on property now in private ownership are ranked higher than those owned by the federal government. This result is inexplicable and blatantly arbitrary.

5. The socioeconomic guidelines of the pre-closure set do not differentiate between short-term and long-term impacts. The majority of the socioeconomic conditions reflect only short-term considerations. The so-called "favorable condition" No. 4 - ("No projected substantial disruption of primary sectors of the economy of the affected area,") is utterly incredible. The Draft Environmental Assessments are absolutely devoid of both data and a rational analysis thereof for each of the five sites to substantiate the conclusion that no disruptions will occur.

6. The pre-closure set of technical guidelines includes surface characteristics, rock characteristics, hydrology, and tectonics. These four guidelines are all used to evaluate the ease and cost of siting, construction, operation, and closure. Although they provide an evaluation of natural resources information, it is solely used for implementation of the project and not in evaluation of potential risk. Their weights should be adjusted to reflect their relative importance.

2.2 APPLICATION OF METHODOLOGY

The DOE's comparative evaluation methodology is both arbitrary and capricious, and is designed to obfuscate rather than make transparent the ranking process. With the limited time available to develop comments on the Draft EA, the State was precluded from performing a detailed study of comparative site characteristics. Despite that constraint, some of the more critical issues with respect to the other two salt sites included in the top five sites, namely Deaf Smith (Texas) and Davis Canyon (Utah), received limited review. Time and manpower constraints caused by DOE's actions precluded the in-depth analyses of those bedded salt sites, and totally prevented analyses of the Hanford and Yucca Mountain sites' Draft EA's.

With respect to the weighting of post-closure versus pre-closure guidelines, it is our position, which is compatible with the intent of Congress as stated in Section 112.(a) of the Nuclear Waste Policy Act, that the post-closure guidelines be weighted much more heavily than the pre-closure guidelines. It is ludicrous that DOE has attempted to implement this by assigning this 51%/49% breakdown to the post- versus pre-closure evaluations, and is clearly violative of the intent of the Congress and the DOE Guidelines. It is the position of the State that the 51%/49% ratio is not in the spirit within which the Nuclear Waste Policy Act, and the siting guidelines, were developed.

Within the pre-closure guidelines, it is required, pursuant to the DOE Guidelines, that the three categories be given decreasing levels of overall significance. The methodology as presented in the Draft EA's, does not adequately reflect the differential weighting by which the radiological, health and safety, socioeconomic, and environmental factors must be weighted more heavily than cost, ease of construction and transportation.

It is obvious that there are important omissions and/or inaccuracies in both the assumptions made and in the numbers assigned by DOE, as recorded in the Draft EA, Appendix B on particular guidelines and sites. For example, in geohydrology, under the post-closure technical guidelines, assignment of a

value of 6 or lower to Richton is more appropriate than DOE's assigned value of 9, given the wanton lack of data on the Richton site.

Further, DOE attempted to take too much credit for the hydraulic conductivity properties of salt, failing to distinguish between the almost total lack of permeability of intact salt specimens in the laboratory and the hydraulic properties of a bulk salt mass in-situ. There may be sufficient anomalies or geologic variations such that, as a total deposit, the host rock is not as impermeable as the same size extrapolation from a laboratory sample. Richton must be significantly degraded because of this, since the geologic anomalies commonly present in and at the boundaries of salt domes can lead, and have led, to hydraulic interconnection with the surrounding sediments which are known to contain significant amounts of water, and have the capability of transmitting it to the accessible environment. Since DOE has defined the accessible environment for Richton as the boundary of the salt stock itself, if the groundwater in the surrounding sediments were relatively stagnant, DOE cannot take credit for this. Furthermore, in the Deaf Smith site, there is a general regional downward hydraulic gradient, so that any water passing through the salt would be expected to carry radionuclides to deposits that are even deeper. In the Davis Canyon site, there appears to be much less groundwater in the vicinity of the host rock, which also improves the possibility for containment.

In the area of geochemistry, the Richton site must also be downgraded because of the limited definition of the accessible environment. Whereas, at Deaf Smith and Davis Canyon, credit can and should be taken for the retardation properties of the nearby aquifers. At Richton, no such credit can be permitted because travel past the initial boundary of the accessible environment is irrelevant to the evaluation of the site. Thus retardation in the regional aquifers is not available in the consideration of Richton. Furthermore, available geochemical evidence is extremely sparse, if not

altogether nonexistent, so that even if the definition of accessible environment were modified, on the basis of present information, there is no reason to believe that significant geochemical benefits would accrue (Richton Draft EA, p.3-50).

In the area of rock characteristics, Richton must also be downgraded because of the important consideration, elaborated on later, pertaining to the presence of anomalous zones within the salt domes. While intact laboratory samples of salt from salt domes such as Richton may show a high degree of purity and homogeneity, it is the rule rather than the exception for salt domes to contain anomalous zones such as shear zones, that are likely to be the controlling factors on the movement of groundwater in the vicinity of the wastes. Such zones arise from the way salt domes grow, and they are not found in bedded salt deposits. For this reason, the domal sites must be ranked below the bedded salt sites. While other kinds of anomalies can exist in bedded salt sites, due to the nature of their deposition they can be identified and are more easily characterized than in dome sites.

Two changes should be made in the values assigned under pre-closure guidelines, both of them pertaining to the Davis Canyon site. First, under site ownership, Richton Dome should be downgraded because the rationale offered by DOE for site ownership problems appears totally without merit. DOE argues that Richton Dome is at an advantage with respect to site ownership because the land is not already owned by the federal government! Apparently DOE believes that it would be more difficult for one federal agency to transfer the land to another than it would for DOE to take it away from unwilling owners at the other sites. This illustrates DOE's obvious insensitivity to the underlying goals for which the siting guidelines were established. It must be realized that the taking of land from members of the public by the Federal Government is in essence a confiscation of private land. This taking of private land from Mississippians, especially when an insignificant amount of nuclear waste is generated by the state, amounts to a removal from private ownership of property when other sites are already in government ownership. It should be obvious to DOE that in a state where

private ownership of land is an important principle, those individuals who face the loss of their property would go through every legal means possible to preserve and protect their ownership. Even though DOE points out that an act of Congress would be required to affect such a change in title from one agency to another, one should note that it was Congress itself that mandated the Nuclear Waste Policy Act and the program under which DOE is now proceeding.

The other change made in the pre-closure guidelines is in the area of environmental quality. Richton Dome had been ranked unreasonably high, even though the environmental impacts on Richton would be experienced by a population living right at the site. Thus Richton Dome should be downgraded in this category.

With the above changes incorporated into the rankings to more accurately reflect the intent of the siting guidelines, and the Nuclear Waste Policy Act, it is obvious that Richton comes out a distant fifth in this comparison.

3.0 TECHNICAL ISSUES

In this chapter we discuss a number of the principal technical issues that arise in the course of applying the siting guidelines. These technical issues are often closely interrelated; nevertheless it seems appropriate from an organizational standpoint to summarize our concerns and comments according to various subjects, realizing that there may be overlap with other sections. This chapter contains eight subsections. Each subsection follows a similar structure, beginning first with a summary of the general themes and issues that we believe are particularly important in the evaluation of the Richton site. Following this general discussion there is a compilation of a number of detailed comments, some of which may be related to the general issues raised and others which may pertain to the accuracy of information provided in the Draft EA or to the validity of particular analyses or conclusions.

3.1 HYDROLOGY

This section pertains primarily to the groundwater hydrology at or in the vicinity of Richton Dome. It has been recognized by the National Academy of Science, the Environmental Protection Agency and the Nuclear Regulatory Commission that groundwater transport is the most likely means for unexpected releases of radionuclides from a nuclear waste repository (This does not mean that there may not also be other release modes in particular circumstances, such as human intrusions or accidents during the operational phase of the repository. These issues are also discussed in the present comment document). An adequate understanding of a site's geohydrology must take into account other related phenomena or processes such as dissolution, geochemistry, faulting, etc. Thus there is considerable overlap between the discussion in this section and the discussions in subsequent sections. Our principal concerns regarding the geohydrology of the Richton site are summarized in the following paragraphs.

The Draft Environmental Assessment for Richton presents an inadequate treatment of the groundwater hydrology in the neighborhood of Richton Dome. In fact not only does it fail to present such an analysis, but by its use of

regional and highly irrelevant data and analyses, it illustrates that DOE may fail to appeciate the variability that is expected to be found in the sediments and in groundwater conditions in the neighborhood of the Richton Dome. First, one should note that the depositional environment leading to the accumulation of such sediments was extremely variable and the character of individual formations may change significantly from one point to another. Second, the development of the salt diapir as a piercement structure has had a significant perturbing effect on the pre-existing sediments and sediment structure. It is well known that the adjoining sediments have frequently been upturned and faulted as a result of salt dome growth, and that such perturbations can lead to the development of pathways for the movement of fluids, whether they be hydrocarbons or groundwater. Third, dissolution processes concurrent with or following the growth of a salt dome have a secondary disturbing effect on the sediments and can lead to additional permeable zones or other flow pathways. None of these factors are adequately addressed in DOE's analysis.

DOE has relied on the primarily regional description of the aquifers in the course of its evaluations of the Richton Dome. Such a regional analysis only provides regional information and cannot be applied to individual locations, especially those containing significant disruptive influences such as a large dome. Estimates of groundwater travel time based on such analyses are meaningless.

In the Draft Environmental Assessment and related studies, DOE has failed to provide some of the information upon which a useful understanding of near dome hydrology could be developed. In particular no groundwater dating studies have been carried out even though these have the potential to verify or contradict DOE's hypotheses about groundwater travel times from the immediate vicinity of the dome.

DOE has characterized the dome as a highly stable geologic structure in which there is little or no evidence for significant past dissolution. While this latter topic is discussed further in later sections, we note here that DOE has failed to consider the perturbing influence of the extensive boring program carried out in the 1940's to investigate the caprock at Richton. While drillers logs are available for most or all of the boreholes, very little information is available on their precise location and on the method by which they were plugged or abandoned. In particular, considering plugging practices for mineral exploration holes at that time, it is likely that the casings were removed and that only the uppermost part of the hole was plugged with cement, if at all. The result is that there are now a number of penetrations connecting productive, near-surface aquifers with the caprock and, in certain cases, with the salt itself. It will be practically impossible to determine the effect of these and other near dome boreholes on the local hydrology at present or even during site characterization. However, any discussion of hydrology should note this relatively recent development of conduits connecting water sources with the dome. The end result is that analyses and hypotheses which are based solely on a consideration of long term geologic processes may not adequately characterize the groundwater situation in the vicinity of the dome at present.

Only a gross idea of aquifer characteristics is in hand. These characteristics have been identified using techniques which should not be acceptable for a project of this importance. At all times it must be recognized that the controlling factor in contaminant transport to the environment is the zone with highest permeability - even if it is small. Gross generalizations are inappropriate.

DOE should not arbitrarily divide the aquifer systems into only two aquifers - an upper consisting of Miocene through Holocene, and a lower in the Eocene consisting of Claiborne and Wilcox units. It is considered that sufficient data are available to differentiate the numerous aquifers present within these "upper" and "lower" aquifer. In using the limited "upper" and "lower"

aquifer, the DOE is also using regional data and applying it generically to the Richton Dome Site. Specific data should be used. Additionally, it is apparent that the DOE has generically characterized the "upper" aquifer as being an unconfined aquifer. A detailed differentiation of this aquifer will give evidence that this is not the case. Further, although the DOE does not differentiate the many aquifers located in the "upper" and "lower" aquifer groups, the DOE does completely differentiate each stratigraphic unit with detailed description. Available data should be applied uniformly.

When developing modeling parameters, the DOE has not sufficiently addressed:

1- possibility of "short circuits" for ground water, such as faults, shear zones and ancient erosional features.
2- presence of numerous aquicludes.
3- numerous aquifers within the "upper" and "lower" aquifer systems.
4- presence of high Cl- anomalies and migration of same.
5- use of extrapolated data for application generically at Richton.
6- potential water bearing zones within DOE's confining units.

The individual entries that follow represent a number of specific comments on DOE's discussion of hydrology.

- The unexpected release of radioactive material from a monitor well, HT-2M (Fenske, 1973) [1], at the Tatum Dome Nuclear Test Facility emphasized the residual uncertainties that may exist even after a site has been reasonably or thoroughly characterized. Contamination flowing from this well originally had been injected into another well, HT-2, 300 feet southeast and supposedly down hydrologic gradient from the monitor well. Additionally, a plugged instrument well, E-14 (BOG)[2] is presently leaking brines at the surface. E-14 is located atop the dome and within 500 feet of an emplacement well where two nuclear devices, Salmon and Sterling, were detonated in Tatum Dome. These two phenomena, to date unsatisfactorily explained, further emphasized hydrologic uncertainties and complexities found in and around salt domes.

*1 Fenske, P.R., 1973, NVO-1253-6, Project Report No. 25.

*2 Unpublished Field Observations, Mississippi Bureau of Geology.

- With respect to Section 3.3.2.1.1, the data base used to divide the stratigraphic column into geohydrologic units appears to be sparse and is applied in a subjective manner. This section is based in part on conclusions presented in ONWI-356, ONWI-456, and ONWI-484. An examination of these documents reveals several points relating to the insufficient quality of the data base.

  1) ONWI-356 discusses the determination of permeability values derived from sidewall cores. The section entitled "Intrinsic Permeability vs. Porosity" (p.57) notes that the permeability studies from Mississippi had "sufficient data points to attempt the statistical analysis...only for the Wilcox Group" [emphasis added]. The next sentence states that the statistics for the Wilcox Group show little correlation. These statements suggest that the sample is too small to make statistically reliable conclusions and the low correlation for the Wilcox Group sample proves that the conclusions are not statistically reliable.

  2) The Draft EA references ONWI-484 as its source for values of vertical conductivity shown in Table 3-16. ONWI-484 (p.65) states that "Hydraulic conductivities and porosities were estimated from the material descriptions of the units." The derivation of values of conductivity from general lithology descriptions does not provide a realistic value upon which groundwater decisions can be based.

  3) ONWI-456 is referenced in the Draft EA (Table 3-16) as a source for the values of horizontal conductivity. The values of conductivity listed in ONWI-456 do not reflect the reported values. The conductivity values in ONWI-456 appear to have been modified to fit the author's definition of the unit. For example, Table 2-1 of ONWI-456 lists a reported conductivity of 1-20 m/day for the Vicksburg and Jackson Groups. The value listed in the Richton Draft EA by the DOE for the same units is

0.0003-0.03 m/day. The Draft EA defends these very low values by stating "This range is more realistic for a confining unit and considers that the available data represent more productive and permeable zones within this unit." No justification is given for these assumptions.

- With respect to Section 3.3.2.1.1, based on existing literature, the "upper aquifer" should not include the Citronelle Formation. None of the previously published literature we have reviewed include the Citronelle with the aquifers in the Miocene section. For example Newcome (1975)[1], Gandl (1982)[2] and Boswell (1979)[3] all consider the Citronelle a separate, unconfined aquifer.

*1. Newcome, Roy, Jr., 1975. The Miocene Aquifer System in Mississippi. U. S. Geological Survey, Water-Resources Investigations 46-75. 3p.

*2. Gandl, L.A., 1982. Characterization of Aquifers Designated as Potential Drinking Water Sources in Mississippi. U. S. Geological Survey, Water-Resources Investigations. Open-File Report 81-550. 90p.

*3. Boswell, E.A., 1979. The Citronelle Aquifers in Mississippi. U. S. Geological Survey, Water-Resources Investigations 78-131. 1p.

- With respect to Section 3.3.2.1.1, the "upper aquifer" section is not subdivided in this section of the Draft EA (p.3-73) because "It is not possible to distinguish between the Pascagoula, Hattiesburg, and Catahoula Formations in terms of lithologic characteristics in the subsurface (Newcome, 1975, p.1)." The Catahoula Formation was identified as a separate unit on the geologic cross section of the Richton Dome, Figure 3-10, p.3-21. Furthermore, in section 3.2.7.1 the Tatum Limestone Member of the Catahoula Formation has apparently been identified. In section 3.2.3.2.2, the lithologies of the Hattiesburg, Catahoula, and the Tatum Limestone Member of the Catahoula are identified and described. The Tatum Limestone is described as "a distinct, fossiliferous basal limestone member" (p. 3-18). The DOE should decide whether these units are or are not lithologically identifiable.

- With respect to Section 3.3.2.1.1, previous authors have cited evidence that would indicate the Miocene/Oligocene section of the "upper aquifer" should be considered a series of aquifers rather than one geohydrologic unit. Numerous authors such as Bentley (1983)[1], Taylor, et al (1968)[2] and Shows, et al (1966)[3] have pointed out the discontinuous and lenticular nature of the Miocene aquifers. Bentley (1983, p.18) states "Because of the discontinuous and lenticular nature of sand, clay, marl, and limestone deposits in the Catahoula Sandstone and Pascagoula and Hattiesburg Formations, both units are in fact aquifer systems consisting of many individual water-bearing zones." Bentley continues by stating "poor to fair hydraulic connection exists between water at different depths". Brown (1944, p.11)[4] points out the lack of good hydraulic connections in the Miocene section by stating "Seemingly there is no hydrologic connection between the supplies from the Hattiesburg formation and the Catahoula sandstone." Therefore, we believe that these data strongly suggest a need to subdivide the "upper aquifer" unit.

*1. Bentley, C.B., 1983. Preliminary Report of the Geohydrology Near Cypress Creek and Richton Salt Domes, Perry County, Mississippi. U. S. Geological Survey, Water-Resources Investigations Report 83-4169. 40p.

*2. Taylor, R.E., C.P. Humphreys Jr. and D.E. Shattles, 1968. Water for Development in Covington, Jefferson Davis, Lamar, Lawrence, Marion, and Walthall counties, Mississippi. Mississippi Research and Development Center. Jackson, Ms. 87p.

*3. Shows, T.N., L.W. Broussard, and C.P. Humphreys, Jr., 1966. Water for Industrial Development in Forrest, Greene, Jones, Perry, and Wayne Counties, Mississippi. Mississippi Research and Development Center, Jackson, Ms. 72p.

*4. Brown, G.F., 1944. Geology and Groundwater Resources at the Camp Shelby Area. Mississippi State Geological Survey, Bulletin 58. 72p.

- With respect to Section 3.3.2.1.1, the Vicksburg and Jackson groups are considered in the Draft EA to be a single confining unit. However, Gandl (1982, p.22)[1] has illustrated the Oligocene Aquifer as extending into northern Perry County. Gandl also notes that water is produced from solution channels in limestone beds as well as sand beds with conductivities varying between 3 and 60 feet per day. Gandl considers only the Bucatunna Formation a confining unit in the Vicksburg group and the Yazoo Clay a confining unit in the Jackson group. We believe that the grouping of units of the Vicksburg and Jackson groups as a confining unit is overly simplified and should be reevaluated.

  *1. Gandl, L.A., 1982. Characterization of Aquifers Designated as Potential Drinking Water Sources in Mississippi. U. S. Geological Survey, Water-Resources Investigations Open-File Report 81-550. 90p.

- With respect to Section 3.3.2.1.1, the storativity values cited for the Upper Claiborne unit are from the relatively remote Madison, Smith, and Rankin counties. We believe these values are not necessarily valid due to facies changes between Richton and the test wells.

- With respect to Section 3.3.2.1.1, in this section the Lower Claiborne is described as a confining layer. The next sentence then states "Too few data exist to define the hydrologic characteristics of the Lower Claiborne." If too few data exist to determine the hydrologic characteristics then there is no basis for defining the Lower Claiborne as a confining unit.

- With respect to Section 3.3.2.1.1, the Claiborne group abuts the salt stock at repository level. The Claiborne is therefore one of the most important groups in the stratigraphic column. The Draft EA presents a very limited amount of information on the hydrologic characteristics of the group. For example, the Lower Claiborne discussion contains only two sentences and presents no values for any hydraulic parameters. We believe this lack of information in the Draft EA is a serious omission and the discussion of the Claiborne group should be greatly expanded.

- With respect to Section 3.3.2.1.1, ONWI-456 (p.17; referenced on p.3-71, Table 3-16 of the Richton Draft EA) indicates that the Upper Claiborne is considered "one vertically continuous aquifer". Included in this "aquifer" is the Cook Mountain Formation which Gandl (1982, p.3)[1] has illustrated as being a confining unit which is approximately 200 feet thick. Newcome (1966[2] and 1976[3]) also considered the Cook Mountain a confining unit. These data suggest that the Upper Claiborne is poorly understood and should have been evaluated further during area characterization.

*1. Gandl, L.A., 1982. Characterization of Aquifers Designated as Potential Drinking Water Sources in Mississippi. U. S. Geological Survey, Water-Resources Investigations Open-File Report 81-550. 90p.

*2. Newcome, Roy Jr., 1966. Ground-Water Resources of the Pascagoula River Basin, Mississippi and Alabama. U. S. Geological Survey, Water-Supply Paper 1839, Part K. 36p.

*3. Newcome, Roy Jr., 1976. The Sparta Aquifer System in Mississippi. U. S. Geological Survey, Water Resources Investigations, Open-file Report 76-7. 3p.

- With respect to Section 3.3.2.1.1, the Naheola Formation is considered an aquifer by Gandl (1982, Table 1)[1]. The Naheola is not mentioned in the Draft EA, but ONWI-456 places it in the Midway confining unit. ONWI-456 (p.24) also states that "This assumption will be reviewed to determine if the Midway unit is appropriately represented." If additional information has been acquired since publication of ONWI-456, the new information should be referenced. If there has been no more information acquired, then the Draft EA should state that the "confining unit" status is based on assumed data.

*1. Gandl, L.A., 1982. Characterization of Aquifers Designated as Potential Drinking Water Sources in Missssippi. U. S. Geological Survey, Water-Resources Investigations Open-File Report 81-550, 90p.

- With respect to Section 3.3.2.1.2, ONWI-525 is referenced as a source of data from which groundwater flow directions were determined. An examination of ONWI-525 reveals that flow directions appearing in the Draft EA are based on monitoring of observation wells only from October, 1982 to September, 1983 (p.1). We believe this is an insufficient length of time to obtain reliable information on the potentiometric surfaces of these units. Furthermore, anomalous changes were recorded from wells in the Cook Mountain, Kosciusko, and Hattiesburg Formations (ONWI-525, p.16-17). The reasons for these changes are unknown and not explained in the Draft EA. These changes should be considered in the groundwater modeling.

- With respect to Section 3.3.2.2, ONWI-456 (p.25) states that the "hydraulic head contour map for the upper aquifer unit closely corresponds with the topography and drainage pattern as is typical of unconfined aquifer systems." Taylor, et al (1968)[1], in their discussion on water levels and movement, note the presence of artesian aquifers in the Miocene section. They state (p.65): "Water levels range from more than 20 feet above land surface to more than 250 feet below land surface..." We believe the model does not accurately represent the aquifers in the Miocene/Holocene section because artesian aquifers are grouped together with unconfined aquifers into one geohydrologic unit.

*1. Taylor, R.E., C.P. Humphreys and D.E. Shattles, 1968. Water for Industrial Development in Covington, Jefferson Davis, Lamar, Lawrence, Marion, and Walthall Counties, Mississippi. Mississippi Research and Development Center Bulletin, 87p.

- With respect to Section 6.3.1.1.1, the Draft EA (p.6-71) states that there is no evidence to suggest vertical groundwater movement along the caprock-salt stock interface and flank interface at Richton Dome. We feel that there is significant data that does suggest upward flow of groundwater along the interfaces. Bentley (1983)[1] has suggested that upward groundwater flow along the dome flanks has caused the high salinity groundwater associated with the Richton Dome. The Base of Freshwater Map in ONWI-120 (Figure 14-5) illustrates a high centered over the Richton Dome. Bentley (1983) also notes the presence of solution cavities at the caprock-salt stock interface of Richton and Cypress Creek Domes. Mullin (1982)[2] considers the pressurized fluids in the Richton interface "an active hydrologic system" (p.53). We believe all of these data suggest upward groundwater flow along the dome flanks and the statement in the Draft EA suggesting no upward flow should be changed or deleted.

*1. Bentley, C.B., 1983. Preliminary Report of the Geohydrology near Cypress Creek and Richton Salt Domes, Perry County, Mississippi. U.S. Geological Survey, Water-Resources Investigation Report 83-4169, 40p.

*2. Mullin, C.W., 1982. Geology of the Caprock and Salt Stock of the Richton Salt Dome, Masters Thesis, Georgia Institute of Technology, 156p.

- With respect to Section 6.3.1.2.2, the travel time calculations fail to consider the open salt stock-caprock interface. If radionuclides should escape the salt stock they would enter the interface which is characterized by Mullin (1982)[1] as an active hydrologic system. If the fluids in the interface move vertically upward, as we believe they do, the radionuclides could be redistributed as high as the Miocene section. Without having to cross confining beds, the travel time to the accessible Miocene aquifers would be considerably reduced.

*1. Mullin, C.W., 1982. Geology of the Caprock and Salt Stock of the Richton Salt Dome. Masters Thesis, Georgia Institute of Technology. Atlanta, Georgia. 156p.

- Structural features such as jointing, faulting, and folding (local) would be expected as a result of the intrusion of the salt stock. Any of these could modify groundwater flow near the dome, yet they are not discussed in the Draft EA. Gera (1972, p. 3572) states "diapirs [salt] would present much more serious hydrologic problems, because of the complexity of groundwater circulation in the adjacent fracture zone and because of the possibility of temporary permeability of the salt mass in correspondence with shearing zones".

3.2 DISSOLUTION

Dissolution or the potential for increased future dissolution is a critical consideration in the evaluation of any repository in which salt will be the host rock. It is especially critical in the case of a salt dome such as Richton because the potential for dissolution exists not only at the top of the salt deposit but also at the flanks which may be relatively close to the repository itself. Much evidence exists to call into question DOE's apparent lack of concern over the potential for dissolution at Richton Dome.

DOE indicates in the Draft Environmental Assessment that Richton ranks first, or in the most favorable position, among candidate salt domes on the issue of dissolution. The primary evidence DOE relies on in comparing Richton with Vacherie, for example, is the presence or absence of surface collapse features associated with dissolution. Such features depend on the depth of the dome and on the question of whether primary interest is in dissolution at the top of the dome or along the flanks. We regard the absence of surface indications of dissolution at Richton, if indeed borne out by further field investigations, as providing practically no useful information and certainly no conclusive evidence pertaining to the occurrence of this phenomenon at Richton Dome. In fact, we believe that evidence will indicate a real problem with dissolutioning at Richton.

Chloride anomalies in the groundwater over and in the vicinity of Richton Dome may indicate dissolution of salt. DOE apparently favors the interpretation that such dissolution has been very slow and is only detectable by the high dissolved salt concentration because the groundwater system at depth is essentially stagnant. There is no evidence to support this hypothesis. It is equally probable that the elevated concentration of chloride is due to a significant ongoing dissolution process. It is noteworthy that DOE has consistently labeled the northern portion of Richton Dome, where the caprock is very thin and where significant dissolution may be occurring, as "not explored."

DOE assumes that the flank of the dome (such as at the repository level) is protected by a caprock type or clay-like sheath that further retards the interaction of groundwater and the salt and, hence, prevents dissolution. First, there is very little evidence about the nature of the flank. It is unknown whether a clay sheath exists or if it envelopes the entire dome. Second, it is not clear how the flank will behave in the presence of excavation and heat-induced mechanical forces from the repository. Since DOE does not know the nature of the flank, they have been unable to estimate its mechanical properties and, hence, whether it might become more permeable as a result of the development of a repository.

Zones of preferential groundwater movement and dissolution contained within the salt stock itself are not given adequate attention. These are discussed further in Section 3.4.

The caprock at the top of the Richton dome contains vuggy zones and some larger voids. These may indicate current dissolution processes.

There is a fallacy in looking for collapse structures as the primary indication of dissolution. It is possible for salt removed by dissolution to be replaced by salt flowage from elsewhere in the deposit, leaving the overall structure of the deposit relatively constant, despite the ongoing movement of the salt contained within it. If the rate of the process is too high, it can indeed lead to brittle fracture of the salt. This possibility has not been discussed by DOE.

The effect of induced dissolutioning by changing of the surrounding groundwater regime as a result of a cone of depression (caused by pumping of groundwater) is not addressed. Furthermore, there is no discussion of the effects of previous boreholes on the possible development of new dissolution processes at Richton, despite the fact that old boreholes have led to the development of extensive dissolution in other salt deposits.

In addition to the comments and general themes outlined above we offer the following specific comments on this subject.

- "The evidence for dissolution at Richton is as strong as for the other domes. Richton should not be given a favorable position in this regard." This quotation is from W. L. Fisher, Director of the Texas Bureau of Economic Geology, in a letter to J. O. Neff, dated May 7, 1981, review of ONWI-109. The Bureau of Geology and other commentors have repeatedly made similar comments. DOE, on the other hand, continues to insist that there is little or no evidence for dissolution at Richton. They base their argument solely on the absence of collapse features, which are interpreted at Vacherie and Cypress Creek. There is no argument that the presence of a possible collapse feature over a dome is "suggestive" of salt stock dissolution. The argument is that DOE ignores other suggestive features such as chloride anomalies, porous conditions at the salt caprock contact, and porous conditions within the caprock, all of which appear to be present at Richton.

- Kreitler and Dutton, in their assessment of the hydrologic stability of two Texas salt domes, Gyp Hill and Oakwood, concluded that the two "represent two end members of a spectrum," Gyp Hill exhibiting ample evidence of recent salt dissolution by meteoric waters and Oakwood showing no evidence of current dissolution (Origin and Diagenesis of Caprock, Gyp Hill and Oakwood Salt Domes, Texas, Texas Bureau of Economic Geology, Report of Investigation No. 131, 1983). Four other salt domes, Vacherie and Rayburn's in Louisiana, and Richton and Cypress Creek in Mississippi, were compared to the two Texas domes. Their conclusions were that Rayburn's was comparable to Gyp Hill, Vacherie was comparable to Oakwood, and that Richton and Cypress Creek are located between the two extremes, indicating that the potential for dissolution at Richton, as well at at Cypress Creek, was greater than that of Vacherie.

- The Earth Technology Corporation in a technical memorandum to the Office of Nuclear Waste Isolation, dated October 3, 1984, has concluded that the gypsum veins filling fractures in the anhydrite caprock at Richton Dome are indications for lack of dissolution. However: "The lack of gypsum or calcite in either the matrix or the fractures of the Oakwood anhydrite section documents the long-term impermeability of the caprock. Fracture fillings of calcite, gypsum, barite and sulfur in anhydrite sections (for example, Richton Dome), or rim gypsification (Sulfur Dome) indicate a more permeable caprock" (Kreitler and Dutton, 1983, page 55). Another "indication" of the impermeability of the caprock at Richton, Earth Technology stated, "--- none of the sulfur exploration borings had loss of drilling circulation in the anhydrite caprock, although such losses were common in the limestone caprock". This statement is in error and, even if it were true, would not necessarily represent a true assessment of the permeability of the anhydrite caprock at Richton. Data contained in the Bureau of Geology files (data furnished to Earth Technology) indicate a loss of circulation in the Masonite Corporation #1 well at a depth of 768 feet. Top of anhydrite is picked at 763 feet. Also, the J. B. Cantrell #1 well experienced a loss of circulation at 833 feet, one foot into the anhydrite. Eighteen sulfur test wells drilled at Richton reported loss of circulation, usually at or within 1-2 feet of the calcite/anhydrite contact. Other sulfur test well data concerning caprock permeability that should be considered are:

  1. Masonite Corporation well #4 lost circulation at 870 feet, only 21 feet above the top of salt.

  2. Masonite Corporation well #9 lost circulation at 728 feet, only 8 feet above the top of salt.

  3. L. E. Ridgeway "B" well #6 lost circulation at 736 feet, only 14 feet above the top of salt.

4. L. E. Ridgeway "B" well #8 lost circulation at 724 feet, only 24 feet above the top of salt.

These data show permeable zones very near the top of the salt stock, but what the old test well records do not show are permeable zone indications such as formations taking drill fluid but not losing circulation, zones contributing fluids to the hole, etc. As an example, during drilling of MRIG-9, drilling records do not indicate loss of circulation within the anhydrite caprock. However, hydrologic testing of the caprock section indicated water was entering the well from two zones, 612-620 feet and 572-588 feet below ground level. (ONWI-178, Well Completion Report, DOE-Masonite Site MRIG-9, page 3-3). Top of the anhydrite is picked at 577 feet.

A number of authors on the origin of salt dome caprock have concluded that the existence of a permeable zone consisting of granular anhydrite at the salt/caprock contact is an indication of recent dissolution. ((1) Goldman, Origin of the Anhydrite Caprock of American Salt Domes, USGS Professional Paper 175-D, 1932-33; (2) Martinez, Salt Dome Caprock - A Record of Geological Processes, Fifth International Symposium on Salt-Northern Ohio Geological Society; and (3) Kreitler and Dutton, Origin and Diagenesis of Caprock, Gyp Hill and Oakwood Salt Domes, Texas, Texas Bureau of Economic Geology Report of Investigations No. 131, 1983). There are others. Granular anhydrite at the salt/caprock contact has been reported in two of the wells penetrating salt at Richton, DOE/MRIG-9 (8-foot zone) and L. E. Ridgeway 'B' No. 8 (7-foot zone). The presence of this zone can be inferred in a third well, L. E. Ridgeway 'B' No. 6, where a 10-foot section of core was missed (not recovered) at the salt/caprock contact 750-760 feet). A fourth well, J. W. Pope No. 2, reported a cavity from 1,520-1,522 feet, but did not penetrate salt. Top of anhydrite in the Pope No. 2 well is picked at 1,111 feet, which indicates porosity well within the anhydrite. These wells are distributed over a large area of the dome; therefore the porous condition of the salt/caprock contact cannot be interpreted to be an isolated and insignificant occurrence.

Kreitler and Dutton concluded that the existence of a cavity at the salt/caprock interface may or may not indicate ongoing dissolution, depending on the condition of the brines in that zone. Cavities containing normally pressurized brines such as those found at Gyp Hill were believed to indicate current dissolution, and cavities containing abnormally pressurized brines as found at Grand Saline and Oakwood were believed to indicate earlier dissolution events that were later followed by an episode of domal uplift trapping fluids at the interface. None of the wells penetrating salt at Richton, including MRIG-9, have reported abnormally pressurized brine at the salt/caprock interface.

- DOE has placed undue emphasis on collapse or subsidence features in the overburden as indications of recent dissolution. Collapse or subsidence of overburden does not necessarily have to accompany dissolution. Subsidence could be expected in cases where long term dissolution occurred after domal growth had ceased or where rates of dissolution exceeded that of domal growth. In cases where rate of domal growth exceeded, or was nearly equal to rate of dissolution, subsidence or collapse would not be expected. Earth Technology has concluded - "There is no evidence of vertical movement indicated by three Pleistocene terraces deposited on either side of both Thompson and Bogue Homo creeks. There is no detectable elevation difference between equivalent terraces on either side of the dome, suggesting there has been no differential uplift since Pleistocene time." (ONWI-484, page 51). Yet in the same document, page 26, - "Three terrace levels were identified in Bogue Homo Creek but only two levels were mapped in Thompson Creek. Data are presently insufficient to correlate terraces between these drainages. Without the benefit of more regional mapping and absolute-age dates it is impossible to confidently correlate these terraces with others mapped in Mississippi or Louisiana, or to estimate rates of uplift." This is another case where DOE has interpreted "absence of evidence" as "evidence of absence."

- With respect to Section 3.2.5.7, it is assumed in the Draft EA that the lack of collapse features at Richton indicates a very slow rate of dissolution. The Draft EA has not discussed the possibility that a lack of collapse features may be the result of a rate of diapiric rise that is greater than the rate of dissolution. Active diapiric rise of a salt spine and active dissolution can explain many of the geologic and hydrologic features at Richton Dome. For example, the chloride anomaly (ONWI-120) could be a result of diapirism providing hydraulic connections between the open salt-stock caprock interface and the surrounding aquifers via faulting and shearing. If this is true, the rates of dissolution should be reviewed.

- With respect to Section 3.2.5.7, several possible sources of saline water are discussed for the chloride anomaly associated with Richton Dome. Each implies either undesirable hydraulic connections, "yet to be defined" components of the groundwater system, or else cannot be supported by available data. The possible sources are discussed below:

  1) "leakage of deeper, more saline water" - this source of saline water suggests hydraulic connections between the deeper, more saline water and the Miocene age aquifers. If this should be the source of the saline water, then upward movement of these waters along the sides of the dome via fault and/or fractures a potential pathway for water to enter the Miocene aquifers. If these faults and fractures exist, then groundwater travel times could be greatly accelerated and the ability of the confining units to retard groundwater flow could be altered.

  2) dissolution of halite from Richton Dome - this source suggests direct groundwater-salt stock contact and/or a hydraulic connection with the fluids in the open salt-caprock interface. Mullin (1982)[1] notes that the interface is open and concludes that this is evidence of "salt stock dissolution by an active hydrologic system". This origin of the chloride anomaly is an interpretation, especially when there is active diapirism

located within the anomaly (we believe there is evidence of active diapirism) to provide fractures, faults and other hydraulic connection to the Miocene section.

3) leakage from a faulty brine disposal well into a shallow aquifer - The evidence to support this as a source of saline water is sparse. The only salt water disposal well within the anomaly is Hinton #2, located in the central region on the eastern edge of the anomaly. If this well was the source of the saline anomaly, it would be necessary for the contaminated water to move up the flow gradient to form the northern extension of the anomaly. Shows, et al, (1966)[2] constructed a contour map of the base of the fresh-water section which is similar to the maps included in ONWI-120. The map in Shows, et.al, pre-dates much of the oil and gas drilling in the area, thus eliminating many possible sources of pollution. Bentley (1983, p.33)[3] states "no disposal of wastes or brines in the vicinity of either dome has been identified". Bicker (1972)[4] does not indicate any salt water disposal wells operating in Perry County at the time the report was published. Based on these data this source of saline water cannot be supported.

*1. Mullin, C.W., 1982. Geology of the Caprock and Salt Stock of the Richton Salt Dome, Masters Thesis, Georgia Institute of Technology, Atlanta, Georgia, 156p.

*2. Shows, T.N., W.L. Broussard, and C.P. Humphreys, Jr., 1966. Water for Industrial Development in Forrest, Greene, Jones, Perry, and Wayne Counties, Mississippi, Mississippi Research and Development Bulletin, 72p.

*3. Bentley, C.B., 1983. Preliminary Report of the Geohydrology near Cypress Creek and Richton Salt Domes, Perry County, Mississippi, U. S. Geological Survey, Water-Resources Investigations Report 83-4169, 40p.

*4. Bicker, A.R., 1972. Salt Water Disposal Wells in Mississippi, Mississippi Geological, Economic and Topographical Survey, Information Series MGS-72-4, 92p.

3.3 GEOCHEMISTRY

Geochemical properties of the soils and rocks in the vicinity of a repository can provide an important barrier to the movement of radionuclides as well as to the behavior of the engineered repository system itself. In this subject area DOE has made many assumptions on the basis of generalized Gulf Coast salt dome data and has applied this generically to Richton. This is an unacceptable approach to such a vital subject area. For example, DOE has ignored the presence of carbon dioxide and its potential for increasing radionuclide migration in the form of carbonate complexing. It has also ignored vegetative changes that are found along lineations that may indicate geochemical processes relevant to the performance of a repository. Chloride anomalies have not been adequately analyzed and insufficient geochemical analysis of groundwater has been undertaken to provide important evidence concerning the flow patterns in the neighborhood of the repository.

Specific comments on the subject of geochemistry also include the following.

- As stated on page 3-50 of the Richton Draft EA, ". . . no detailed data on the mineralogy and chemistry of sediments near the dome are available. Only limited water-chemistry data are available, as described in Section 3.3.2.3," the Department of Energy (DOE) has no conclusive geochemical data for the Richton Dome site. The majority of the data comes from generic sources such as other salt domes and the WIPP site. By extrapolating this data, DOE tries to provide an analysis of the Richton Dome. Geochemical data like all other scientific data cannot always be extrapolated and must be taken on a case-by-case situation.

- DOE has failed to consider many of the thermochemical effects caused by the waste emplacement. It is noted that brine migration is going to be toward the canister, but it is not noted that this heat could cause chemical reactions creating some toxic and corrosive chemicals. The migrating brine contains several chemical species such as NaCl, H_2O, $CaSO_4$ (in ionized form) and other reactive species which could combine

in a detrimental fashion. Gamma energy produces free ions such as chlorine and fluorine which can combine with hydrogen to produce the corrosives hydrochloric and hydrofluoric acid. Toxic gases such as chlorine and fluorine could also be produced. Although these facts are not mentioned, they definitely warrant consideration in the light of waste package life and employee health.

- The Draft Environmental Assessment did not consider the change in equilibria caused by the thermochemical effects. Solubility, kinetics and even dissolution can be influenced by the change in heat and pressure.

- With respect to Section 7.1.1.2, The following statements are found in the Richton Draft EA, pages 7-16 and 7-13, respectively:

  "At the Richton Dome, the clays incorporated into the sheath that envelopes the dome and the clay-bearing sediments adjacent to the dome may also act as a sorptive barrier to radionuclides in groundwater."

  "At the Richton site, the groundwater along the likely flow path is highly saline and not suited for irrigation or human consumption."

  Seismic evidence suggests a structurally anomalous zone around the dome, but no data have been collected supporting its composition. It has not been proven that this "sheath" enveloping the dome contains clays nor has it been proven that it envelops the entire dome; therefore, the assumption that it will act as a natural barrier for radionuclides passing through to the accessible environment is unfounded. The above statement regarding the high salinity of the groundwater around the dome suggests that groundwater can flow between the dome and its surrounding "accessible environment".

3.4 DOME GEOMETRY AND STABILITY

Salt-dome structures (such as at Richton, Cypress Creek, and Vacherie Domes) are more complex than bedded-salt deposits (such as at the Davis Canyon, Lavender Canyon, Deaf Smith County, and Swisher County sites). Generalized logs from 1940's sulfur exploration holes and a few scattered petroleum drillholes provide Richton's limited subsurface data base. This general lack of data is evidenced by the apparent simplification of the diapiric structure (even though such features are typically very complex) and the repeated changes in domal configuration that have occurred from one program document to the next. Substantial work is needed to determine geometry and geologic structure before it can be concluded that Richton Dome is suitable as a potential repository site.

There also appears to be significant uncertainty regarding the recency of diapiric movements at Richton Dome. Geologic mapping of surficial deposits suggests that Quaternary uplift may have occurred and that movements may even be occurring at present. Even the subsurface, geologic cross-sections constructed to date suggest doming of the overlying Quaternary Citronelle Formation. Although DOE appears to have discounted the significance of these data, there seems to be enough evidence to indicate that considerably more study of the Quaternary uplift rate is needed before Richton Dome is considered suitable as a repository site.

Even though the Richton Dome is a piercement dome intruded into a complex system of sedimentary deposits, which themselves were deposited in an extremely variable environment, little effort has been made to secure the same level of data as exists at other less complicated bedded salt sites. This lack of on-site evidence is apparent throughout the Draft EA, and is a shortcoming in all evaluations.

The actual geometry of the boundary of the dome is not well understood. Program estimates have changed frequently in the published reports. Not only is this relevant to the nature of the host rock in the vicinity of the repository, but it also illustrates the fact that at greater depths the nature of the dome is not well understood either. It is possible that there are traps for oil or gas that may be exploited in the future. Such traps frequently occur where the sediments are perturbed near the flanks of a dome.

The interior structure of the dome is practically unknown. Salt domes frequently contain "shear zones" where sediments have been entrapped during the growth of the dome in the form of multiple spines. DOE's assertion that such structures are generally found only at the flanks of the dome and are not to be expected in interior domes (as opposed to coastal domes) is simply not correct. In fact the general contour of the top of Richton Dome suggests that there may be two or more main lobes that grew independently, in which case such an anomalous shear zone may intersect the dome transversely just south of its center. This would be very significant from the point of view of a repository. There has been very little evidence collected on this subject.

There is also stratigraphic evidence that the diapiric growth of the dome may be continuing. The geomechanical argument that the cessation of sedimentation in the Gulf Interior Region has eliminated the forces necessary to cause continual dome development only represents a theory. The theory is more convincing for small domes that are very tenuously connected, if at all, to the mother salt beds. Richton Dome is sufficiently large that it may continue to grow even though other interior domes have stabilized.

Throughout the Draft EA the reassuring impression is given that shear zones and other anomalies, which could create severe engineering problems during the site characterization and repository development and operation (e.g., gas leaks or blowouts, brine seeps, back slabbing and possibly flooding), are <u>not</u> a major concern because:

a) These phenomena are predominantly associated with edge anomalies, whereas the repository will be centrally located, within the dome.
b) If such geohydrologic anomalies cannot be avoided, the ensuing problems could certainly be managed and controlled by proven engineering practices.

These arguments are open to serious question. First, experience at domal salt mines indicates that interior domes and coastal domes do not differ substantially in morphology and structure; interior domes may not be as high a flooding risk, but they are not risk-free. In fact, the interior domal Carey Salt Mine in Winnfield Dome in northern Louisiana was lost in 1965 when it flooded for the second time. According to Martinez and Wilcox (Martinez, et al 1976): "A water-filled cavernous zone exists at the salt/caprock contact. Water gradually penetrated the upper 400 feet of salt until it broke through into the mine. The resulting flood drained enough water from the cavernous basal caprock to allow the overlying quarry to remain dry for 2 1/2 years while the cavernous zone was refilled. Evidence of surface subsidence suggests some collapse in the cavernous zone as well."

*Martinez, J.D. and R.E. Wilcox, 1976, An Investigation of the Utility of Gulf Coast Salt Domes for the Storage or Disposal of Radioactive Wastes, page 313 through 320, ORNL sub 4112-25.

Second, according to Kupfer (1980, 1976), Central Anomalous Zones (CAZ) shear fault features are common and pervasive in the salt domes mined to date. These are intradomal geologic anomalies consisting of relic interbedded sediments (shale and limestone), which were sheared to nearly vertical attitudes by differential uplifting of separate spines of salt during domal uplift. They contain usually pressurized gases and trapped brines and may connect to boundary shear zones. The whole Edge Anomalous Zones (EAZ) can be and are usually avoided in mining, but the CAZ transect the dome and cannot be avoided. In fact, the major blowout, collapse and water problems noted at some of the 5-Islands salt mines are clearly associated with the CAZ: At Avery Is. continual grouting controlled to some extent water inflows, but the

central dislocation zone which crosses the shaft pillar remains a major risk. Similarly, at Belle Isle a shaft has been completely lost to flooding, major fires and explosions have crippled operations, and both shaft and mine leaks have been a costly and perennial problem. Some formation water inflows were indeed associated with the boundary shear zone at Belle Isle, but both shaft inflows and mine inflows have been attributed to the CAZ. The Weeks Is. mine has also suffered from gas and fluids problems associated with a well-documented CAZ.

Hence, major hazards to site characterization, ESF and repository development and operation and to the long-term hydrogeologic stability of a domal salt repository can be anticipated. There are numerous indications (such as parallel lineaments, drainage patterns, minor faults aligned with the domal axis; the caprock contours and the bi-lobate salt isopach structure) that Richton Dome is likely to have a major central anomalous shear zone - separating two main spines of salt and possibly transecting the dome at the repository horizon (LETCO, Vol. IV A, 1980).

Although the Draft EA makes the point that site characterization activities will clarify the presence and nature of such geologic anomalies, they are difficult to detect and delineate by surface soundings and easy to miss in drilling, because of the typical geometry (nearly vertical, narrow and sinuous) of such features. As mining practice has proven, even though geologic anomalies are recognizable to trained miners and can be often avoided underground, CAZ and EAZ features pose major control problems (technical and cost) and often jeopardize personnel and the mine itself.

It is also a truism that water leakage between top alluviums and caprock into the salt dome commonly leads to serious -- and often uncontrollable -- flooding through the shafts. Indeed, out of 17 shafts in 5 salt dome mines, 11 have had leakage through seals. In a third of these shafts, annual

maintenance is required. A major flood occurred in 1970 at the Cominco (Sask., Canada) potash mine due to ducting of groundwater by freeze holes behind the shaft, which were penetrated during routine shaft maintenance. Dangers of flooding would be increased at Richton because of the presence of large numbers of aquifers above the dome.

In the last decade, in spite of control efforts utilizing proven technology, at least two Louisiana salt dome mines have been irreparably destroyed by flooding or abandoned due to potential flooding and other problems (Winnfield Dome, Jefferson Island, Belle Isle). (Mining Engineering, May 1984, page 530) Two of the other mines (Avery Island and Weeks Island) have expensive and extensive water control programs in place. (Mining Engineering, May 1982, page 574)

In view of this evidence, Table 6-4 (Mitigation of Potentially Adverse Environmental Problems) and Chapters 4 and 5 describing engineering controls to be utilized for risk management appear to be unjustifiably optimistic projections. The main caveat remaining is the "absence of evidence" should not be construed as "evidence of absence" of potentially major adverse conditions at the Richton Dome site.

We believe there is evidence to suggest active spinal movement within Richton Dome. An examination of data collected in ONWI-120 demonstrates a number of indications of diapiric rise within the same geographic area. The lines of evidence are briefly discussed below:

(1) The structural contour map of the Richton Dome caprock (Werner, 1984, Figure 2) illustrates caprock at high elevations in Sections 26 and 27.

(2) Gypsum veining occurs only in the caprock on the "highs" as illustrated on the structural contour map in Werner (1984,, Figure 2). Since the age of formation of the caprock is unknown and may be presently forming at the interface, the veining suggests late upward movement causing the fracturing of the caprock. The veining is present in the structural high located in Sections 26 and 27.

(3) The stream drainage map in ONWI-120 (Figure 13-51) illustrates radial drainage patterns developed over the structural high in Sections 26 and 27.

(4) The structural high and radial drainage are both located within the Miocene surface outcrop which is surrounded by Citronelle or younger sediments. The outcrop pattern is typical of domal uplift.

(5) If there is diapiric movement associated with the structural high in Sections 26 and 27, then faulting would be expected to accompany the deformation. ONWI-120 (Figure 13-59 and 13-57) illustrates two normal faults that occur on the eastern and western sides of the structural high. If the upthrown and downthrown sides of these faults are plotted, then the structural high in Sections 26 and 27 could be interpreted as a horst. The eastern fault location appears to coincide with a north-south trending lineament (ONWI-120, Figure 13-55) and the linear eastern boundary of the Miocene outcrop (ONWI-120, Figure 13-54) Therefore the eastern fault suggests post-Citronelle displacement, and therefore post-Citronelle diapiric movement.

(6) ONWI-120 illustrates the top of very saline water is at a higher elevation in the vicinity of Sections 26 and 27 (ONWI-120, Figure 14-6). An explanation for the high elevation of the very saline water is that shearing, jointing and faulting associated with dome spine movement has formed hydraulic connections between the salt stock interface and the Miocene aquifers over the stock.

We believe these data not only strongly suggest post-Citronelle uplift, but also provide an explanation for a number of geologic features present in this area of the dome.

Further detailed comments on the issue of the geometry and stability of the Richton Dome are given below.

- Major uncertainties exist about the size, shape, and caprock characteristics of Richton Dome. The elimination of the northwestern extension of the dome by Earth Technology Corporation has significantly altered the mapped shape of the dome from that presented by LETCO in the Area Characterization Report (ACR). A recent high-resolution seismic reflection study of Vacherie Dome (see ONWI-520) has indicated that that dome may be 20% smaller than expected from the LETCO ACR information. Such work has not been done on Richton Dome, and its exact size and shape remain uncertain. The nature of the salt-caprock interface and the diapir-sediment interface are poorly known at Richton Dome, and very little is known about the presence of caprock or a shale sheath on the flanks of the dome at repository depth. Thus serious questions remain regarding geologic and hydrologic characterization of the dome, especially about possible short-circuit pathways and mechanisms for radionuclide transport or potential for salt dissolution.

- DOE has apparently ignored the well documented existence of porous permeable inclusions of foreign material in Gulf Interior Salt Domes. For example, section 6.2 reads "Under the conservative assumption that fluid movement occurs through interconnected pores, the minimum groundwater travel time from the edge of the engineered-barrier system to the dome flank has been calculated to exceed 100,000 years." We have serious concerns as to how inclusions of foreign (often porous and permeable) material typically present in salt domes, will be located prior to mining and how the known existence of these foreign inclusions were weighted in ranking dome verses bedded salt. Since salt dome mines may be flooded via these pathways, an accident analysis should be performed on how the flooded mine would be evacuated of waste. Quoting from A.I. Levorsen's "Geology of Petroleum," "Fragments of sandstone are found occasionally, one of the larger pieces being a thin vertical slab in the salt dome on Avery Island, Louisiana. This is only 10 inches or less in thickness, but it extends over 80 feet vertically and along a strike 75 feet horizontally." In addition to potential inflows during operations, these zones compromise the long term hydrologic isolation of the repository.

- There are no fewer than five interpretations of the geometry of Richton Dome in Bureau of Geology files. Probably more than these five could be found if a detailed literature search were conducted. Three of these, showing a cross-sectional area of the salt stock, appear frequently in publications relating to the nuclear waste program. The Karges (1975) interpretation, appearing in the regional characterization studies and other pre-area characterization publications, shows a cross-sectional area of 4,500 acres at the -2,000 foot level. The LETCO interpretation, appearing first in area characterization reports, shows a cross-sectional area of 5,585 acres, also at the -2,000 foot level. This is an increase of nearly 20% over Karges' interpretation. The LETCO interpretation appears in all publications subsequent to area characterization reports until the Earth Technology Corporation interpretation appeared in BMI/ONWI-555. Earth Technology interprets a cross-sectional area at -2,000 feet of 4,910 acres. This latest figure is a decrease of 12% from the LETCO interpretation and an increase of 8% from that of Karges. Earth Technology's version is used in the Draft Environmental Assessment and is apparently the final version accepted by DOE.

  Comments on dome geometry are not intended to criticize any of the three interpretations, nor are they intended to select an interpretation preferred by the Bureau of Geology, but rather to point out the inherent complexity of salt dome geometry and also the difficulty in accurately characterizing size, shape and surrounding geology. Salt at the northern extremity of Richton Dome was interpreted to be from -2,000 to -3,000 feet by LETCO. Earth Technology has interpreted salt in this area to be -10,000 to -13,000 feet (BMI/ONWI-555) - a considerable variation! Earth Technology's interpretation is based on seismic data not available to the state.

- George D. DeBuchananne, U.S. Geological Survey, commented on the complexity of domed (diapiric) salt geology, as compared to the relative simplicity of near-horizontally bedded salts of the west, in a letter to Colin Heath, dated March 7, 1981. DeBuchananne's comments were general

in nature, yet clear, concise, and to the point. Because of the interest generated by this letter, John B. Robertson, USGS, wrote a letter of clarification, though by no means a retraction, to Robert Morgan, DOE, dated April 6, 1983. In spite of the letter of clarification, DOE-NPO directed ONWI to conduct a formal review of the DeBuchananne letter. ONWI assigned this task to Ertec (Earth Technology Corporation) by a letter from Owen Swanson, ONWI, to Kenneth L. Wilson, Ertec, dated July 3, 1982. The Earth Technology review resulted in a technical report, BMI-ONWI-511, dated August 1984, and received by the Bureau of Geology November 21, 1984, only one month prior to the issuance of the Draft Environmental Assessments. The timing and contents of this report are somewhat mysterious and smacks of a "geologic" review based on predetermined conclusions.

BMI-ONWI-511 severely criticizes and attempts to refute the DeBuchananne letter by dissecting it line by line. From BMI-ONWI-511, "Complexity of structure is totally irrelevant unless it has the potential to adversely affect the hydrologic system and to compromise waste isolation.", page 18. A potential to adversely affect the hydrologic system and to compromise waste isolation cannot be determined unless the geology and hydrology of a site can be accurately characterized. This, Earth Technology acknowledges. What they seemed to ignore is that a differential of 20% in cross-sectional area at projected repository horizon by two separate investigators is significant and emphasizes the complexity in characterizing dome geometry.

Other comments concerning BMI/ONWI-511, although not directly concerning dome geometry, address the broader criterion of Rock Characteristics. "A salt stock is simple and predictable because it is a homogenous, wholly recrystallized, and relatively pure mass of dry salt.", page 4. Two salt mines in salt domes - Avery Island, Louisiana, and Grand Saline, Texas were visited in recent years, and both mines exhibited features in the underground excavations that would tend to cast doubt on this statement. A sylvite-rich zone was encountered in the southeast portion of the Kleer

mine at Grand Saline, which caused mining to be discontinued in that area. The sylvite zone is described in ONWI-117, volume I, page 2-54. An observation of the area revealed the halite to be much finer grained, more loosely compacted, and structurally weaker than what was observed elsewhere. The sylvite-bearing halite wall had slumped and brines were seeping from the slump area. An anomalous upturned sandstone zone was observed in the Avery Island mine. This zone, which had been correlated from the upper mine level to a lower level, is considered to be a shear zone or boundary between two separate spines. Brines were observed seeping from this zone. It could be argued that undesirable conditions existing in one dome are not necessarily expected to be present at another dome. To advance this argument would of course be a contradiction to the spirit of the technical position taken by DOE concerning sites within a single geohydrologic setting - "The reason behind selection of one site per setting is that sites in similar settings --- could be subject to a common mode of failure."

- The presence of zones of mineralogical and structural change, water content change, and the presence of anomalous shear zones could substantially reduce the "usable" area at projected repository level, particularly at a site with finite lateral boundaries such as a salt dome.

- Nothing in the Draft Environmental Assessments nor in the references indicates if studies have been done to predict what effect anomalous zones, if present, would have on host rock properties such as thermal conductance, permeability, and creep closure. Nothing in the Draft Environmental Assessments nor in the references indicates if studies have been done to detect the presence of such zones prior to site characterization. It would be impossible to locate anomalous zones, such as the sylvite zone in Grand Saline, prior to site characterization in-situ testing. The mine operator and consultants believe this zone is an indication that mine workings are approaching the edge of the salt stock; however, they also admitted that they did not know the exact location of this edge. Grand Saline is a dome that has been extensively

explored for over one hundred years. It may be possible to assess the potential for boundary shear zones by studying the configuration of the top of the salt stock and caprock. (Kupfer, Transactions, Gulf Coast Association of Geological Societies, vol. 24, 1974, page 206.)

- All three major interpretations of Richton Dome discussed earlier display features that could easily be hypothesized to reflect two or more major spines of movement. The significance of encountering a shear zone while constructing a repository has been glossed over by DOE contractors. "--- such problems are accommodated more or less routinely in normal mining operations. Although shear zones will be of little consequence ---", (BMI-ONWI-511, page 20). It should be pointed out here that what DOE is proposing at Richton Dome is not a salt mine, but a permanent high level nuclear waste repository constructed in mined salt.

- With respect to Section 3.2.5.6, the third paragraph of this section is not clearly written. The first sentence states that "diapirism occurred from the late Cretaceous to the early Oligocene". Later, in the same paragraph, the Draft EA states: "Growth of Richton Dome ... appears to have ended prior to the early Pliocene." The next sentence then states: "Between late Oligocene and early Pliocene times, dome growth appears to have occurred..." The Draft EA should clearly state when diapirism ended, if it has, and give evidence for stating this.

- With respect to Section 3.2.5.6, the Draft EA states that dome growth appears to have ended and cites the lack of deformation of the Citronelle Formation as evidence to support this inference. The geologic map of Richton Dome (ONWI-298) illustrates Miocene sediments surrounded by the Plio-Pleistocene Citronelle Formation or younger sediments. This outcrop pattern occurs over the dome and is typical of domal uplift. Futhermore, cross-sections contained ONWI-120 illustrate apparent deformation of the Hattiesburg-Citronelle contact near the area of Miocene outcrop. These cross-sections also illustrate outliers of Citronelle at higher elevations

in the area of Miocene outcrop. In a discussion of salt domes, Billings (1972)[1] states "...if Pleistocene or Recent gravels on the dome are uplifted relative to their position in the surrounding region, it is obvious that the salt has been active during the Quaternary". Therefore, we believe that although sedimentation has ceased in the Gulf Interior Region, vertical pressure exerted by overlying sediments combined with the relatively low specific gravity of salt favors continued upward migration of the salt in Richton Dome.

*1. Billings, M.P., 1972. Structural Geology, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 606p.

3.5 FAULTING, SEISMICITY, AND TECTONICS

A number of interrelated issues are addressed in this section. Faulting has long been recognized as an important issue in repository siting, both because it may be indicative of the geologic instability of the repository site or host formation and also because faults themselves may provide pathways for preferential groundwater movement where they may otherwise perturb normal groundwater flow. The presence of old faults even if they are not still active may cause local groundwater flow conditions to differ significantly from those assumed in regional models. Seismicity, which may or may not be related to the movement of identified faults, gives further information concerning the geologic stability of the region. Microseismic monitoring can detect geologic processes such as continued salt diapirism that are relevant to an evaluation of a salt dome site. Tectonic information provides an understanding of the geologic framework within which the site is evolving and large scale regional processes that may affect its suitability.

We believe there has been inadequate investigation of surface indications of faulting in the vicinity of the Richton Dome. The existence of lineations and faults that show up at depth through seismic profiles should have been more thoroughly pursued. The Draft Environmental Assessment gives the mistaken impression that the absence of evidence of faults provides favorable information. However, the degree of investigation does not warrant this conclusion. It should be noted that the State of Mississippi had requested funds for a microseismic network and those funds were denied by DOE and thus that information is not available.

In fact, it has been noted that the region has been undergoing uplift in the Quaternary and that furthermore there are important regional fault systems in the vicinity of the dome. We wish to call to DOE's attention the additional specific comments that follow on parts of the Draft Environmental Assessment that pertain to this subject.

- The discussion of seismicity in the Richton Dome Draft Environmental Assessment grossly underrates the potential for earthquakes activity at that site. This is due at least partially to the inadequate and incomplete treatment of the subject in previous program documents (e.g., Area Characterization Reports, ONWI-109). The issue is important because under the Draft EA category Tectonics, of which seismicity is a major part, Richton Dome ranks second (among the five nominated sites in Chapter 7) in the post-closure and tied for first place in the pre-closure guidelines. These ratings are improper for the reasons discussed below. On the issue of seismicity, Richton can be differentiated from the other salt domes within its geohydrologic setting and from the other Potentially Acceptable Sites.

- Seismicity is discussed in several subsections in nearly every chapter of the Draft EA (e.g., 3.2.5.1, 4.1.1.1.11, 5.2.1.1, 6.3.1.7, 6.3.3.4, 6.4.2.6, 7.2.1.7, and 7.3.3.1.4). These discussions cross-reference each other and contain the same, limited facts upon which the conclusions are drawn. These facts are: (1) the nearest earthquake epicenters are 75 km distant to the SSW and NNE of the site; (2) these earthquakes are not within the tectonic setting within which Richton Dome is located, which is described as being the Mississippi Salt Basin; (3) the maximum shaking experienced historically at the site was MMI V to VI from the 1811-1812 New Madrid earthquake series; (4) a cited reference (Nuttli and Herrmann, 1978) estimates the maximum random earthquake for the region might be of magnitude 5.3, giving MMI up to perhaps VII and accelerations on the order of 0.14g; (5) no seismically active tectonic structures within the geologic setting are indicated; and (6) no known surface ruptures have been associated with earthquakes.

  This handful of facts, on which seismicity at Richton Dome was evaluated, can be shown to be inadequate as follows: (1) The two earthquakes cited in the Draft EA as the nearest epicenters to Richton Dome should be called the nearest known epicenters. As there are no seismographs in operation to adequately cover southeastern Mississippi, the lack of earthquake activity can be attributed in part to this lack of instrumentation.

Earthquakes of magnitudes below 3, minor but evidence of active seismic activity nonetheless, could be occurring within the salt basin and simply are not being detected. For example, the Tennessee Earthquake Information Center (TEIC) commenced operation of their Memphis Area Regional Seismic Network (including the only network station in Mississippi, in the northwestern part of the state) in late 1979. They soon began detecting epicenters in northern Mississippi at a rate much greater than that shown in any period of the previous historic record. (See TEIC Quarterly Seismological Bulletin, vol. 5, no. 1, p. 37, for a map showing 6 epicenters in northern Mississippi in the period October 1980 - March 1984. The map also shows two earthquake epicenters in southeastern Mississippi and one in southwestern Alabama). The installation of seismographs in southeastern Mississippi would result in the detection of more earthquakes than are being observed at present. Since several of Mississippi's known earthquakes are scattered randomly across the state, activity closer than 75 km from Richton Dome could be found. (2) The two closest earthquakes may not be within the Mississippi Salt Basin, but they are located on geologic structures bounding the basin to the north and to the south. As stated previously, the lack of known earthquakes in the salt basin can be attributed in part to an absence of seismic instruments in the area. It may be argued that two of the known Mississippi earthquakes <u>are</u> located within the Mississippi Salt Basin (the tectonic setting of Richton Dome). The 13 November 1927 earthquake at Jackson was described by Docekal (1970) as follows: MMI IV. "Dishes rattled and objects fell from tables at Jackson, Mississippi. At Meridian, Mississippi, a few people felt houses shake and doors rattle. The earthquake was also reported from Jefferson Davis, Rankin and Simpson Counties." The second known earthquake located within the salt basin is the 28 June 1941 shock at Vicksburg. The Mississippi Salt Basin is not devoid of earthquake activity. Another factor that should be considered is that earthquakes in the eastern U.S. are felt over much wider areas than are earthquakes of equivalent magnitude in the western U.S. Thus, the significant cluster of earthquake activity at the northern boundary of the salt basin should be treated with much more concern in the Draft EA.

(3) The fact that the site experienced shaking as great as MMI V to VI from earthquakes as distant as the 1811-1812 New Madrid series should be given more credence than was done in the Draft EA. This is particularly true when considering the great uncertainties about the exact nature and locations of those shocks. (4) The terms of uncertainty used to describe the maximum expected earthquake point out the lack of consideration given to description of a Design Basis Earthquake (DBE) for the Richton Dome site. The 4th Draft Richton EA admitted in subsection 5.2.1 that the DBE has "yet to be established." The Draft EA reviewed here attempted to hide this gap in the needed background information by simply deleting the sentence with that admission from subsection 5.2.1.1. The maximum expected earthquake that is mentioned is not described as being the DBE. Nuttli has stated "I didn't expect as big (an earthquake) as 1811-1812 but if it happens, and a big earthquake can happen in the future, it could be of magnitude of 7.6 right now, or bigger as time progresses."[1] (5) The statement that no structural features in the geologic setting are seismically active is an opinion that can be challenged. The cluster of earthquake epicenters in northwestern Mississippi may be associated with either or both the buried Ouachita Tectonic Belt or the "zone of abrupt dislocation of basement" that is shown on the Basement Map of North America, 1967, by American Association of Petroleum Geologists and U.S. Geological Survey, Peter T. Flawn et al. The cluster of earthquakes in east-central Mississippi and neighboring Alabama may be associated with the buried Appalachian Tectonic Belt. The cluster of earthquakes in southeastern Mississippi and neighboring Alabama may be associated with the Pickens - Gilbertown Fault Zone, which can be spotted on surface geologic maps by a series of faults disrupting upper Eocene sediments. The Wiggins Anticline/Hancock Arch and the Mobile Graben also may be associated with known earthquake epicenters. The 1927 Jackson earthquake epicenter is plotted on the Jackson Dome. The lack of seismic instrumentation and seismological work is responsible for a great degree of uncertainty in correlating these structures and (insufficiently) known earthquakes. (6) The paucity of surface ruptures associated with

earthquakes or cutting Quaternary sediments is due to: (1) the extreme difficulty of identifying such ruptures in unconsolidated sediments overlain by thick soils and vegetation, and (2) the small number of searches made for such evidence. Dr. Richard L. Bowen, University of Southern Mississippi, a former NWTS program subcontractor, mapped the surface geology around Richton and Cypress Creek domes. He found a possible fault at the surface near Cypress Creek Dome (see letter from Alvin Bicker, Bureau of Geology, to John Green, MDET, dated June 26, 1981). This fault and others known by Dr. Bowen have not been properly investigated in the NWTS program. Thus, the statement that no surface ruptures exist is erroneous.

*1. Dr. Otto Nuttli, An Overview of the National Earthquake Problem, Procedings of the National Earthquake Conference, Breckenridge Concourse Hotel, St. Louis, MO June 2-5, 1984.

- Such doubts about the adequacy and accuracy of the background information regarding seismicity lead to grave concerns about the assumptions made in Chapter 6 of the Draft EA in the discussion of the suitability of Richton Dome for site characterization and for development as a repository. Subsection 6.3.1.7 states: "Finally, it is assumed that the available record of historical earthquakes is sufficiently complete with respect to large earthquakes to predict whether or not seismicity will affect post-closure performance. This assumption is reasonable based on (1) the stability of the spatial patterns of seismicity in the Gulf and Midcontinent through time, and (2) the absence of geologic evidence of Quaternary fault movement." Actually, the assumption is totally invalid as demonstrated by the previous discussion. While there are persistent clusters of activity, especially in the New Madrid Seismic Zone, around Memphis, in northwestern Mississippi, and in southeastern Mississippi, there is a wide scatter of epicenters elsewhere throughout Mississippi and in adjacent states. One significant example can illustrate this point. The most severe known earthquake with an epicenter in Mississippi, the 16 December 1931 Batesville earthquake, is spotted in several sources to the

northeast of its location as indicated on Figure 3-16 of Richton Dome Draft EA. A location around 34.1°N, 89.8°W, places the earthquake out of the cluster in northwestern Mississippi. This shock reached MMI VI-VII and was felt over an area of 65,000 square miles. So little is known about Mississippi seismicity that there is no certainty that any location within the state is free from seismic activity. The record of historical earthquakes cannot be considered complete enough to form a basis for predicting large earthquakes. The largest earthquakes on record in the area are the 1811-1812 shocks of the New Madrid series. They represent the only such event occurring in the period covered by historical records (approximately 200 years). Geologic evidence indicates a recurrence interval for large earthquakes in the New Madrid area greater than the length of this historical record. David P. Russ of the U.S. Geological Survey (1979, Late Holocene faulting and earthquake recurrence in the Reelfoot Lake area, northwestern Tennessee: Geological Society of America Bulletin, vol. 90, no. 11, p. 1013) states: "Thus historical data and the sediments in the trench record a history of three earthquakes near the trench site strong enough to liquefy sediments and generate faulting. Carbon-14 dates obtained on fresh-water shells indicate that the trench sediments have a maximum age of about 2,000 radiocarbon years. A recurrence interval of 600 yr or less is suggested for large earthquakes in the New Madrid area." Finally, regarding the statement in subsection 6.3.1.7 that the assumption quoted is justified by the "absence of geologic evidence of Quaternary fault movement" -- the absence of <u>evidence</u> does not prove the absence of Quaternary <u>faulting</u>.

- In Chapter 2 of the Draft Richton Dome EA discussion of the site selection process, it is apparent that the seismic risk at Richton Dome was underrated and that it was not considered a differentiating factor among <u>dome</u> sites. This error of omission overlooks the proximity of Richton Dome to the poorly understood Phillips Fault System. Also, Richton Dome is closer to the Pickens-Gilbertown Fault Zone, the site of an active cluster of earthquakes.

- The map of earthquake epicenters in Figure 3-16 is reasonably accurate, with the exception of the location of the 1931 Batesville earthquake and the omission of some recent earthquakes (12 October 1980 in northeastern Mississippi, 15 February 1981 on the Mississippi-Alabama border, and 25 April 1983 in northwestern Mississippi).

- Figure 4-8, Proposed Location of Microseismic Monitoring Stations, is incomplete due to the omission of the Pickens-Gilbertown Fault Zone. Other faults were shown, and the extension of the array to the north (alluded to in the text) was designed to give coverage of earthquake activity along the Pickens-Gilbertown Fault Zone. The source cited on the figure (Ertec, 1983) is not listed in the Chapter 4 references.

- With respect to Section 3.2.3.1, the Richton Draft EA states: "The contact between the Citronelle and Hattiesburg Formations exhibits relief in excess of 60 meters (200 feet) ... and is probably erosional." We suggest that the relief on the Citronelle-Hattiesburg contact could also be a result of post-Citronelle faulting associated with the diapiric rise of the salt stock. Faulting of the Miocene outcrop area over the salt stock has been discussed in ONWI-120[1]. Paulson (1980)[2] discusses evidence for post-Citronelle faulting in the area adjacent to the Miocene outcrop area. Since there is little site-specific data, we believe that post-Citronelle faulting should be included as a possible cause of the large amount of relief associated with this contact.

*1. Gulf Coast Salt Domes Geologic Area Characterization Report-Mississippi Study Area, ONWI-120, vol.6, Technical Report, July 1982, Figures 13-59 and pages 13-146 through 13-160.

*2. Paulson, D.L., Jr., (1980), Topographic Profiles and Stream Profiles, in Draft Area Characterization Report of the U. S. Gulf Coast Salt Dome Basins, First Draft, Appendix D, pp. 18-19.

- With respect to Section 3.2.5.1, the discussion of the Phillips Fault contains the following two errors:

  1) The Draft EA states that " the fault is beneath the Louann Salt". We interpret this to mean that the fault does not cross-cut the Louann Salt. Paulson and Pescatore (1979)[1] present evidence for movement throughout the Jurassic, stating "Variations in thicknesses on all isopach maps indicate structural movement, at least until the end of the Jurassic."

  2) Oxley, et al (1968)[2] is referenced as stating that fault movement ended prior to the end of the Jurassic. An examination of the reference indicates that this interpretation is incorrect. Oxley et al (p.43) states only that the fault "moved intermittently during Jurassic time". There is no statement suggesting when movement ceased. Furthermore, Paulson and Pescatore present evidence for post-Jurassic movement of the fault. This section of the Draft EA should be changed to more accurately state the uncertainty of time of movement on the Phillips Fault and correctly state the interpretations of the authors of referenced materials.

  *1. Paulson, O.L. and F.T. Pescatore, Jr., 1979. Effects of the Phillips Fault Zone on Subsurface Jurassic Sediments and Petroleum Production in Jasper County, Mississippi. The Mississippi Mineral Resources Institute, Report of Investigations No. 792, 15p.

  *2. Oxley, M.L., E. Minihan, and J.M. Ridgeway, 1968. A Study of the Jurassic Sediments in Portions of Mississippi and Alabama, in Dinkins, T.H., Jr. (ed.), Jurassic Stratigraphy of Mississippi, Mississippi Geological, Economic and Topographical Survey, Bull. 109.

- With respect to Section 3.2.5.1, most of the information contained in ONWI-120,[1] such as lineament maps and drainage pattern maps, have not been evaluated in terms of indication of Quaternary fault movement. As lineaments and drainage patterns may reflect faulting, they should be evaluated in the Draft EA. Additionally, the faulting of Citronelle sediments proposed by Paulson (1980)[2] is not discussed.

*1. Gulf Coast Salt Domes Geologic Area Characterization Report-Mississippi Study Area, ONWI-120, vol. 6, Technical Report, July 1982.

*2. Paulson, O.L., Jr., 1980. Topographic Profiles and Stream Profiles, in Draft Area Characterization Report of the U. S. Gulf Coast Salt Dome Basins, First Draft, Appendix D, pp.18-19.

- With respect to Section 3.2.5.1, the DOE should take a position either for or against faulting in the area over the salt stock and support that position throughout the Draft EA. The Draft EA describes faulting and the resulting displacement in the area over the salt stock, but the last sentence of this section then disclaims the previous discussion on "over dome" faulting. The reference used to disclaim the area characterization work (Werner, 1984)[1] is an internal communication. Relatively inaccessible internal communications should not be used as reference material as they do not easily allow public review.

*1. Werner, M.L., 1984. Stratigraphy and Structure Over Richton Dome-Data and Findings Relevant to the Issue of Dissolution, in The Earth Technology Corporation, Technical Memo (EW-ONWI-82-7562) to Ken Wilson, Jim Miller and Gerald Allen, dated September 12, 1984, 18p.

- With respect to Section 3.2.5.2, in the discussion of regional faults that may be a source of earthquakes, the Draft EA states: "No historical earthquake has had associated surface fault rupture." Fisk (1944)[1] notes that a surface fault occurred in April, 1943 within a well defined fracture zone. Therefore, documented accounts of surface rupture resulting from faulting within the region are available.

*1. Fisk, H.N., 1944. Geological Investigations of the Alluvial Valley-Lower Mississippi River, Mississippi River Commission, Vicksburg, Mississippi, p.66.

- With respect to Secton 3.2.5.2, no mention is made in this section of the Wiggins Anticline as a potential source of seismicity. Burnett and Schumm (1983)[1] have cited evidence for Quaternary uplift along the structure. The lines of evidence include: 1) resurveys across the Wiggins by the National Geodetic Survey which consistently show uplift, 2) convexities of stream channel profiles, 3) deformed Quaternary terraces, and 4) stream patterns indicative of uplift. These data support earlier work by Williams (1967)[2] who noted deformation of the Citronelle-Miocene contact in George County, Mississippi. Based on a structural geomorphological analysis of modern stream channel orientations, Owen, (1982)[3] came to the conclusion that the Wiggins is caused by wrench faulting. All of these investigations indicate Quaternary deformation and should be considered a potential source of seismicity.

*1. Burnett, A.W. and S.A. Schumm, 1983. Alluvial-River Response to Neotectonic Deformation in Louisiana and Mississippi, Science, vol. 222, no. 4619, pp.49-50.

*2. Williams C.H., 1967. George County Geology and Mineral Resources, Mississippi Geological, Economic and Topographical Survey, Bulletin 108, pp.79-87.

*3. Owen, G.C., 1982. Regional Geomorphic Expressions of Subsurface Structure on Poorly Consolidated Surface Sediments, Coastal Mississippi, Oxford, Mississippi, 65p.

- With respect to Section 4.1.1.1.11, the proposed locations of microseismic stations illustrated in Figure 4-8 do not cover the area of the Wiggins Anticline. Burnett and Schumm (1983)[1] have cited the following evidence to indicate Quaternary uplift: 1) resurveys across the Wiggins by the National Geodetic Survey which consistently show uplift, 2) convexities of stream channel profiles, 3) deformed Quaternary terraces, and 4) stream patterns indicative of uplift. The conclusion of Burnett and Schumm

support earlier work by Williams (1967)[2] in George County, Mississippi. Williams indicates that the Citronelle Formation - Miocene contact reflects uplift along the Wiggins. Owen (1982)[3] suggests that the Wiggins is a result of wrench faulting. His conclusion is based on a structural geomorphological analysis of modern stream channel orientations. All of these data strongly indicate Quaternary tectonism along the Wiggins.

*1. Burnett, A.W. and S.A. Schumm, 1983. Alluvial-River Response to Neotectonic Deformation in Louisiana and Mississippi. Science, volume 222, no. 4619, pp.49-50.

*2. Williams, C.H., 1967. George County Geology and Mineral Resources. Mississippi Geological, Economic and Topographical Survey, Bulletin 108, 227p.

*3. Owen, G.C., 1982. Regional Geomorphic Expressions of Subsurface Structure on Poorly Consolidated Surface Sediments, Coastal Mississippi, Master's Thesis, University of Mississippi, Oxford, Mississippi, 65p.

- The Draft EA (page 3-28) states that the earthquake locations used in their evaluation were "based on felt reports and sparse intrumental coverage". The extent of the "sparse instrumental coverage" is not discussed. Bograd (1981) states that measurements from calibrated seismographs have been available only for the past 20 years. Earlier reports are based on felt occurrences. Nuttli (1979, page 67) states that "even 200 yr is far too limited a time to present information on large earthquakes which may have a return period of as much as 10,000 yr". Therefore, the data base for southern Mississippi is very limited. Furthermore, the record of earthquakes based on reported occurrences are a function of the population available to record such events. The instrumental data base is much too limited to arrive at valid conclusions and the record of felt earthquakes may be very incomplete.

- The Richton Dome is located along the eastern margin of the Mississippi Embayment. The embayment is a large scale synclinal feature characterized by extensive normal faulting. The New Madrid seismic zone is located at the northern extremity of the embayment. The most severe earthquakes in the contiguous United States have occurred in the upper region of the Mississippi Embayment. In 1811-1812 three of the most severe earthquakes known to history occurred in the New Madrid seismic zone (Coffman and von Hake, 1982). The Richton Draft EA describes the seismic potential as low at Richton. The Pickens-Gilbertown Fault Zone is located close enough to Perry County to be considered a potential source of seismic activity. The Draft EA notes that seismic events have been recorded in Clarke County, Mississippi, and at Melvin, Alabama, that may be associated with this fault zone. Copeland and others (1976, page 94) describe faulting in Clarke County, Alabama, along the Pickens-Gilbertown trend that may have displaced Quaternary age gravels. Therefore the Pickens-Gilbertown Fault Zone should be considered a potential source of earthquake activity.

  The Wiggins Anticline is present in southern Perry County. The Draft EA does not discuss the potential of seismic activity associated with this feature although there is evidence of Quaternary uplift. The work of Burnett and Schumm (1983) is especially convincing because they use four lines of evidence to prove Quaternary uplift. Their work supports the earlier findings of Williams (1967).

  The Draft EA states, in a discussion of regional faulting, that no historical earthquake has been associated with surface rupture. Fisk (1944, pages 33, 66) notes that a slight earthquake took place in St. James Parish in southeast Louisiana, between April 12 and 15, 1943. Fisk states that surface displacement could be traced for almost one mile. Fisk states that this fault can be traced to his Red River Fault Zone. Nuttli (1979, page 68) states "In the New Madrid seismic zone, there is no surface evidence of faulting...". Therefore the absence of fault scarps does not necessarily correlate with a paucity of earthquake activity.

Nuttli (1973, 1979) and Nuttli and Herrmann (1978) have noted the very large areas of damage associated with earthquakes in the Mississippi Valley. He cites the low attenuation of short period surface waves as the reason for these extensive areas of damage. Because Richton is located within the Mississippi Valley, earthquakes occurring even in relatively remote areas could have significant effects at the Richton Dome.

We believe that with respect to seismicity, these data are sufficient to show that DOE rated Richton Dome much higher than available scientific information warrants and further, these data establish that seismicity in the Richton area constitutes an adverse condition to guaranteed short and long term protection of human health and the environment.

References Cited

Bograd, M.B.E. 1981. Earthquakes in Mississippi, Mississippi Geology, Vol. 1, pp. 4-6.

Burnett, A.W. and S. A. Schumm. 1983. Alluvial-River Response to Neotectonic Deformation in Louisiana and Mississippi, Science, Vol. 222, No. 4619, pp. 49-50.

Coffman, J.L. and C.A. von Hake (eds.). 1982, Earthquake History of the United States. Publication 41-4, Reprinted 1982 with supplement, 1971-1980, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, and the U. S. Geological Survey. 208 p.

Fisk, H. N. 1944. Geological Investigations of the Alluvial Valley-Lower Mississippi River, Mississippi River Commission, Vicksburg, Mississippi.

Nuttli, O. W. 1973. The Mississippi Valley Earthquakes of 1811 and 1812: Intensities, Ground Motion and Magnitudes. Bulletin of the Seismological Society of America, Vol. 63, No. 1, pp. 227-248.

Nuttli, O. W. and R. B. Herrmann. 1978. State-of-the-Art for Assessing Earthquake Hazards in the United States, Report 12, Credible Earthquakes for the Central United States, U. S. Army Engineer Waterways Experiment Station, Miscellaneous Paper 5-73-1, 99p.

U. S. Department of Commerce. 1980. 1980 Census of Population, Vol. 1, Chapter A, Part 26. 38p.

Williams, C. H., Jr. 1967. George County Geology and Mineral Resources, Mississippi Geological, Economic and Topographical Survey, Bulletin 108, pp. 79-87.

3.6 GEOMECHANICAL AND GEOTECHNICAL CONSIDERATIONS

In the area of geomechanical and geotechnical considerations, the analyses presented in the Draft Environmental Assessment suffer from the same lack of site specific information and site specific modeling efforts as in other subject areas discussed previously. While generic data may be necessary, in particular cases its indiscriminant use simply because nothing better is present is an unacceptable and non-illuminating approach. We have the following specific comments.

- A summary of geomechanical data is provided in Table 3-4, page 3-41, entitled Estimated Geomechanical Characteristics of the Overburden - Richton Dome. Parameters addressed are density-porosity-water content, plasticity, undrained shear strength, compressibility, swelling potential, angle of internal friction for coarse-grained soil, maximum strain shear modulus, and soil corrosiveness. As the title implies, almost all data contained in this table are estimated. This lack of geomechanical data is surprising in view of the fact that LETCO drilled a series of 35 borings in Richton Dome Site Twenty-five borings, 100-200 feet in depth, were sampled by standard penetration (splitspoon) method, usually on 5-foot intervals. The remaining 10 borings were drilled to the caprock with standard penetration samples terminating 20-30 feet into the Hattiesburg Formation (ONWI-167, Shallow Boring Completion Report, Richton Dome, May 1981). There is no record of "undisturbed" samples (shelby tube) being collected, which would be necessary to obtain accurate geomechanical data. Some testing, such as Atterberg Limits, could have been conducted on samples obtained by the standard penetration method.

- With respect to Section 3.2.6.1.2, the Draft EA states: "Previous in-situ stress measurements in the salt stocks of the Gulf Coast Salt Dome Basin indicate an average vertical stress gradient of approximately 2.3×10^{-2} megapascals per meter (one pound per square inch per foot) (Hoek and

Brown, 1980, pp.95-101; Linder and Halpern, 1977, pp.1-6). A more detailed and quasi site-specific stress calculation by Tammemagi (1981, ONWI-394 p.20) for a geologic repository at a depth of approximately 580 meters (1,900 feet) indicates a stress level of 12.4 megapascals (1,798 pounds per square inch). Therefore, the stress magnitude at a depth of 648 meters (2,125 feet) at Richton Dome is estimated to be between 13 and 15 megapascals (1,885 and 2,175 pounds per square inch). Actual stress measurements in salt mines in the Gulf Coast Region have deviated from calculated values (Tammemagi, 1981, ONWI-64, p.21; Linder and Halpern, 1977, pp.4C, 1-6). These likely were due to the presence of the mine itself and should be distinguished from the in-situ stress field in an undisturbed salt dome."

The above information presents an estimation of the in-situ stress field in an undisturbed salt dome at the repository depth for Richton. However, Hoek and Brown base their calculations on data generated for the east coast (Appalachian) region; and Tammemagi's calculations are for broad regional areas, including many different depositional environments. Neither reference is specifically for salt domes.

3.7 RESOURCE PRE-EMPTION AND POTENTIAL INTRUSIONS

The evaluation of potential resources at a repository site is important from at least two distinct points of view. First, in deciding to develop a repository at a particular site, society needs to be aware of the resources whose future use may be preempted by such a development. If an inadequate characterization of such resource is provided then society may be forced to give up opportunities that it would otherwise wish to retain. Second, the presence of important resources at a site increases the likelihood that future societies might attempt to recover them, thereby possibly subjecting themselves to the risks associated with the buried nuclear waste. There are, in fact, methodologies such as whip-stocking/directional drilling which allow for well-bottoming in areas far removed horizontally in the subsurface from the surface location of the drill site. Thus it is not sufficient simply to indicate that the existence of the repository would be known by future generations. The discussions that follow are relevant to both of these considerations.

A technical review of the Draft Environmental Assessment for Richton, Mississippi, was conducted to evaluate discussions within these documents relating to the issue of mineral resource potential and future human intrusion. Although time constraints did not allow for a more-detailed review of the text and references concerning this issue, the initial review indicates that this issue has not been adequately addressed. Principal inadequacies or omissions in these discussions include: 1) the potential for brine production, 2) the potential for geothermal-geopressure utilization, 3) salt and petroleum production potential, 4) current and predicted trends in salt dome utilization, 5) the likelihood of future human intrusion resulting from credible salt dome exploration and/or development, and 6) compressed air storage.

The importance of Richton as a potential future resource should not be underestimated. It is a rather unique dome because of its large size and nearness to the surface. It might be particularly useful for various kinds of storage space.

DOE mentions the use of Richton Dome as a potential salt resource, but they largely discount its economic potential by concluding that other sources of salt of "comparable or greater value" are present elsewhere. Although this may be true at the present time, DOE seems to ignore the unique shallow nature of the Richton Dome that may some day act to increase its value as a salt resource as present sources become depleted.

Richton's potential as a hydrocarbon source should not be ignored. This is still a poorly understood subject. The reported occurrence of a 100-foot thickness of oil sand on the flanks of Richton Dome indicates that Richton's potential as a hydrocarbon source cannot be ignored.

The presence of the resources that have been cited above not only implies that society needs to make a conscious decision to forego future use of these resources, but it also introduces the important question of future human interference with the site. Future societies may decide to try to develop these resources and they may do so without fully appreciating the risks associated with the repository. A salt dome is a more "fragile" structure than other potential host rocks. For example, it has a very small lateral extent so that if the dissolution processes were to begin at the flank of the dome, perhaps as a result of human activities; there is a high probability that the waste would be affected. It is unlike bedded salt deposits which have a large lateral extent and are not so well exposed to ground water.

Furthermore, DOE has essentially ignored:

- oil and gas/LPG storage potential.
- future sulfur/other mineral production.
- the Griswold prediction that within 365± years there will be no virgin salt domes left.

- the potential for geothermal capabilities or storage of compressed air (for turbine generation of electric power).

- groundwater as a valuable resource or a problem because of the "current abundance" of surface and ground water at Richton.

Additional comments on this subject are given below.

- Evidence has been found of a reduction/oxidation front in the Hattiesburg/Pascagoula and Catahoula formations in Perry County (Russell, 1984)[1]. Russell concludes that this front provides a good environment for uranium ore deposits. This information should be included in assessing the mineral potential in the vicinity of the Richton Dome.

  *1. Russell, C. W., 1984, Hydrological/Geochemical Search for Sandstone - Type Uranium Deposits in Forrest, Jones, Perry, and Eastern Lamar Counties, Southeastern Mississippi, MMRI, Open File Report, 83-115, 39p.

- The mineral resource discussions in Chapters 3 and 7 of the dome site Draft EA's are incomplete. The discussion of salt production from domes in the Gulf Interior Region fails to point out the amount of salt produced as a function of U. S. production of salt (about 55%) and the economic benefits of dome salt production over bedded salt deposits (e.g. purity, production costs, transportation impacts). These Draft EA's contain no discussion of brine production potential or geothermal-geopressure utilization from salt domes, although the Draft EA reference for this section (Murray, 1983) does at least mention these possibilities for utilization.

- The Richton Draft EA states: 1) that "significant exploration" for petroleum resources has been conducted in the Richton Dome vicinity; 2) that "only 15 of 100" shallow salt domes in the interior salt basins have associated hydrocarbons; and 3) that "if hydrocarbons are present, the volume will be small". These statements may lead the reader to the erroneous conclusion that the Richton Dome area will not be subjected to future exploration for hydrocarbons. Continued developments in seismic and other sophisticated exploration techniques (e.g. gravity, lithofacies mapping, porosity mapping) will stimulate continued exploration for petroleum in the near-dome areas. These local anomalous areas (bullseye targets) within the larger salt basin have the potential of producing a variety of structural and/or stratigraphic traps for petroleum and other resource concentration. As depletion of larger non-renewable energy reserves continues, and as the demand and market price for petroleum increases, smaller petroleum reserves associated with salt dome areas will become increasingly important targets for exploration and development.

- The Draft EA for Richton includes only token (one sentence or less) discussions of the potential for solutioning and underground storage development in shallower Gulf Coast salt domes. Petal Dome in Forrest County and Emminence in Covington County and being utilized for the storage of natural gas and LPG products. This is a clear indication of resource utilization of nearby salt domes in the area. It remains unclear why discussions and conclusions of a program-generated report by Griswold (PNL-3190, 1981) were not cited in any of these Draft EA discussions concerning underground storage development. The report goes into considerable detail in: 1) describing underground storage development in salt domes, 2) establishing "technically-conservative" rates of future utilization of salt domes for a variety of purposes, 3) illustrating that shallower salt domes themselves constitute a finite, non-renewable natural resource, 4) predicting the time period for shallow virgin salt domes as a resource to be depleted, and 5) evaluating the probability of future human intrusion and radionuclide release scenarios for a repository located in a Gulf Interior Region salt dome.

- With respect to the Richton Dome Draft EA, Chapter 2, the Richton Dome was found to be preferable over the other two domes in the Gulf Interior Region based on its "ability to better ensure compliance with the waste-isolation requirements" (p.6). One of the features of the Richton Dome that the DOE claimed made it more desirable was the "absence of previous mining or resource extraction within the site that could affect containment or isolation". The Richton Dome has two oil test wells associated with it (Shell Masonite No. 1 and Shell Masonite No. 23-7), both of which were drilled to depths well below repository depth. Examination of geophysical logs for the Shell Masonite 23-7 well reveals that the well penetrted the salt stock at the proposed repository horizon. According to the logs, the well entered the salt stock at approximately 1975 feet and continued in salt to a depth of approximately 2920 feet. On file with the Mississippi Oil and Gas Board is a telegram from Shell Oil stating that they had a "severe problem in maintaining [a] straight hole". At present, it is not known whether or not these wells were sufficiently plugged and cased to prevent any hydrologic connection between the dome and the accessible environment.

- The qualifying guideline for Human Interference (Draft EA p.2-22; Guideline 10 CFR 960.4-2-8-1) states that the repository must be located such that the "presence of natural resources...including groundwater suitable for crop irrigation or human consumption...will not be likely to give rise to interference activities by future generations". The Citronelle Formation and sand beds within the Hattiesburg and Pascagoula Formations are present at Richton Dome and are considered to be aquifers (Boswell, 1979[1], and Newcome, 1975[2]). The City of Richton is presently drawing water from the Miocene aquifers. Since groundwater should be considered a natural resource it should be discussed in this section of the Draft EA. This is an oversight that should be corrected in the Draft EA, especially in view of the prime agricultural soils above the proposed repository.

*1. Boswell, E.H., 1979. The Citronelle Aquifers in Mississippi, U. S. Geological Survey, Water-Resources Investigations 78-131, 1p.

*2. Newcome, Roy, Jr., 1975. The Miocene Aquifer System in Mississippi, U. S. Geological Survey, Water-Resources Investigation 46-75, 3p.

- With respect to Section 3.2.8.1, Karges (1975)[1] reported 100 feet of low gravity oil saturated sand along the eastern flank of Richton Dome. This is a substantial hydrocarbon resource that may be of increased value in the future as energy needs become more severe and hydrocarbon recovery technology advances. The Draft EA does not discuss the importance this resource may assume in the future. Note that the purpose of the guidelines on natural resources and human interference is to evaluate the potential loss of waste isolation due to future extraction of economic mineral deposits (10 CFR 960.4-2-8 and 960.4-1-8-1).

*1. Karges, H. E., 1975. Petroleum Potential of Mississippi Shallow Salt Domes, Transactions - Gulf Coast Association of Geological Societies, volume 25, pp.168-181.

- With respect to Section 3.2.8.1, this section of the Draft EA has not discussed the presence of natural gases in the Richton area. Section 3.2.7.2 (p.3-53) of the Richton Draft EA states: "Deeper units within the study area also were found to contain methane, ethane, and hydrogen gas." A discussion of this topic should be added to the "Hydrocarbons" section.

- With respect to Section 3.2.8.1, the Draft EA notes the presence of Tiger and Glazier Fields, but fails to point out the fact that Richton Dome is situated along the same salt ridge extending between the Tiger and Glazier Fields. Thus Richton is situated along a productive trend which would be a prime exploration area in the future. Murray (1983, p.63)[1] states: "The 7 domes [including Richton] are all situated in, or along extensions of productive trends of Jurassic, Cretaceous, and early Tertiary strata."

*1. Murray, G.E., 1983. Evaluation of Potential Mineral Resources in the Vicinity of Seven Selected Domes in Texas, Louisiana, and Mississippi. Technical Report, ONWI-169, 88p.

- With respect to Section 3.2.8.2, the discussion of sand and gravel in the Richton area states that demand is local and sand and gravel deposits are abundant. Sand and gravel does commonly occur in the Richton area, but their occurrence does not imply that economic deposits are abundant. Furthermore, the demand for sand and gravel is more extensive than the local usage stated in the Draft EA. The last paragraph of this section states, "Sand and gravel have low potential for development except for local use because of the abundance of these materials in the region". The definition of 'local use' could be questionable; however, shipping (via trucks) to the Gulf Coast area, a distance of over 65 miles, should be considered beyond 'local use'. For instance, gravel and sand has been shipped to Moss Point, Mississippi. Another term of questionable definition is 'abundance'. Deposits of gravel and sand of commercial significance are <u>not</u> abundant. The quality and quantity of a deposit are the major factors that must be considered in the determination of whether or not a deposit is commercial. It is a known fact that these factors do not exist in abundance.

- With respect to Section 3.2.8.2, Mullin (1982)[1] notes the presence of barite, rutile, apatite, zircon, and fluorite in the caprock. Also, Price (1983)[2] identified potential economic mineral deposits at Hockley Dome, Texas. Although these minerals could not be referred to as reserves, in the future they may be of increased value. These resources should be examined and discussed in the Draft EA.

*1. Mullin, C.W., 1982. Geology of the Caprock and Salt Stock of the Richton Salt Dome, Georgia Institute of Technology, Masters Thesis, 156p.

*2. Price, P., J. R. Kyle, and G. R. Wessel (1983) Salt Dome Related Zinc-Lead Deposits - AAPG Bulletin, preprint.

- With respect to Chapter 4, The evaluation of oil test wells is not discussed in the Draft EA. Oil test wells penetrate the salt stock and should be evaluated for dissolution potential. The effectiveness of the plugs to prevent direct connections between the salt stock and the surrounding groundwater systems should also be determined.

- The Draft EA states several times there are no reserves of oil and gas within the repository site. The accuracy of these kinds of statements is questionable. A major oil company is currently running 17 miles of seismic line that parallels the dome. Getty is drilling a well located in T5N-R9W, Section 13, which is near the dome. With the oil market depressed as it is now, any activity needs to be economical for an oil company. If there is current activity in an area one would speculate there must be something attracting that activity.

- The size, shallow depth, and location of the Richton Salt Dome make it a unique natural resource. This was illustrated when a commitment was made and land option obtained (by Diamond Shamrock Company) on the Mississippi Gulf Coast at Pascagoula for a process chemical plant which would use salt from the Richton Dome as their raw materials. A pipeline was to be built from the Richton Dome to the Mississippi Gulf Coast. The Mississippi Legislature enacted Chapter 439, Laws of 1980, appearing as Section 59-5-31 in the Mississippi Code of 1972, as amended, to authorize cooperation between the local governmental entities for the purpose of construction of the pipeline for the benefit of a large petrochemical complex to be located in Pascagoula, Mississippi. This indicates a clear attempt by the State to assist private industry in the utilization of the Richton Dome.

3.8 PERFORMANCE ASSESSMENT

The subject of performance assessment deals with the use of models to make long term predictions about the performance of the repository system or subsystems. We realize that it is difficult to carry out meaningful performance assessment calculations when the data required by the models are not yet available. Thus we do not direct our comments here primarily on the individual model analyses that have been reported on by DOE in the Draft Environmental Assessment. They are correctly labeled there as highly preliminary and subject to change when additional data have been obtained. More fundamental, however, are some of the model assumptions and frameworks that have been assumed by DOE and thus these are the subjects of our comments.

A number of the performance assessment (modeling) calculations carried out by DOE assume that any leached radionuclides must be transported a distance of ten kilometers to the "accessible environment". This distance is out of date and gives an overly beneficial picture of the performance of the repository. This issue is particularly crucial since the water wells servicing the Richton areas are within 10 kilometers. DOE should limit its calculations to either of the following: (1) The boundary of the dome, since the Draft EA assumes that this is the limit of the controlled area, or (2) A two kilometer distance from the boundary of the repository, since this is the distance that corresponds to the proposed EPA environmental regulations. It is inconsistent for DOE to take credit for a ten kilometer distance when evaluating a repository performance, and a minimum distance that only extends to the boundary of the dome, when evaluating environmental impact. The DOE has failed to delineate a consistent restricted zone, buffer zone and control area. This failure has has a serious adverse effect on the people of the town of Richton and may result in the town of Richton being completely moved. This comment is discussed in further detail in Section 4.0 of this document.

The performance assessment calculations relating to the movement of the wastes from their position of emplacement to the boundary of the dome are based on molecular diffusion. It is unlikely that this would be the dominant process,

since almost any type of advective transport would be much more significant. DOE has not considered migration in three-phase brine inclusions, nor has it considered diffusion or advective transport in the more permeable zones represented by the backfilled repository drifts within the repository that would connect to more permeable anomolous zones that could transport radionuclides to the accessible environment. It has only modeled movement through intact salt which is clearly a non-conservative calculation.

An important issue which has risen in performance assessment is the potential for thermally induced convection of surrounding ground water. DOE presents a brief analysis of this in the Richton Draft EA, but it turns out that it is based entirely on calculations for the Palo Duro Basin in West Texas! This latter is a bedded salt deposit where, in addition, there is a naturally occurring downward hydraulic gradient. The calculations reported in the Richton Draft EA are completely irrelevant to Richton and they give a misleading impression of the extent to which DOE has analyzed this question.

Thermally induced convection is important in addition because, not only can it reduce the ground water travel time to the accessible environment or to productive aquifers, but also it can accelerate dissolution processes.

Further to the subject of "accessible environment", the whole concept as defined in the DOE siting guidelines in conjunction with the term "controlled area" is ambiguous. When applied to a salt dome site, several problematical questions immediately arise; the diapir has a limited areal extent as compared to sites in bedded salt, basalt, or tuff. A significant discontinuity (the perimeter of the diapir) will be located a few hundred feet from the edge of the underground disposal area, supposedly within the controlled area (which may extend up to 10 kilometers out from the waste). Such a discontinuity in proximity to a bedded salt site, for example, may have called into question the licensability of the site. Would the caprock or a shale sheath, if present, be considered part of the host rock, or would the term "host rock" be limited to the salt stock? Will there be adequate characterization of the salt-caprock interface? Will there be adequate characterization of the diapir-sediment interface?

4.0 ENVIRONMENTAL IMPACT

DOE has significantly underestimated the environmental impact of a repository at Richton. It has done this by using a very restrictive definition of the controlled area, namely, the limits of the salt dome itself at the depth of the repository. It was obviously necessary to do this to avoid conflicting with the siting guidelines, which require that the repository not impinge on towns or heavily populated areas. However, this definition of the controlled area may not be acceptable to the NRC in licensing. For example, it does not give control over any underground exploration activities just off the flanks of the dome. Such activities could affect the deep groundwater patterns and they could provide shortcuts for contaminated ground water to be brought to the surface. These activities might lead NRC to not allow credit to be taken for the chemical properties of the aquifers, which DOE expects to retard the radionuclides should they get out of the repository. Therefore, in order to be licensed, DOE would probably be forced into defining a larger controlled zone. This would impinge on its siting guidelines, a difficulty that could not be overcome without severe environmental and socioeconomic impact on the town of Richton.

Detailed comments on many aspects of DOE's evironmental analysis follow.

- The source terms for intentional venting of radioactive gases as reported in Table 6-18 of the Richton Draft EA do not reflect proposed operating methodology; therefore, they are not conservative. In particular, E. R. Johnson Associates have examined several operational alternatives, including:
    a. removal of assembly end fittings
    b. venting of fission gases and resealing
    c. fuel disassembly and close packing of fuel pins
    d. fuel chopping and immobilization in a solid matrix.

These alternatives could alter the operational source terms very significantly, and are apparently neither explicitly ruled out nor examined in calculations for the Draft EA's. Neither separated gas from cryogenic fractionation, nor is the potential explosion hazard from cryogenic processes addressed at all.

- The source terms for accident scenarios examined in Tables 6-21 through 6-25 of the Richton Draft EA do not include the classic human factor accidents, with multiple simultaneous failures. This is the type of accident which occurred at the Three Mile Island Nuclear Station, and which has historically been responsible for large accidental releases at many types of nuclear facilities. Since fuel chopping would create radioactive process waste streams similar to those encountered in reprocessing facilities, it is imperative that the accidental releases historically occurring be incorporated in the operational source terms used. For example, on May 2, 1979, 479,000 Curies of Tritium are reported to have accidentally been released from the Savannah River Plant. Table 6-18 of the Richton Draft EA reports .03 Ci per year of Tritium, only .6 Ci in 20 years.

- The X/Q values used for computation of atmospheric dispersion, and subsequently dose commitment from vented radionuclides, are not adequate. Stability was not measured continuously, but at large discrete intervals at locations remote to the proposed repository. Inversion conditions were missed on an almost daily basis because the airport data is not temporally continuous. Inversion conditions could occur at night and in early morning hours, and therefore "F" should be conservatively used as the limiting stability class in absence of continuous site specific data. The Grand Gulf Nuclear Station Final Safety Analysis Report summarizes stability taken continuously over a three year period at nearby Port Gibson, MS. and shows, about 25% of the time, conditions are of at least "F" stability with a large fraction of inversions. In contrast, the discontinuous data used by waste from the star program indicates no "F" stability whatsoever.

- Transportation, handling and waste packaging for separated Krypton-85, Iodine-129, etc. already existing and potential future quantities from future reprocessing activities are not detailed and could be a very important consideration in operational and accidental releases.

- The Richton Draft EA dose commitments generated by the PABLM code for the Richton site are not a serious attempt to model reality because inputs tabulated by Waite seem to be arbitrary. For instance, Waite reports no leafy vegetables, no above ground vegetables and no melons in the Richton area (Perry County, Mississippi). In stark contrast, the Mississippi Extension Service has compiled real data for Perry County on 1984. This 1984 data reports 50 acres of pole beans; 35 acres of green (bush) beans; 22 acres of lima beans; 30 acres of lima (bush) beans; 15 acres of cabbage; 10 acres of cantaloupe; 15 acres of collards; 75 acres of cucumber; 35 acres of mustard; 15 acres of okra; 25 acres of southern peas; 10 acres of bell peppers; 5 acres of spinach; 15 acres of turnips; and 25 acres of watermelons. (Personal communication with Perry Countians indicated that more than the above acreages are used for agricultural purposes.) Growing periods for the above ground and leafy vegetables vary up to nine or ten months as opposed to the ninety days applied in the PABLM code.

- The Richton site is located in a very humid rural area. The abundant rainfall coupled with a long growing season support a variety of agricultural products and activities. Richton is within the five mile radius of the proposed venting of radioactive gases. These factors should account for a significantly greater risk for the Richton site in pre-closure radiological safety comparisons, but do not do so in the Draft EA's. The Draft Environmental Assessment fails altogether to analyze the statistical significance, based upon site specific radiological measurements, of the increase of adverse health-related effects due to the increase in individual and population dose as the result of releases from the proposed repository. A closer examination of the models, and especially of all inputs and data is warranted.

- "Similarly, no area known to be particularly sensitive to human disturbance is known to occur in or around the Richton Dome area." (page 3-96). No mention is made in the Draft EA concerning "acid bogs" which are known to be associated with "southern mixed forest" (3-92). Bogs are often found along edges of streams and bottomland hardwoods and potentially contain "sensitive" plant species. Acid bogs are particularly sensitive to human disturbance.

  Also, reference is made to the expected low numbers and diversity of aquatic (plant) species to be found in the area (Richton Draft EA Chapter 3-96, 2nd paragraph). What does the word "low" have to do with expected impacts upon plant communities? From an ecological perspective, habitats with small numbers of species may already be in sensitive environmental situations.

- "Vertebrate and invertebrate species of other classifications and all plant species are not protected under current State legislation dealing with threatened and endangered species. . ." (Richton Draft EA Chapter 3-96, 3rd paragraph). Does this mean that species not already listed in the Draft EA are to be ignored by DOE? If so, then only some of the Threatened and Endangered (T&E) species of national visibility will be deemed important in the process. On review of the Federal Register 49(100): 21664-21567, one will find 11 species of mayflies, dragonflies, and stoneflies and 27 species of fresh water mussels which are known to occur in Alabama, Mississippi, and/or Louisiana. Specific knowledge on the occurrence of these species in the study area is generally unavailable.

- The discussion of wetlands is unclear and inadequate. Because wetlands are "sensitive" habitats and because unique species often occur in wetlands, proper assessments should be made to pinpoint the locations of such areas prior to land disturbing activities. Also, inventories of indigenous species should be made and proper mitigation procedures should be developed.

- The climatological data used for Richton Dome were obtained from the U.S. Weather Bureau, Jackson and Mobile station. Wind patterns, speed, and other meteorological conditions were estimated from data far removed from the Richton site. This surely has introduced some error into the predicted impacts, particularly for salt, at the Richton repository site. Also, there is a lack of emphasis on the severe weather conditions, tornadoes and hurricanes, experienced in south Mississippi which could affect estimates of environmental damage caused by air and water-borne salt.

- Also, the data is wholly inadequate and fails to acknowledge the occurence of Hurricanes Camille and Frederic, or the devastating human and property damages that they caused by consistent cyclonic weather activity in the area.

- T&E Search.. Plans presented in this section described a less than adequate effort to describe threatened and/or endangered species associated with the study site and areas of potential impact. Species not occurring on site, but in environs likely to be impacted, will be ignored until they appear in the results of the ecology study. Also, it is unlikely that a botanical biologist and a wildlife ecologist will be able to cover the technical knowledge necessary to identify signs of life styles and breeding habitats for all T&E species in all groups.

- 12-month Study. Plans call for "detailed" ecological investigations of the study area. It is not clear as to how much of the region will be covered by these studies (aquatic systems including the Leaf and Pascagoula Rivers should be included). The proposed studies are designed to characterize dominant components of the salt dome (and adjacent systems?); the purpose being to generate data for use in decision making.

  A 12-month study, however, is insufficient to thoroughly characterize the biota of the study area and areas of potential impact for the purpose of this project. Since the Richton site, the surrounding areas, and areas to

the south, including the Mississippi coast might eventually be subjected to the largest concentration of nuclear materials ever assembled in the history of mankind, and because these ecosystems possess high potential for aquatic transport of radionuclides and elevated salt concentrations, the suggestion that a single year's worth of data will provide sufficient information on which to base a 10,000 year decision is an oversimplification of the situation.

A single 12-month study, for example, would logically involve sampling of the environment on a seasonal basis, particularly for the biotic portion of the ecosystems. In reality, and assuming that this will be a standard sampling program, each season would be represented by a collection effort which spans only a few days out of the season. Naturally occurring variations in rainfall, temperature, and other physical variables which "drive" ecosystems, can lead to misconceptions of important details in ecosystems; ecosystems structure and function.

One should assume (and hope) that monitoring of biological communities would continue for the duration of the repository project.

- One of the greatest, immediate environmental concerns is the effect of salt on the environment. The salt pile created by the repository is not coarse rock salt but salt fines, and is estimated to be 20-50 feet high with an area of 50 acres. It is also estimated that little effect on the environment will occur past a distance of 200 feet. It is estimated that environmental effects will be decreased by engineering. It is highly unlikely that these engineering measures will be ideally useful under all weather conditions likely to be encountered for the duration of the project. Since there are no precise climatological data for Richton, the exact impact of weather variables upon dispersal of salt from the stock pile is difficult to calculate. It should be noted that variations in wind speed and extremes in rainfall have potential to create severe salt-induced impacts in the environs surrounding the repository site. It is difficult to imagine that a 200 ft. buffer strip will be sufficient to

confine impacts to the repository site. It is also suggested that rainfall will be sufficient to continually purge excess salt from both terrestrial and aquatic habitats of the area. These habitats will likely suffer tremendously during periods of extended drought.

- In Section 4.2.1, DOE has mentioned that they have managed salt excavation and stockpiling at two separate locations. Both these sites are in arid New Mexico where the average annual rainfall is approximately 1/5 of that in the Richton area. It seems that their model for predicting the behavior of the salt is based on the behavior of the salt in the two arid areas mentioned. If they have any experience to support the application of that data to the humid southeastern U.S. it is not presented. Most of the concern of the Draft EA seems to be on the effects of windblown salt. Of equal or greater concern should be the release of dissolved salt (estimated to be 5%/yr. Ver Planck, 1958) to the environment due to the failure of the system to contain the runoff water and the possible dissolution of the pile by the high humidity of the Richton area.

  Another environmental concern is that of radionuclide cycling in the environs of the salt dome and those of the south. What kind of background information exists on current levels and species of radionuclides presently found in this area?

- DOE should be required to mitigate for the loss of 16 acres of wetlands and damage to 3 acres more as required by the Fish and Wildlife Coordination Act and in National Environmental Protection Act.

- In Section 5.2.4.2, DOE makes the statement that impacts on aquatic biota will be minimal and compensated for by recolonization of the new channels. We know that channelized sections of streams are not nearly as productive as unchannelized portions of the same stream.

- The table of endangered/threatened species protected by state law is now out of date as a new public notice has been published. This document should reference the more recent list rather than the out of date one. Public Notice 2408 is attached.

- What about the proposed historic Bartram Walking Trail? Will it come close enough to Richton to have any impact on planning?

- Yellow-blotched sawback turtle, an endangered species, inhabits the Leaf River.

- Mississippi Natural Heritage Law of 1978 does not apply to cultural resources but to Natural Resource Preservation and Protection (the previous catagory).

- The Indigo snake (Federally threatened) also may be in the area in addition to the Red Cockaded Woodpecker.

  The recently designated Leaf River Wilderness Area was given very little environmental consideration. The impacts of this project need to be accurately assessed.

  Drainage problems from the repository site, both in site characterization and repository development phases, will need careful monitoring. Elevated turbidities and siltation in adjacent receiving streams can cause habitat destruction and species elimination.

- A technical review of Chapter 4 of the U. S. Department of Energy (DOE) Draft Environmental Assessments for Richton and Cypress Creek Dome Sites, Mississippi, has identified a major issue of concern to the State of Mississippi. The issue involves the DOE preferred method for disposal of excess salt resulting from Exploratory Shaft Facility (ESF) construction (Section 4.3.4.2 and Table 4-19).

MISSISSIPPI DEPARTMENT OF WILDLIFE CONSERVATION
BUREAU OF FISHERIES AND WILDLIFE
P.O. BOX 451
JACKSON, MISSISSIPPI 39205

PUBLIC NOTICE NO. 2408

In accordance with section 25-43-9, Mississippi Code of 1972, the Department of Wildlife Conservation, pursuant to the requirements of The Non-Game and Endangered Species Act (Sections 49-5-101 through 119, Mississippi Code of 1972), at its regular meeting in Biloxi, Mississippi on May 25, 1984, conducted a review of the Official State List of Endangered and Threatened Vertebrates adopted by the Commission on July 23, 1981. After conducting this review of the official State list of endangered or threatened vertebrates and after consideration of all pertinent information derived by surveys conducted by qualified persons and by the best scientific data available on the designation of species as endangered or threatened, the Commission made known its intent to amend and sixty (60) days thereafter did amend the listing of endangered and threatened species. Be it ordered that Public Notice No. 2156 is hereby revoked and in its place the Official State List of Endangered Vertebrates is as follows:

ENDANGERED SPECIES

FISH :
Dace, Southern Redbelly (Phoxinus erythrogaster)
Western Mississippi disjunct populations only.
Darter, Bayou (Etheostoma rubrum)
Darter, Crystal (Ammocrypta asprella)
Madtom, Frecklebelly (Noturus munitus)
Sturgeon, Atlantic (Acipenser oxyrhynchus)
Sturgeon, undescribed Tombigbee River (Scaphirhynchus sp.)

AMPHIBIANS :
Salamander, Cave (Eurycea lucifuga)
Salamander, Green (Aneides aeneus)
Salamander, Northern Spring (Gyrinophilus porphyriticus)

REPTILES :
Alligator, American (Alligator mississippiensis)
Snake, Black Pine (Pituophis melanoleucus lodingi)
Snake, Eastern Indigo (Drymarchon corais couperi)
Snake, Rainbow (Farancia erytrogramma)
Snake, Southern Hognose (Heterodon simus)
Tortoise, Gopher (Gopherus polyphemus)
Turtle, Atlantic Green (Chelonia mydas)
Turtle, Atlantic Loggerhead (Caretta caretta)
Turtle, Atlantic Ridley (Lepidochelys kempi)
Turtle, Black-knobbed Sawback (Graptemys nigrinoda)
Turtle, Hawksbill (Eretmochelys imbricata)
Turtle, Leatherback (Dermochelys coriacea)
Turtle, Ringed Sawback (Graptemys oculifera)
Turtle, Yellow-blotched Sawback (Graptemys flavimaculata)

BIRDS :
Crane, Mississippi Sandhill (Grus canadensis pulla)
Eagle, Bald (Haliaeetus leucocephalus)
Falcon, Peregrine (Falco peregrinus)
Pelican, Brown (Pelecanus occidentalis)
Plover, Snowy (Charadrius alexandrinus)
Stork, Wood (Mycteria americana)
Warbler, Bachman's (Vermivora bachmanii)
Woodpecker, Ivory-billed (Campephilus principalis)
Woodpecker, Red-cockaded (Picoides borealis)
Wren, Bewick's (Thryomanes bewickii)

MAMMALS :
Bat, Gray (Myotis grisescens)
Bat, Indiana (Myotis sodalis)
Bear, Black (Ursus americanus)
Manatee, West Indian (Florida) (Trichechus manatus)
Panther, Florida (Felis concolor coryi)
Whales, all species (Order Cetacea, excluding Family Delphid

It shall be unlawful for any person to take, possess, transport, export, process, sell or offer for sale or ship, and for any common or contract carrier knowingly to transport or receive for shipment any species on the above list except as may be permitted by the Commission under Section 49-5-111 of the Non-Game and Endangered Species Conservation Act.

This adopted Public Notice will become effective July 29, 1984.

Witness my hand and seal this the 25th day of May, 1984.

MISSISSIPPI COMMISSION ON WILDLIFE CONSERVATION

By: _____
Edmund Keiser, Chairman

MISSISSIPPI DEPARTMENT OF WILDLIFE CONSERVATION

By: _____
Lon Strong, Executive Director

I certify this to be a true and correct copy:

_____
Executive Director

_____
Notary

My Commission E...

Publication of the Draft Environmental Assessments (Draft EA's) represents the first occasion where a preferred method for disposal of excess salt and salt-contaminated materials resulting from ESF construction has been identified by the DOE. The proposed method for both the Richton and Cypress Creek Draft EA, (i.e. land disposal in an offsite solid waste landfill), is based primarily on telephone conversations of a DOE subcontractor with Mississippi Department of Natural Resources, Bureau of Pollution Control (DNR-PC) personnel (Biggert, 1984) and with a commercial landfill operator (Sullivan, 1984).

Initial review of this issue involved confirmation of these references cited in the Richton and Cypress Creek Draft EA's. In a telephone conversation with Mr. Tom Sullivan (Bush Construction, Inc.) on January 9, 1985, it was learned that the subcontractor in question made no mention of the anticipated volumes of salt and salt-contaminated materials to be disposed of (Richton Draft EA = 40,000 yds^3; Cypress Creek Draft EA = 48,000 $yds.^3$). Mr. Sullivan also stated that the subcontractor was informed that acceptance of salt materials for disposal would be contingent upon: 1) available space in the landfill; 2) DNR-PC approval for disposal of this material under their existing solid waste permit; and 3) the ability of the operator to make a profit from disposal of this material.

In a telephone conversation with Mr. Johnny Biggert (DNR-PC) on January 9, 1985, it was also learned that the subcontractor in question again gave DNR-PC no indication of the volumes of salt and salt-contaminated materials to be disposed of. Mr. Biggert stated that he was led to believe that the subcontractor was "merely referring to relatively small volumes of drill cuttings".

Subsequent to this initial review of these Draft EA reference, a meeting was held with Mr. Biggert and Mr. Jack McMillan at DNR-PC on February 25, 1985, to further discuss the issue of landfill disposal of salt material. Mr. McMillan stated that salt is classified as "non-hazardous" by DNR-PC

from the standpoint that it is non-toxic for human consumption and is non-volatile; however, salt can be environmentally harmful if disposed of improperly. Mr. McMillan also stated that no existing sanitary landfills within this state would be allowed to dispose of these volumes of salt under existing DNR-PC solid waste permits.

The conclusions of the meeting regarding disposal of salt materials in Mississippi are detailed as follows:

1. Due to the potential for serious ecological and environmental impacts resulting from improper disposal of salt materials, current landfill operation practices for non-hazardous solid waste landfills in Mississippi would not be amenable for the disposal of significant volumes of salt.

2. Applications for the permitting of sites for landfill disposal of salt and salt-contaminated materials would have to be evaluated by DNR-PC on a case-by-case basis to determine the suitability of a site for salt disposal and isolation from the natural environment.

3. To ensure that controlled releases from the landfill do not exceed drinking water standards, the installation of synthetic liners, a leachate collection system, and/or a groundwater monitoring system may be warranted.

4. Specific handling, operation, and disposal practices for the land disposal of significant volumes of salt would have to be developed and implemented to ensure that potentially harmful releases to the environment do not occur.

5. Potential impacts resulting from the improper handling and disposal of salt can be significant, and may include groundwater and surface water contamination above acceptable limits and/or a reduction in land productivity.

- Volume estimates of the amount of salt and salt-contaminated materials to be disposed of following ESF construction differ markedly. Table 4-19 for the Richton and Cypress Creek Draft EA's cite volumes of salt and salt-contaminated waste of 40,000 yds^3 and 48,000 yds^3, respectively. In contrast, a Draft EA reference document (Libno 2247), not referenced in discussions of this topic, cites total estimated volumes of salt and salt-contaminated waste for ESF construction at Richton and Cypress Creek to be 53,900 yds^3 and 61,250 yds^3, respectively. The basis and justification for volume estimates used in these Draft EA's should be elaborated, as disposal of excess salt materials for both ESF and Repository construction has a direct relationship to Repository Siting Guidelines concerning Ease and Cost of Siting, Construction, Operation and Closure (10 CFR 960).

- The preferred method of excess salt disposal during ESF construction differs between the land disposal method presented in the Draft EA's and the Draft EA reference document (Libno 2247, dated October 9, 1984) which calls for the commercial marketing of excess salt as the preferred disposal option. It would appear that a more detailed, quantitative analysis of the various options and costs for salt disposal should be included in the Final EA's. The analysis should include the methodology for selecting the preferred disposal option, for both ESF and Repository construction, at each site.

- The removal of salt from the facility for ultimate disposal is estimated at 82 rail cars per week, and could be over 100 trucks per week if trucks were used. These transportation and environmental effects are not considered.

- Present non-hazardous solid waste landfills <u>are not permitted</u> to accept significant volumes of salt. Applications for permits or permit modifications to dispose of salt materials in a solid waste landfill would have to be reviewed and evaluated by the Mississippi DNR-PC on a case-by-case basis. Current landfill construction and operation practices

may need modification in order to ensure that salt disposal in a solid waste landfill does not produce environmental impacts to the groundwater surface water, and the land surface.

- A justification for the estimated volumes of waste produced from ESF and Repository construction used in the Draft EA's for all sites appears to be necessary to properly evaluate the cost and impacts of various waste disposal options.

- With respect to Section 3.3.3 of the Richton Draft EA, the regional information presented in this section lacks the type of water supply data needed for proper evaluation, e.g. water well inventories of Richton Dome, projected population growth and water needs, projected industrial growth and accompanying water needs, and projected increase in the number of irrigation wells drilled per year.

- With respect to Section 3.3.3 of the Richton Draft EA, Brown (1944)[1] and Taylor, et al. (1968)[2] note decreasing water levels in the aquifers of the Miocene section. The regional decline in water levels in addition to the cone of depression developed as a result of repository construction could reduce both the quantity of groundwater available for the city of Richton and the source of water used for irrigation. Note that a disqualifying condition (10 CFR 960.5.2.6-d, Socioeconomic Impacts) states: "A site shall be disqualified if repository construction, operation, or closure would significantly degrade the quality, or significantly reduce the quantity, of water from major sources of offsite supplies."

*1. Brown, F.G., 1944. Geology and Groundwater Resources of the Camp Shelby Area. Mississippi State Geological Survey, Bulletin 58. 72p.

*2. Taylor, R.E., C.P. Humphreys Jr. and D.E. Shattles, 1968. Water for Development in Covington, Jefferson Davis, Lamar, Marion, and Walthall Counties, Mississippi. Mississippi Research and Development Center. Jackson, Mississippi. 87p.

- With respect to Section 3.4.2.3, the Richton Draft EA states: "...natural wetlands may exist in the Richton Dome area" (chapter 3, p.3-95). In direct contrast, chapter 5 (p.5-46) states: "...6.6 hectares (16.3 acres) of federally classified wetlands will be lost as a direct result of cut and fill activities associated with site preparation". The initial implication is that the potential for wetlands in the domal area is undetermined but later the DOE states that the wetlands are present in that part of the dome area that will be affected by site characterization and/or repository development. The American Alligator, listed on both the state and federal lists of endangered species, is known to occur in Perry County in the vicinity of the Tallahala and Bogue Homo Creeks. The greatest threats to its existence are "habitat destruction [wetlands alteration] and human harassment" (Jackson, no date)[1]. What measures will be taken to ensure that this species and other wetland inhabitants will be protected and will be allowed to continue living in their natural, unaltered environment?

- With respect to Section 3.4.3.6 of the Richton Draft EA, the potential for tornado or hurricane activity occurring in the domal area is briefly discussed. The Richton Draft EA claims that the possibility is slim of either activity significantly affecting the repository performance. This belief is based on the number of storms that have historically entered the domal area. The intensity of the winds, rainfall and flooding accompanying these storms need to be considered. Historic information must be collected and analyzed in order to determine what effects past storms have had on area building (i.e.-structural damage) and what degree of flooding has occurred. How would these effects be intensified if sea level were higher than at present and the probability of hurricanes affecting the domal area were increase?

*1. Jackson, J.A., no date. Threatened and Endangered Species Survey for the Richton Salt Dome Area: Terrestrial and Aquatic Animals; Eco-Inventory Studies, Mississippi State, MS, 41p.

- With respect to Section 4.1.3.1, the Richton Draft EA does not clarify whether or not the proposed twelve-month ecological study is planned to be conducted before or during site characterization. Since most of the species identified on the Threatened and Endangered lists for the Richton Dome area suffer from destruction of habitat, it is imperative that a thorough twelve-month study be done prior to a decision to conduct any land-disturbing activities at Richton. As an example, the endangered Red-cockaded Woodpecker is adversely affected if excessive noise levels are introduced into the area during nesting activities. The result may be a loss of the reproductive attempt for the year (Jackson, no date)[1]. These "excessive noise levels" may occur during site characterization activities. Additionally, Jackson goes on to say that if there are Red-cockaded Woodpecker colonies on the Richton Dome Site, a careful management program would have to be followed in order to retain the habitat favored by these birds. Another potential inhabitant of the Richton Dome Area is the Southern Bald Eagle. Nesting areas of the Southern Bald Eagle are protected by the USDI Management Guidelines for the Bald Eagle in the Southeast Region. Such guidelines include the establishment of protected zones around Bald Eagle nesting areas. Restrictions within these zones include (but are not limited to): 1) the restriction of land-use changes, 2) the restriction of the development of new commercial and industrial sites, 3) the restriction of the building of new roads, and 4) the restriction of major activities such as seismographic activities involving the use of explosives. Because of the diversity of species potentially inhabiting the domal area and especially because these species have diverse seasonal activity periods, a general reconnaissance would not be adequate to properly characterize the area. A thorough ecologic study encompassing all seasons is necessary and should be conducted prior to a decision to conduct land-disturbing activities at Richton.

*1. Jackson, J.A., no date. Threatened and Endangered Species Survey for the Richton Salt Dome Area: Terrestrial and Aquatic Animals; Eco-Inventory Studies, Mississippi State, MS, 41p.

- With respect to Section 4.2.1, the Richton Draft EA reaches the conclusion that "salt mining and stockpiling can be conducted without significant environmental impact" (p.4-85). This finding was based on analyses of salt deposition at the WIPP site and at the Gnome Project Test Site, both of which are located in the arid environment of southeastern New Mexico. Soil composition and vegetation types differ between the two distinctly different climates of southeastern New Mexico and southern Mississippi. Because absorption of the sodium and chloride ions differs in different soils and plant species, it is questionable whether or not the two environments cannot be directly compared. Though these ions are universal in plant materials, deposition of excessive amounts will have a deleterious effect on humans, animals and vegetation.

- With respect to Section 4.2.1.2 of the Richton Draft EA, our major concern with this section involves emphasizing the need to monitor daily on-site activities in order to minimize possible adverse environmental effects on adjacent environments caused by site characterization activities. The Draft EA states that temporary increases in turbidity and sediment loads may be expected in intermittent streams proximal to and within the Richton Dome area. The primary reason for the troubled status of most of the threatened or endangered aquatic species near Richton Dome is habitat degradation due to channelization, siltation and other stream disturbance activities that alter the water quality.

- Throughout the Draft EA a single phase repository design is used when assessing the impacts and evaluating the site. One section of Chapter 5 of the Richton Draft EA is devoted to the two phase design. The DOE plan, according to their own Mission Plan, is to use a two phase design, but this design is only briefly mentioned in the Draft EA, and it is not the design used in the evaluations. It is unfortunate that the State of Mississippi has not been afforded the opportunity to examine the references cited in the discussion of this alternative design approach. The rather limited discussion of this alternative appearing in Section 5.5 of the Richton Draft EA indicates that implementation of this design may

have significant impacts on the thermomechanical response of the repository; the size of the restricted area; the overall repository construction and operation procedures; and resulting socioeconomic impacts. A more thorough discussion of the repository design alternative and subsequent impacts on the siting guidelines, and Richton's overall ranking appears warranted.

5.0 SOCIOECONOMIC IMPACT

This review will judge the Draft EA's against two criteria:

(1) Do the Draft EA's suggest that the Department of Energy has made a reasonable, good-faith effort to obtain substantial evidence relevant to the significant impacts that would be considered reasonably likely by persons with the relevant expertise?

(2) Do the Draft EA's present substantial evidence in a manner representing good-faith objectivity, providing an adequate basis for (a) recommendation of sites for characterization, (b) identification of probable impacts of site characterization activities, and in particular, (c) a reasonable comparative evaluation of sites by the Secretary of Energy, as required by the Nuclear Waste Policy Act of 1982 (P.L., 97-425, Section 112(b)(1)(E) (96 Stat. 2209)?

It should be noted explicitly that this approach is significantly less stringent than asking whether the Draft EA's have considered (or even gathered) all possible relevant data, and it takes into account the desirability of keeping down the costs of data collection. In other words, it is substantially less stringent than the criteria that would be appropriate for judging an environmental impact statement. Even so, when the Draft EA's are judged against these two relatively weak criteria, both are clearly inadequate. Both Draft EA's present only a small portion of the data that would need to be considered to permit informed decision making on the potential suitability of sites for characterization, both fail to identify even the significant socioeconomic impacts of site characterization, and both fail to provide even a preliminary estimation of the kinds of impacts likely to result from repository development. In addition, the factual evidence points to the conclusion that the Richton Dome site, in particular, is disqualified and ineligible for consideration under the legal requirements of the Nuclear Waste Policy Act (NWPA). Even if this were not the case, however, neither Draft EA

would provide even an approximation to the quality of data base that would be needed for the Secretary of Energy to be able to perform a reasonable comparative evaluation of the potential sites.

Despite the fact that socioeconomic impacts are identified as not requiring characterization to be assessed - and that they should therefore be assessed more carefully than a number of other impacts - the Draft EA's analyses of socio- economic impacts are at an unacceptably low level of quality. The problems are of three sorts. First, the documents that are evidently used as the basis for the Draft EA's assessments of socioeconomic impacts are unacceptably deficient in quality even in the areas of socioeconomic impacts that have been considered. Second, major areas of socioeconomic impacts - and probably the most important areas, for the purposes of these Draft EA's - are omitted entirely. Third, in some areas, the Draft EA's are presented in a manner that is so misleading as to appear almost intentionally designed to mislead rather than to inform policy decisions. The discussion will turn below to each of these three problems in turn.

THE DRAFT EA's ARE BASED ON INADEQUATE SUPPORT DOCUMENTS

Discussions in the environmental assessments indicate that their discussion of socioeconomic impacts and effects are based on two supporting documents - Battelle National's "ONWI-499" and a simple letter from Stanley Goldsmith to T. J. Taylor. Mississippi has already had the opportunity to review both the draft and final version of ONWI-499, and has clearly indicated to the Department of Energy that many inadequacies exist in that data base. While the state has not previously had the opportunity to review the Goldsmith letter, its inadequacies appear to be at least equally severe. Moreover, even when the Draft EA's draw on these two other support documents, they often fail to include some of the most important and relevant data they contain.

In the interest of brevity, we will not repeat all of the difficulties of ONWI-499, although this should be considered an explicit request that the

state's comments on ONWI-499 be entered into the official record as criticisms of the Richton Dome Draft EA. To summarize briefly, however, there are several key problems. First, the approach of trying to use a "one-size-fits-all" impact area is simply not adequate to the task of identifying important impacts. The so-called "socioeconomic study area" of the Draft EA's is too large to allow an adequate focus on a number of impacts that will be felt most acutely in Perry County and Richton in particular, and yet at the other extreme, the "socioeconomic study area" is too small to allow the Draft EA's to consider the truly significant socioeconomic impacts that are likely to be experienced elsewhere in the state. Some (although by no means all) of the Richton/Perry County impacts will be noted elsewhere in this review. In a second obvious example, the Draft EA's contain literally no discussion of the impacts already being experienced by the recreation-dependent communities along the state's Gulf Coast, despite the significance of these impacts. Given the fact that controversy is one aspect of judging the "significance" of impacts under the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act, and given the fact that the Gulf Coast hearing on the Draft EA's turned into a "near-riot" (in the words of several newspaper reports), presumably the Department of Energy will not recognize the significance of these impacts.

While it has not yet been possible to examine the Goldsmith letter in detail, even a preliminary examination reveals that many deficiencies of this letter as a basis on which to build an adequate environmental assessment. First of all, despite the fact that DOE has spent vast sums on developing demographic projection models, the Goldsmith letter makes virtually no reference to that work and instead turns to what the letter frankly acknowledges to be "judgmental inferences." Second, what the letter calls "tests" of the model do not appear sufficient to provide any degree of confidence in the model's assumptions or conclusions, and indeed, they appear in general to suffer either from questionable relevance or logical circularity. Third; the specific numbers drawn from the Goldsmith letter - stating the unreasonably low estimate that only 50% of the workforce for constructing the facility will come from outside the local area - simply cannot be accepted as providing a

reasonably conservative basis for decision making. Fourth, available evidence (e.g., Murdock et al., 1984) strongly suggests that early workforce estimates for the still-untried technology of repository development will be far too low. The net result is that in-migration is underestimated both for the Cypress Creek and Richton Dome sites, and a similar underestimation takes place for the operational phases of the facilities, meaning that all subsequent calculations - including impacts on facilities, services, local socio-cultural conditions, and so forth are significantly underestimated. As additional points of concern, the so-called "logic diagram" in Section 5.4 (page 5-94) appears to be so thoroughly inconsistent with accepted logic for calculating demographic changes (subtracting certain numbers for no apparent reason, for example) that it would be more charitable to assume that the diagram is merely uninterpretable. And finally, even the numbers obtained from the Goldsmith models and elsewhere seem to vary inexplicably from application to application; while it is not possible to point out all examples of these problems in a letter of this length, perhaps the simplest illustration is provided by Table 4.27 (Page 4-116) in which it is not possible to compute the "number of total in-migrants" from any combination of the other figures in the Table for any of the four towns included, and for which not even the proportionate error is constant (it is relatively consistent for Hattiesburg, Laurel and Richton, but the town of Petal shows a purported total of "two" in-migrants - a figure smaller than any of the subcomponents of the total shown in the same Table). Nor do matters improve when the Draft EA's turn to the computation of service demands, economic impacts, and so forth. In addition to the above-noted fact that all population projections (and resultant service demand projections) are likely to be underestimated, the document fails to take account of the large and growing body of social science evidence pointing out that rapid growth tends to disrupt the informal community mechanisms through which the residents of normally functioning rural communities tend to provide many services for one another, such as control of deviance and socialization of the young. The disruption of these mechanisms tends to mean that a given increase in population will require a greater-than-proportionate increase in more formalized service provision than would be suggested by a straight-line extrapolation of the sort employed in this

environmental assessment. Moreover, the Draft EA's are also deficient in other ways assessing existing levels of service provision, a fact that again makes the document inadequate and inappropriate as a basis for informed decision making. Finally, in noting the possibility that many residents and businesses might find their livelihoods and homes condemned by the project and be forced to relocate, the document notes merely that "fair market value" would be provided, ignoring the clear conclusion of the Panel on Social and Economic Aspects of the Radioactive Waste Disposal (National Research Council, 1984: 91-93) that the so-called "market value" is likely to be anything but "fair":

"During the decision making period, residents in the vicinity of the candidate sites are likely to place less emphasis in property maintenance, properties will be hard to sell, and economic development is often hampered. . . ." The possibilities of relocating a small business are often severely limited. Such businesses generally have a localized clientele that is lost when the business is moved. The assessment also overlooks the fact that relocation, itself, has impacts that go significantly beyond economic implications (National Research Council, 1984: 96-98). Other problems with the EA's handling (and avoidance) of the question of relocation and related impacts will be noted below.

The net result of these deficiencies is that both Draft EA's are clearly deficient in assessing even the most conventional of economic and demographic impacts. These deficiencies, unfortunately, are merely the beginning of the EA's problems. Other significant categories of socioeconomic impacts are not even considered, and it is to these impacts that this review will turn next.

ENTIRE CATEGORIES OF SIGNIFICANT SOCIOECONOMIC IMPACTS ARE OMITTED ENTIRELY

Again, in the case of these problems and omissions, it is not possible here to list all of the omissions, and perhaps not even all of the significant omissions, but an illustative list will be provided. These omissions start

with the fact that the Draft EA's fail to take account of the types of data that could be gathered from even the most cursory discussions with local residents and visits to the local area. As a result, the Draft EA's omit any discussion of the impacts already incurred in the form of social disruption, uncertainty, economic opportunities foregone, specific plans for industrial developments that were evidently cancelled because of the possibility of a repository, and the many other impacts of DOE's repository-related activities to date - despite the fact that these impacts are, for legitimate and obvious reasons, intensely salient to local populations. It can be taken as a measure of the degree of the lack of familiarity with the area shown in (this EA) that the documents even claim that the Leaf River Plant, which has been quite visibly in operation for some time now, is still "under construction" (Page 3-117 of the EA). (This error could also be attributed to the DOE's lack of attention to the state's detailed criticisms of ONWI-499, since the same problem was pointed out to DOE in that context several months ago.) Indeed, it would not be appropriate to conclude that DOE has merely been inattentive to the types of data that could be gathered from local residents, since entire categories of socioeconomic impacts - research on which is easily available to professionals having the relevant expertise - have inexplicably been excluded from the Draft EA's as well. The four most obvious examples will be noted below.

HISTORICAL DATA. Particularly for a study region having the rich and complex history of Perry County, an understanding of the historical context is the first prerequisite for obtaining an understanding of the region and providing a basis for informed decision making. Yet the Draft EA's are even more deficient in their discussions of the historical record than was ONWI-499. A reading of the documents has identified no discussion of this important and complex topic more recent than the brief note that American settlement "was well established by the early 19th Century" and that "forced migration of the Africans and Afro-Americans in the 18th and 19th Centuries" had "influenced the history and culture of the state" (Page 3-131).

Surely neither DOE nor its contractors would wish to claim that nothing happening in the state in the last century or more is worthy of consideration or relevant to an understanding of the likely impacts of repository development, yet that is the implication of this otherwise inexplicable omission. The assertion that "No cultural resource investigations (historic, prehistoric, or oral histories) are known" for the region (Pages 3-105 and 3-106) is more accurately taken as an indication of DOE's failure to consult the available documentation than as a suggestion that no relevant studies would be available. As merely one example of the inappropriateness of the failure to provide an adequate historical assessment, it is worth noting an event far more recent than the "forced migrations" the 19th Century, one that has a direct bearing on the impacts already being felt. Another experiment in nuclear technology - an explosion in another salt dome roughly forty miles from the Richton/Cypress Creek Domes did far more to stimulate distrust of Federal agencies, particularly those offering relatively cheerful assessments of the likely implications of hitherto untested nuclear developments. Similarly, the nuclear power plant at Grand Gulf has experienced so many problems that local residents commonly refer to it as "Grand Goof." The region's unhappy experiences with nuclear developments, and particularly with the earlier experiment in a nearby salt dome, have left an important legacy that severely affects the credibility of the Department of Energy (and hence also affects other likely socioeconomic impacts). The unique historical context of the Mississippi sites, in this and a variety of other ways, is of sufficient importance that the Secretary of Energy simply will not be able to make a reasonably informed comparative evaluation of the sites without having the relevant historical information available.

CONVENTIONAL SOCIOCULTURAL IMPACTS. Despite the State's extensive criticisms of the shortcomings of ONWI-499, the EA's discussions of the full range of sociocultural impacts - a major category of socioeconomic impacts (American Association for the Advancement of Science, 1984) - remains at least as incomplete as the discussions of historical data. Indeed, the deficiencies are so extensive that little detailed criticism would be useful. The Draft EA's devote roughly one-and-a-half pages to existing "social conditions," but

do not actually describe social conditions in a meaningful way even in that limited space, dividing it instead between a vague generalization about "the generally rural nature of the study area" (Page 3-131) and a listing of agency statistics on matters such as crime rates and the proportion of the population receiving Social Security benefits. In terms of the socioeconomic studies planned during site characterization activities, the Draft EA's inexplicably list literature searches and surveys as "forms of community involvement" (Page 4-84), indicating a degree of confusion about relevant data collection techniques that would be humorous if this confusion did not hold such significant implications for decision making on serious topics. The discussions of impacts on "social conditions" in Chapter 5 of the Richton Draft EA are given only approximately one column inch of space; they convey, for all practical purposes, none of the information that would be needed for properly informed decision making. And not surprisingly, in assessing the purported suitability of the Richton dome in Chapter 6 and comparing the sites in Chapter 7 of the Richton Draft EA, the Draft EA completely ignored even these conventional sociocultural impacts. The ultimate result is that the EA's evaluations are flawed and incomplete to the point of being unacceptably deficient.

In fact, as virtually any social scientist with the relevant training would be able to ascertain from even limited contact with the region, the local culture is of vital importance to the Perry County residents. The region has long been one of the poorest in the nation, and yet most of its citizens report having had quite a high quality of life, at least before the start of repository selection activities. It is readily apparent upon discussing the matter with them that a primary reason for this high quality of life can be found in the importance of pre-repository sociocultural conditions. (As one woman put the matter, "Sure, we don't have much money here. What we do have is a real community.") Particularly given their experiences to date with the Department of Energy, the local residents are highly fearful that repository-related activities could destroy sociocultural support systems and disrupt community mechanisms that often do an admirable job of meeting community needs without tax dollar or private investment support (and hence are missed

completely by the "available statistics" upon which DOE has relied, and would continue to be missed by those statistics even if DOE's gathering of the statistics had been more comprehensive). In general, knowledgeable residents fear, with justification, that repository development could irreparably damage these and a broad range of other sociocultural resources that are vital to the continued welfare of the human populations in the area.

Under the circumstances, it is puzzling in the extreme that the DOE has failed so completely to assess sociocultural impacts. While it is understandable that DOE might not have gone to the considerable expense of conducting a comprehensive analysis of the sociocultural resources of the area and the ways in which they might be disrupted by repository development, it is not understandable that these impacts should be excluded completely from the EA. Nor is it sensible for the Draft EA's to provide no evidence that DOE has even taken the rudimentary step of making available to itself the necessary expertise. There are literally tens of thousands of social scientists who have Ph.D.s in relevant disciplines that are totally excluded from this environmental assessment - psychologists, anthropologists, and non-demographic sociologists, just to name three - and who belong to national associations that have headquarters in Washington D.C. The Department of Energy could thus take the first steps in accessing the relevant expertise with the simple expedient of making a local telephone call to the relevant associations from DOE headquarters. It is respectfully suggested that DOE take steps immediately to insure that the full significance of the local cultural, social structural, and other sociocultural resources - and the significant impacts that would be likely to occur in those areas if repository development or site characterization were to proceed - be given full consideration in the final environmental assessment. Substantial evidence and expertise already exists in these areas, and a careful reading of the relevant regulations can only lead to the conclusion that the Department of Energy is required to present and discuss the relevant evidence in its environmental assessments.

SPECIAL SOCIOECONOMIC IMPACTS. It has become common among specialists in socioeconomic impact assessment to differentiate the likely impacts of a radioactive waste repository into two categories - "conventional" impacts, which are the sort that could be expected to result from any large-scale industrial facility in a rural area, and "special" impacts, which are "those that arise as a result of the special characteristics of a repository for radioactive wastes" (National Research Council, 1984:85). As the foregoing discussion in this letter has indicated (e.g., in the areas of economics/ demographics, historical background, sociocultural impacts, and impacts on local relationships with the physical environment). Perhaps even more puzzling, particularly since the Department of Energy itself has funded much of the relevant research in this area, is the total exclusion of any discussion of a repository's likely impacts of "special effects." Indeed, the Draft EA's even go so far as to compare the esthetic impacts of repository development to those associated with the Leaf River Forest Products Plant (Page 5-65), ignoring the fact that the Leaf River plant is seen with considerable pride by locals while the possibility of a nuclear waste repository appears to have inspired more hostility than any other development in recent memory.

The Draft EA's totally ignore the broad range of significant special effects - community conflict, stress, community stigma, impacts on tourism (including amenity-dependent tourism in areas such as the Gulf Coast), the rather eerie visual impacts that could be created by perpetual markers ("tombstones for history's worst nightmare," as one local resident put it), the difficulty that might be created for future efforts to develop further economic diversification, and a broad range of other special effects. As far as can be determined on the basis of a relatively complete reading of the Draft EA's and a thorough reading of all discussions of socioeconomic impacts, these special effects - amazingly - are not even mentioned, and they are certainly not taken into account in assessing the suitability of the Richton Dome and Cypress Creek sites or in comparing Richton Dome against other potential repository sites. In a word, this is inexcusable. To quote again from the National Academy of Sciences' panel on the Social and Economic Aspects of Radioactive Waste

Disposal, "The special effects associated with the radiological mission of the repository will interact with, and may well exceed, the more conventional effects" (National Research Council, 1984:12). (These special effects are discussed starting on Page 100 of the report, but the conclusion just quoted is repeated both in the summary of the Chapter and in the executive summary of "major findings of the panel's overall work." The Academy report also makes it clear that the special impacts of site characterization, similarly missing from the Draft EA's, are particularly noteworthy.. As is indicated by the degree of concern expressed by Mississippians at hearings on the Draft EA's, the experts and the citizens are evidently in agreement upon the importance of special impacts, and the special impacts appear to be particularly significant at the Mississippi sites. The DOE simply will not be able to perform an adequate comparison of the study sites without taking these special effects explicitly into account.

IMPACTS ON LOCAL RELATIONSHIP WITH THE PHYSICAL ENVIRONMENT. The Draft EA's also fail to examine most of the important ways in which Perry County residents interact with, and depend upon, their physical environment, failing as well to discuss the likely impacts of repository characterization and/or development activities on these important relationships. These impacts, too, are particularly important in the Mississippi study areas, and the Mississippi salt domes cannot be adequately compared to other potential sites for a repository until or unless local residents' direct relationships with the physical environment are explicitly taken into account. To note only the most obvious example, roughly a third of the land in the area is categorized as farm land, hunting and fishing have importance as subsistence activities and cultural expressions as well as forms of recreation, and there is a widely shared perception among people who live in the area of the domes (and downstream of them) that, particularly given the low credibility of DOE in the area, assurances about the safety of groundwater from potential radioactive contamination cannot be believed. Relationships with the land are so significant that the Mississippi state exhibit at the recent New Orleans exhibition focused on the theme of "a Sense of Place." Yet rather than noting the significance of these attachments - and pointing out the impacts that

would probably be created if the attachments were severed, if people were forced to relocate or even if they came to see their native soil not as "the good earth" but as a porous covering underlain by dread substances - the Draft EA's fail to provide the necessary information in these areas as well. On the contrary, the document merely concludes that the area "does not possess any aesthetically unique features" (Page 11) and notes that, if hunting and fishing by the new residents cause excessive pressure on the important fish and game resources of the area, new regulations could be implemented and enforced to "mitigate" these impacts - without considering the important impacts that these purported "mitigations" would have in an area and on the people for whom fishing and hunting have such importance.

UNDERESTIMATION OF IMPACTS

It is significant that the net result of the omissions noted above is for the Draft EA's assessments of a broad range of socioeconomic impacts consistently to underestimate the actual impacts of repository characterization and development - and to avoid noting the impacts that have already taken place. In addition, however, a number of other aspects of the Draft EA's would almost appear to indicate that significant impacts are deliberately being understated in the environmental assessment. This problem is particularly severe in the Richton Draft EA.

For the record, the town of Richton is not only adjacent to but may even lie on top of part of the dome that the Department of Energy may ultimately decide to condemn and acquire (or "protect," to use the misleading euphemism employed in the environmental assessment). In addition, it is important to keep in mind the presence of what the Richton Dome EA notes to be "numerous" residences (Page 3-92) over the dome that, while perhaps outside the corporate boundaries of Richton, would be considered by most community specialists to be part of the functional community of Richton.

Rather than pointing out this fact in a straightforward manner and assessing its impacts in a balanced and appropriate way, however, the EA almost appears designed to hide this fact, and it certainly fails to come to grips with its significance. The executive summary, for example, notes that "the proposed restricted area is about two miles northwest of Richton" (Page 8), and even concludes that no important habitats "appear to be present at the site" (Page 13) - even though the fact that "much of the land over the dome has been disturbed by . . . urban development" (Page 11) would seem to indicate that there are in fact human inhabitants of the site, and any social scientist with adequate familiarity with the local area would be forced to conclude that those people's places of habitation - their homes - are quite important to them. In fact, despite the failure of the Draft EA to discuss this most significant of impacts, it appears likely that if DOE were to decide to develop a repository at the Richton Dome site, it would buy out the whole dome, often through condemnation proceedings, not only disrupting the people who currently live over the dome but splitting the community and thus seriously affecting a broad range of other people in the Perry County area, including those who do not live above the dome. To make matters worse, one of the purported "mitigating" measures listed on Page 4-107 for noise impacts would be for the DOE to buy more land - further increasing these already severe socioeconomic impacts.

This observation leads to an important point: condemnation and expulsion are major local concerns, and they are presumably a major reason why Congress explicitly forbad the development of a repository facility "adjacent to" an existing community. In fact, it appears that development of a repository at the Richton site would have precisely the types of implications that Congress wished to avoid. Indeed, most dictionaries give a primary definition of "adjacent" as "close to," or "lying near." The significance of nuclear wastes is so great that surveys indicate most Americans would actively consider moving if a nuclear waste repository were to be located within 100 miles of their homes. It is only reasonable to conclude that a surface facility within two miles of the town of Richton would indeed be considered by most reasonable observers to lie "close by" or "adjacent to" the community of Richton, and

thus that the site should be dropped from any further consideration. For evidence that even DOE implicitly recognizes such proximity one need look only as far as the selection of the Deaf Smith site over the Swisher site in Texas. The documents explicitly conclude that the primacy of radiological safety considerations make other factors "of lesser importance than the difference in distance to population centers." Since the town of Richton is a population center of a size that Congress itself decreed to be of interest - over 1000 human beings - it is difficult to escape the conclusion that DOE is deliberately choosing to ignore Congressional intent and its own guidelines in the interest of expedience.

The Draft EA's consistently avoid or understate other impacts as well. An earlier portion of this review already noted that "fair market value" for homes and businesses would probably be anything but a "fair" settlement, and in any case, relocation has been shown by a number of studies to have particularly important impacts - impacts that the Draft EA's are required by law to assess as a potential consideration for decision making, and that would continue to exist even if the financial costs of relocation in comparable facilities would be equitably borne. Similarly, in all of their discussions of noise impacts, the Draft EA's carefully avoid any consideration of the noise of seismic activities. Unlike the noise that would be concentrated in the "surface facility" area, moreover, the seismic activities - which could apparently include an "average" of 70 explosions daily, taking place 24 hours per day - would be spread throughout a 10,000 acre area (Pages 4-86 to 4-106 of the Richton Draft EA). As another example, the documents provide no discussion of the many lessons learned from previous studies of the nuclear industry, which is widely seen as being below average in organizational effectiveness, commitment to safety, and ability to meet its claims. (Perhaps the simplest example comes in the area of nuclear power plant costs: a Department of Energy sample of reactors completed or near completion in recent years showed that not one of the 57 facilities had been completed for its originally estimated cost or less, that over three-fourths of the reactors cost more than double what they had originally been expected to cost, and that roughly half cost more than four times the original estimate (U.S. Department

of Energy, 1983). Finally, the Draft EA's also fail to consider what Yale University professor Charles Perrow calls "normal accidents" - accidents that are caused by the sheer complexity of a system such as a nuclear waste repository and by the inability of designers and engineers to foresee all the complex interactions in such a system. An organizational system as complex as a nuclear waste repository, in short, can lead almost inevitably to "normal accidents" of the sort that occurred at Three Mile Island. If the Department of Energy is indeed serious about producing conservative estimates of risk, it then needs to take explicitly into account the very real possibility that its waste repositories would experience similar "unanticipated" accidents of the sort that have in fact been predicted by Dr. Perrow and others.

SUMMARY

This list could easily be expanded, but such an expansion would not change the major conclusions to be drawn from this review. The net result of the errors and omissions noted in this review, along with other problems in the Draft EA's that would be noted if additional space and time were available, can be summarized as follows.

(1) Even where relevant data exist or could easily have been obtained, they are missing both from these environmental assessments and from the support documents upon which the Draft EA's are based.

(2) The Draft EA's have not even identified the most significant of the socio-economic impacts that are likely to be created, and contrary to the claims made in the Draft EA's (e.g., Table 6-7, Page 6-59g), some of these significant "missing" impacts are of major importance.

(3) Because some of the relevant impacts have not been considered, efforts proposed for "mitigating" other impacts (e.g., noise, wildlife, etc) could actually serve to exacerbate the socioeconomic impacts.

(4) As a result, the environmental assessments clearly provide an inadequate basis for comparing either of the Mississippi sites, and particularly the Richton Dome site, against other potential repository sites.

(5) All of the omissions, moreover, are in the direction of <u>understating</u> the socioeconomic impacts of repository development at the Mississippi dome sites, particularly with respect to two of the guidelines against which the five sites nominated for characterization are to be judged - the "socioeconomic impacts," in which the Richton Dome is supposedly ranked third, and "site ownership and control," in which Deaf Smith and Richton are supposedly tied for second.

(6) It is indefensible, given the many omissions and the failure to consider any of the most important of the socioeconomic impacts, to rank the Richton site third in terms of its socioeconomic impacts.

(7) It is similarly indefensible for the Richton Dome site to be rated above either the Yucca Mountain or Davis Canyon sites in terms of site ownership and control; in fact, those other sites are both already largely owned by the Federal government and are essentially uninhabited, while for the Federal government to obtain title to the Richton Dome site, it would be creating major, negative, and highly disruptive impacts for innocent citizens that could be avoided at either the Yucca Mountain or Davis Canyon sites.

(8) As the National Academy of Sciences panel has pointed out, characterization itself would have particularly significant socioeconomic effects, and as this letter has pointed out, these Draft EA's are so thoroughly deficient in their assessment of the likely socioeconomic impacts of characterization that the Draft EA's can be considered, from a practical point of view, not to have assessed such impacts at all. The Draft EA's are thus not in any way sufficient to meet the legal

requirements of the Nuclear Waste Policy Act for an assessment of "the effects of the site characterization activities . . . on the public health and safety" and other socioeconomic and environmental impacts under Section 112 (b)(1)(E)(iii) of the Act.

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Additional comments by Section and Paragraph

- The eight-county region identified for study impacts is not adequate, particularly in light of the large impacts of public forums on the Mississippi Gulf Coast. Impact areas should be specific to the specific impact being considered. (Section 3.6)

- The concentration of impacts are focused on municipalities, while a large portion of Mississippi's population lives outside municipalities and a large portion of new urban growth always occurs beyond municipal boundaries. (Section 3.6)

- The methodology for calculation of population density using county averages is inaccurate, particularly when consideration is given to the large amount of national forests in the area where no people live. (Section 3.6.1.1)

- Trend projections are not adequate to project population in the area. Economic base growth potential must be evaluated. Hattiesburg's growth was held back in the 1970's because of a specific problem which has been solved. Also, the Hattiesburg-Laurel area is reaching a population and resource size where growth should accelerate. Consideration is being given to metropolitan area status. (Section 3.6.1.3)

- The assumption that Mississippi study area cities will maintain the same percentage of the county population as in 1980 is wrong. Cities are growing at a higher rate. (Section 3.6.1.3)

- Under "population characteristics," no mention is made about stability or the length of time residents have been located in one area. This is extremely important in rural areas and small towns where much is dependent on family ties and long-time friendships. (Section 3.6.1.4)

- Unemployment is a statistic of questionable use and must be defined where used. People who are long-term unemployed and not seeking work because jobs are not available are not considered in unemployment statistics. This is often the case in rural areas and small towns. (Section 3.6.2.2)

- Law enforcement distribution of service is a major problem, particularly outside municipalities. Based on recent information obtained in Jones County, it appears that the statistics presented are totally inaccurate. These mistakes cause one to question the entire data base. (Section 3.6.3.5)

- A recent study by the Fantus Company identified sewage treatment as the number one problem in Laurel with facilities well over capacity, yet this study says none of the treatment facilities are at 100 percent load capacity and Laurel is at 45 percent capacity. Mistakes of this type cause one to question the entire data base. (Section 3.6.3.7 and Table 3-42)

- The first sentence should include fear of nuclear materials and accidents. (Section 5-4)

- Under "displacement of residents," fair market value does not compensate for damages associated with relocation when not desired. To have a fair market you must have a willing buyer and a willing seller. (Section 5.4.1.4)

- The employment picture is clouded by a lack of classification of local skills versus skills needed. (Section 5.4.2.1)

- In the area of protective services, allocation by population is not valid because current distribution of services is heavily weighted to incorporated areas; yet much of new growth occurs outside corporate limits. (Section 5.4.3.3)

- Sewage treatment is a major problem and currently inhibiting growth in the Laurel area. Water supply could become a problem in the near future. (Section 5.4.3.5)

- There exists a continued refusal to admit that nuclear facilities and the fear factor are a major cause of social impacts and that impacts currently exist. (Section 5.4.4)

- It is incorrect to state that lifestyles of in-migrants will blend into the region, particularly in rural areas. Culture, standards, and education levels will be different and cause conflict. (Section 5.4.4.2)

- The word "socioeconomic" is misused as "economic." The disqualifying conditions are more likely to be social, but little is said about social structure. Conditions which are not mitigable are likely to be found in dealing with people problems, particularly the elderly and those dependent upon existing systems remaining in place. (Section 6.2.1.7.1)

- Past trends in Mississippi's growth in rural areas has found trade expansion being dominated by national chains to the detriment of locally owned businesses. No mention is made of how individual business loss will be mitigated. We would not consider this a favorable condition, but rather a disruption. (Section 6.2.1.7.2)

- The socioeconomic ranking of Deaf Smith versus Richton should have Richton with the greatest impact because of community impacts. Deaf Smith impacts were based on agriculture, yet we currently have more agricultural land in production than needed. (Section 7.3.2.1.2)

- The Draft EA does contain evidence that the report authors identified the existing archaeological sites, as recorded by the State of Mississippi, and historical sites, and as recorded in The National Register of Historic Places. However, in most project-oriented studies, it is standard procedure to undertake a cultural resource survey. The survey would include a team of archaeologists and historians performing an on-site inspection to identify any endangered cultural resource sites or artifacts.

As part of the historical site survey, a more up-to-date historical narrative of the surrounding area should have been included. Given the material that is presently contained in the Draft EA, it is impossible to understand the context of the project study area's economic, political, or social development. In some cases, a study area's historical profile can indicate to decision makers whether a community's past and existing development will be conducive to the types of changes anticipated by project development. For example, an historical review of the Hanford Reservation in Washington State would demonstrate that the area's exposure to nuclear energy development would be consistent with a future role as a host site for a nuclear waste repository. However, an historical review of the Richton Dome Site might suggest that other forms of economic activity are more consistent with the area's historical character.

- The population characteristics information provided in the Draft EA should be improved by including a point of reference; that is, contrasting historical population growth trends and future projections to statewide trends and projections. Such a comparison would include ten-year intervals of average annual rates of growth, providing indicators of how the population is changing within the study area as compared to the state as a whole. As the information is now displayed, it is not clear whether the project study area is losing population to other counties within the state or elsewhere. Once population growth is put into "perspective," the following descriptions of economic activity become more meaningful.

  Population age cohorts are usually displayed graphically in population pyramids rather than in statistics tables. This allows the reader to perceive immediately the age distribution of the study population. In the Draft EA, the significance of the study area's age distribution received limited discussion. Different age cohorts rely more heavily on different types of services and affect regional economic activity in different ways.

- In general, the economic activity sections of the Draft EA lack detail and interpretation. For example, the economic sectors depicted in Table 3-34 could have been disaggregated to a broader level. By using the U.S. Bureau of the Census General, Social and Economic Characteristics data (1983), the nine sectors indicated could have been disaggregated into a forty-sector model. In the same vein, by utilizing the Census of Agriculture, the Census of Retail Trade, the Census of Wholesale Trade, the Census of Manufacturing, and the Census of Service Industries, more explicit information about the primary economic sectors could have been made available. As the information now stands, we are aware that manufacturing is a very important economic activity to the regional economy, but we do not know what type of manufacturing is being conducted. The same could be said of the wholesale and retail trade sectors, as well as agriculture to a lesser extent (though this sector is always of great political importance).

  There seemed to be a lack of regional planning techniques employed to analyze economic activity in terms of income, employment, and magnitude of economic sector activity. For example, although the Draft EA preparers acknowledged that employment patterns are an effective measure of economic activity, historical employment trends, based on disaggregated economic sectors at a county-by-county and regional level, were not depicted. Neither was the project area's economic activity evaluated according to basic and service employment for interregional relationships among economic sectors and for the study region as a distinct economic unit. Two simple approaches could have been employed: the minimum requirements technique and the preparation of location quotients. By using the minimum requirements technique, "baseline" employment multipliers could have been provided for each county and for the study area at large. Also, location quotients could have been used to compare relationships between the county or project study area economies and the larger economy of the state. Location quotients are valuable, because they allow for identification of those local and regional economic activities that have "comparative advantage" when compared to the same activities in a large economy.

Again, by developing economic multipliers through the minimum requirements technique and developing location quotients, the Draft EA preparers could have relied upon a straight-forward means of providing a higher level of interpretation of the project study area's economic activity (also, other regional planning methods could have been employed to develop multipliers or describe economic activity).

Given the significance of a nuclear waste repository site to the local economy, it would appear necessary to described baseline economic activity by using a regional input/output model. Input/output models are commonly used to assess internal transfers of production among economic sectors within a specific geographic region. The I/O models identify the magnitude of interregional activity--expressed as demand among sectors, income and employment multipliers, and gross regional production. Although an existing I/O model for the region is probably not available, a statewide I/O model has probably been developed, and it should have been modified to prepare a regional model for the project study area.

State and local government and private sector policies should have played an important role in determining how repository siting might affect or be affected by future patterns of economic activity already planned within the study area. Therefore, the Draft EA preparers should have contacted economic planning agencies within the state to determine likely policies that would affect the project study area. From the information given in the Draft EA, it is difficult to determine whether this type of economic policy evaluation was conducted in a thorough manner.

- The information provided in the Draft EA is very limited, and it is not characteristic of the current standards usually employed by social impact assessment practitioners. While it may not be reasonable to expect the Draft EA to contain community profile information, such as that obtained from survey and ethnographic research, other less rigorous methods could have been employed to convey an adequate perspective of community social interaction. For example, the Draft EA preparers could have prepared a

preliminary quality of life or social well-being indicators data set based on existing census data, the Social Indicators III data set, and from a review of existing survey research in the project area (such as surveys conducted by the state's land grant university).

- The Draft EA states that "various multipliers and percentages were chosen on the basis of research conducted for other large-scale developments in rural settings." As stated above in the economic section, income and employer multipliers should have been prepared for the project study area. These multipliers will identify basis to service employment characteristics that, in turn, will affect the level of inmigration to the project area. It is inappropriate to apply multipliers from other areas to the project study area, particularly given the project's magnitude.

  The Draft EA notes that "the analysis presented here is considered a worst case scenario"--the worst case scenario being no mitigation policies to limit repository-related inmigration, and this scenario is being used for various site comparisons. But the Draft EA preparers also note that mitigation measures are required by the Nuclear Waste Policy Act of 1982 and will be developed by DOE for the selected site. Although DOE is accurate in assuming that mitigation measures should be formulated according to specific site conditions, it is misleading not to incorporate, to the extent possible, local factors into the Draft EA evaluation that would have a direct bearing on population growth and inmigration related to various levels of employment. Population growth and corresponding economic activity will have a direct bearing on the types of fiscal expenditures necessary to provide community infrastructure needs. So, in one sense, while DOE is being conservative in presenting a worst case scenario in terms of population inmigration as a result of economic activity, this type of scenario tends to skew an interpretation of public and private sector service needs as presented in the Draft EA.

A related factor to the above comment concerns the arbitrariness of the worst case scenario. For example, in Table 519, the inmigration model predicts direct inmigration for the repository work force (construction phase) to be approximately fifty percent. This "fifty percent" figure appears to be completely arbitrary (even if it is based on case studies in other areas) and probably does not reflect the reality of local conditions. In effect, the arbitrary nature of the worst case scenario turns the impact assessment process into one of the "scenario generation" rather than impact measurement. At the risk of belaboring the point, I would offer one concise example. Clearly, if the repository were sited at the Hanford Reservation in Washington State, the percent of the repository work force inmigrating would be fifty percent; it would be much lower (a large work force is already available in the Tri-Cities area). On the other hand, it seems likely that the work force in the area of the Richton Dome site would not be adequate to cover a fifty percent construction employment. As a result of the size and nature of the existing work force, it is probable that the direct employment inmigration would be much higher than fifty percent for the Richton Dome area. Enough said.

- One point should be stressed concerning employment opportunities generated by repository siting. In areas where either a large or skilled work force is not readily available, contractors for large-scale projects tend to bring their own employees with them to the site. Consequently, it will be very important for strict mitigation policies to be developed and employed by the Department of Energy in order for local area residents to gain the greatest advantage from new employment opportunities. It would also be reasonable for the states under siting review to require DOE to outline, at least in a preliminary form, mitigation plans that would enhance the employment opportunities of local citizens. Mitigation policies of this type are difficult to enforce, and consequently, these policies should be given careful scrutiny at an early stage.

It is suggested in the Draft EA that, during construction, approximately $56 million will be spent in the local area as a result of direct and indirect purchases related to the project (this assumption is based on an estimated 3.5 percent of repository purchases being made locally). Two points should be stressed here. First, because the anticipated repository purchase percentages are based on experience with other large construction projects, there is no guarantee that the seemingly minimal 3.5 percent of repository purchases will actually be made in the project area. Characteristically, contractors purchase building materials in bulk quantities from venders who reside outside the work area and who have already established long-term purchase agreements with contractors. As such, in the case of the Richton dome project, this 3.5 percent estimate of repository purchases may be overly optimistic. At any rate, better evidence is needed to substantiate this estimate. Second, it should be emphasized that, as noted in the Draft EA, this $56 million represents an annual increase of ".4 percent" of the total 1982 sales for the study area. To be sure, the real contribution of repository siting to the study area's economy will be in basic and service employment, and not due to the economic stimulus of direct project purchases.

- A description of the existing public and private services and the ability of local governments to meet service demand is lacking. The Draft EA does not provide enough detailed information to determine how public sector costs (social overhead costs) and revenues are affected by program or project development. For example, as part of a fiscal impact analysis, the existing service environment should have been more adequately described. This could have been accomplished by providing a matrix (matrices) of local government functions and revenue sources. These services would include education, medical and mental health, public safety, utilities, transportation, libraries, and recreation facilities. Explicit service costs should be included, as well as, existing service standards of comparable jurisdictions (rather than national service standards). Average unit demands and marginal capabilities of the existing services should have been identified and discussed.

It would be equally important to discuss existing projections of future revenues and public service expenditures, although the Draft EA notes that the Nuclear Waste Policy Act of 1982 requires the Department of Energy to provide grants in lieu of tax payments to state and local governments that host a repository site. But a systematic plan to alleviate fiscal stress resulting from infrastructure needs is lacking. This is, no doubt, a generic problem associated with all of the Draft EA's that are being prepared by the Department of Energy, but surely a more thought-out or systematic plan of action could be specified in the Draft EA's. It should not be taken for granted by the repository host that adequate fiscal impact assessment needs will be met entirely by the federal government.

- One major feature is conspicuously lacking in this description: implementation of public involvement programs. Although the Department of Energy has invested considerable funds in the review and design of public involvement programs for nuclear waste repository siting, DOE seems to have forgotten to include a meaningful discussion of public involvement programs as part of the agency's socioeconomic analysis (a one-sentence statement is not meaningful discussion). Public involvement programs will become a necessary and vital part of the planning and decision-making process surrounding repository planning and local development. The primary goal of the public involvement programs will be to allow DOE to approach project implementation as a community development effort and to convey this theme to the general public and special interest groups. Public involvement programs are the implementation of a systematic process, where community residents can provide an on-going contribution to local planning activities stimulated by repository development. More importantly, a public involvement program is not a public hearing, but a comprehensive set of activities that must be employed systematically over time.

Department of Energy officials to enforce the public involvement principles outlined in: Howell and Olsen, Citizen Participation in the Socioeconomic Analysis of Nuclear Waste Repository Siting. Columbus, Ohio: Battelle Memorial Institute, 1981. This report was prepared under a Battelle contract for DOE.

- The format and substance of the draft environmental assessment for the Richton Dome site reflects a generic approach to evaluation that the Draft EA contractor, no doubt, employed in all of the various assessments prepared. As a result, state and federal decision makers received a minimal amount of information necessary to interpret significant socioeconomic impacts that could enhance or hinder the siting of a nuclear waste repository. Given the level of detail indicated, the Draft EA preparers could identify practically any rural location in the United States and arrive at the same "generic conclusions" that apply to the Richton dome site, concerning socioeconomic components. However, the Department of Energy will likely try to "escape" the above criticism by stressing that, under the site characterization process, "[further] socioeconomic conditions would also be investigated in the area expected to be affected by the repository." In other words, DOE would avoid the above charge by stating that it intended to do a full and comprehensive socioeconomic analysis that is contained in the environmental assessments are relatively useless in terms of identifying advantageous or prohibitive factors concerning nuclear waste repository siting.

  If the Department of Energy adopts the stance that the socioeconomic components of the Draft EA for the Richton Dome site are indeed adequate, then the state of Mississippi should thwart this charge by comparing the Draft EA to state-of-the-art socioeconomic impact assessments of other large-scale projects--specifically, water resources development projects. With a marginal amount of effort, a number of examples could be made available to demonstrate conclusively the insufficiencies of the Draft EA.

6.0 ADDITIONAL COMMENTS

There are many comments generated by reviewers of the Richton Draft EA that do not fit neatly into the major issues discussed earlier. In addition, there are comments that are primarily editorial in nature which pertain to slight clarification or corrections of facts. These comments have been collected together in this section. In certain cases, the issues written here have also been discussed in other sections.

- The projections for water usage (page 3--84) state that less water will be used in 2000 than at present. This fall in usage is said to occur due to new technology in power generation. This projection is absurd due to the fact that population and industry will surely increase. We are now in a stage of nuclear generation. According to the same references, nuclear power generation requires more water than any other source of generation. These projections should have been revised possibly with the use of USGS usage projections.

- The system of placing two numbered pages per sheet and rotating 90 degrees counter-clockwise from the normal is further complicated, and irritating to the reader, when one numbered page is again rotated 90 degrees counter-clockwise, making it 180 degrees or upside down from the normal (i.e., pages 3-36 and 3-37). This peculiarity is found throughout the entire document and is most distressing.

- The systems used for comparative evaluations such as those found in Table 2-5 and all tables in Chapter 7 seem to be a concerted effort by the DOE to confuse the reader. Table 2-5 lists discriminating conditions for the three salt dome sites. The conditions present at a particular site for each criterion are denoted by either P (Present) or by NP (Not Present), and could be either desirable or undesirable depending on the presence of a very small + (plus) or - (minus) preceding the condition description. Comparative evaluation tables found in Chapter 7 are rendered almost unintelligible by the rating system (i.e. - 1a, 1b, 2a, 2b, etc.).

- There is a disturbing lack of site specific and basin specific data for Richton Dome. This is evident by the small number of references at the end of each chapter specific to Richton Dome or the Mississippi Salt Basin. When references are examined, all too often one sees "no direct information available", "previous investigations did not include tests", "present data are insufficient", etc., yet comparative evaluations are being made on such (lack of) data. References for Chapter 1 list only 3 references specific to salt domes or Gulf Coast Salt Dome Basins, 25 references specific to other study areas or rock types and 20 not specific to any area or site. Of the 20 nonspecific references, there are 2 on salt deposits in the U.S. References for Chapter 2 list only one specific to Richton Dome and two specific to the Mississippi study area. A similar accounting has not been done for the remaining chapters.

- With respect to Section 3.2.1 of the Richton Draft EA, The text implies that the Citronelle Formation was deposited only on the Hattiesburg Formation. The Citronelle Formation is an extensive unit deposited unconformably over a number of units.

- With respect to Section 3.2.3 of the Richton Draft EA, The Claiborne group is located adjacent to the repository level in the salt stock, yet there is only a very brief discussion of the group. If radionuclides should penetrate the salt stock they may move into the adjacent Claiborne group. Therefore, we believe this unit is one of the most important units surrounding Richton Dome and should have been discussed in considerable detail.

- With respect to Section 3.2.5.7 of the Richton Draft EA, In the discussion of the geologic history of the Richton caprock, the Draft EA cites evidence of erosion of the "false caprock". This evidence consists of locally thin or absent "false caprock" that "coincides with removal of middle Oligocene sediments". It should be noted that the limestone section or "false caprock" is generally thought to be formed by calcium

enriched fluids associated with the anhydrite section or "true caprock" (McLeod, 1960)[1]. Therefore, the "erosional" areas may actually represent areas of low permeability and/or porosity which were not affected by the calcium enriched fluids.

*1. McLeod, R.R., 1960. A Theory for the Formation of Limestone Cap Rock of Salt Domes, Transactions of the Gulf Coast Association of Geological Societies, volume 10, pp.151-157.

- With respect to Section 5.2.1.1, although similarities exist in repository depth and construction between the WIPP site (New Mexico) and Richton, the geologic setting is entirely different. It is of questionable validity to use projected amounts of subsidence and thermal expansion derived from the WIPP site for application to the Richton site.

- With respect to Section 7.2.1.5, the Draft EA's report the Richton Dome to be 160-190 feet above mean sea level. According to ONWI-278, potential rises in sea level of up to 360 feet above present mean sea level are predicted with the melting of glacial ice. A change in sea level of this magnitude would result in inundation of the Richton site. More moderate rises would affect drainages and possibly result in increased swamping or flooding of inland areas. Given a rise in sea level of as little as 150-200 feet above the present Gulf Coast shoreline, coastal erosion could seriously threaten waste isolation.

APPENDIX A

DEPARTMENT OF ENERGY & TRANSPORTATION
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August 6, 1984

Mr. Theodore J. Taylor, Chief
Socioeconomic, Environmental and
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Salt Repository Project Office
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505 King Avenue
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RE: Additional comments on ONWI-499

Dear Mr. Taylor:

As indicated in previous correspondence, we had one of consultants review and supply us with comments on the subject document. Please accept this correspondence as our specific comments on ONWI's "Socioeconomic Data Base Report for Mississippi: Preliminary Draft". There are four major deficiency areas cited by our consultant.

First, under the guidelines established by the President's Council on Environmental Quality (CEQ), impacts are "significant" if they are important locally, nationally, or at some other point along the geographic size continum. ONWI's selection of "Mississippi Socioeconomic Study Area Counties" contains far too much area in some respects and too little area in others. The very real impacts that have already taken place and are likely to continue taking place in the immediate vicinity of the site — within a few miles of the Richton Dome — are masked in the aggregation of all impacts across an eight-county region, rather than brought out clearly as the CEQ regulations require. At the same time, different (but also important) types of impacts will be taking place outside of the ONWI study area. The document itself notes that many of the workers will come from "major urban areas in the region, i.e., . . . Gulfport/Biloxi, Pascagoula/Moss Point, and Mobile" (page 7), and as the degree of controversy at public hearings indicates, the potential for a repository has especially significant implications from the communities along Mississippi's Gulf coast that are "downstream" from the repository and heavily dependent upon tourist revenues. A representative survey of visitors to these resort areas could reveal that a significant fraction of the visitors would be reluctant to return if a nuclear waste repository were to be located some seventy-five miles away -- particularly since competing resorts would not suffer such a drawback.

The second problem is that it is limited to "available data" even from the counties that are included. The result is not only incomplete but misleading.

The ONWI report fails to consider very important nonmarket goods (e.g., food grown in gardens or obtained through hunting, fishing, and gathering from local forests) and services (e.g., the kind of public safety protection that is provided by friends and neighbors who "keep an eye out" for one another, the kind of the mental health and other counseling provided by friends and neighbors, or the kind of "welfare" and social services provided both through organized means such as church group charities and through informal means such as "caring for one's neighbor" that are so common in the region). These omissions, moreover, are quite serious in that they lead to an underestimation of both the goods and services currently available in the region and the impacts that can be expected to occur (and have already occurred) from repository-related activities will be significantly underestimated rather than clearly identified unless this omission is rectified.

Third, even the data that are publicly available are not adequately utilized. To note only some of the more obvious omissions, the report provides no 1980 census data on births, death, or migration, no information on education levels, land use/ownership patterns, etc., and no data on social services/ crime prevention, etc. Moreover, available data are often not presented with sufficient specificity to allow for informed decisionmaking. The report presents data for the economic sector of "services -- without providing specific information on income obtained from tourism, which is likely to be affected far more directly than will other services such as shoe repair -- and it provides no information on specific crops or on specific mineral resources that could prove to be differentially affected by repository activities. The report reflects no serious effort to draw upon available documents discussing the history and culture of the region, makes no reference to newspaper files or existing historical documents, and generally reflects a total absence of effort to obtain relevant insights on the culture and social structure of the region and its people.

Finally, while errors of "commission" are generally less severe than the document's errors of omission, even where the report draws upon and analyzes the available data, it sometimes does so erroneously. Perhaps the most serious error of this sort is contained on pages 10-11: while six of the eight socioeconomic study area counties have populations that are at least 20 percent black the text somehow erroneously concludes that "approximately 10 percent" of the study area residents are black. In fact over 20 percent of the residents are black, a figure that is significantly higher than the national average -- and is an important factor to be considered in assessing likely impacts, particularly since many blacks could prove to be more vulnerable than whites to the disruptions created by repository development even after the effects of poverty are controlled statistically. A number of other errors suggest that, the document may have been prepared with less care than might be desirable; for example, the report concludes that Perry County's relatively high unemployment "may be due to a significant decline in agricultural employment" of 29 percent between 1971-81, "without sufficient increases in other employment sectors" (page 29). A quick look at Table 1.2.1, which is cited to support this conclusion, shows that this 29 percent decline amounted to a total of 40 jobs, a figure more than offset by the 100-job increase in manufacturing alone. Other errors include the fact that the

University of Southen Mississippi, not Mississippi University, is located in Hattiesburg, and that the document's discussion of "underserviced facilities (such as schools)" appears to be an effort to create a definition that most professionals in the field would find puzzling (and that clearly is not representative of general usage).

The overall result of these errors and problems is that the "Socioeconomic Data Base Report for Mississippi" is seriously deficient even for preliminary planning purposes. The Department of Energy is not required to gather all conceivable data on the local area or broader impact region, and in fact such an exercise would have little usefulness or relevance either for the Department of Energy or for the State of Mississippi. The DOE is required, however, to make a good-faith effort to obtain data on significant impacts and on factors that can reasonably be expected to be relevant to decision-making. In the area of economic impacts, narrowly defined, the document has a reasonable amount of bulk while still providing little information on the specific kinds of economic impacts that could reasonably be expected to occur (both in the short term and in the long term) and that are clearly relevant to decisions on repository siting. In the areas of social, cultural, psychological, and institutional impacts, the picture is considerably worse. The report makes no visible effort to discuss the unique and deeply important characteristics of the local culture. The discussion of data that could be relevant to potential psychological impacts is nonexistent, and the discussions of social-structural factors is so thoroughly inadequate that no detailed critique is likely to prove useful. Even so, the discussions on page 93 are instructive: under "social well-being", a complex and many-faceted set of considerations that is often considered by professionals to be the "bottom line" in social impact assessment, the document notes merely that "data on crime rates were not available". Similarly, the equally complex and important area of "community attitudes and perceptions" is apparently equated by the ONWI study team with attitudes about "new and expanded community facilities and equipment, additional utilities and industrial park development".

I would like to thank you for this opportunity to present these more comprehensive comments. I look forward to seeing your contractor's revision to the socioeconomic data base report. If you have any questions or comments please do not hesitate to contact us.

Sincerely,

John W. Green
Director, Nuclear Waste Division

JWG:ja

cy: Technical Assistance Subcommittees;
NWPAC and NWTRC

NE # 5348-94

DEPARTMENT OF ENERGY & TRANSPORTATION
Watkins Building, 510 George Street
Jackson, Mississippi 39202-3096
601/961-4733

March 4, 1985

Mr. Jeff O. Neff
Program Manager
Salt Repository Project Office
U. S. Department of Energy
505 King Avenue
Columbus, Ohio 43201-2693

Dear Mr. Neff:

The State of Mississippi believes that there are many inconsistencies and a definitive lack of data in the preparation of the "Socioeconomic Data Base Report for Mississippi: Technical Report" (ONWI-499). The attached comments as prepared by Dr. William Freudenburg, reflect the views of the State of Mississippi. Please accept these comments to aid in correcting deficiencies in the final Environmental Assessment. Your cooperation is greatly appreciated.

Sincerely yours,

John W. Green
Director, Nuclear Waste Division

JWG:cpf
Attachment

cy: Dr. Beth Darrough
Dr. Theodore Taylor
Dr. William Freudenburg

SSRA

Social Science Research Associates

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NWP

December 11, 1984

Mr. Ronald J. Forsythe
Nuclear Waste Program Manager
Department of Energy & Transportation
510 George Street
Jackson, MS 39202-3096

RE: Review of "Socioeconomic Data Base Report for Mississippi: Technical Report" (ONWI-499, December 1984)

Dear Ron:

This letter will provide you with my technical review of the above-noted document from the Office of Nuclear Waste Isolation (ONWI).

On the positive side, a number of the errors contained in the preliminary (September) draft of this document have been corrected. In addition, the final technical report makes increased use of 1980 Census data in a number of places where the preliminary draft made use of less appropriate data sources, and limited quantities of additional data have been provided. On the negative side, however--and on balance--the final technical report retains many of the problems and inadequacies that characterized the preliminary draft. The net result is that ONWI-499, while marginally improved in certain respects, remains a flawed document, containing information that is essentially irrelevant for decisionmaking on the issue at hand, failing to provide evidence of a good-faith effort to obtain relevant data and subject those data to appropriate analysis, and succeeding only in consuming large sums of money while producing a final report with little to no utility as an input to informed decision-making.

The remainder of this letter will provide more specific details, but it needs to be noted that the report's inadequacies and omissions are so pervasive as to make it impractical in a letter of this length to discuss or even list them all. Nor does it appear likely, given the lack of responsiveness to the state's constructive technical criticisms of the preliminary draft of the report, that much purpose would be served by an extended discussion of the many types of socioeconomic data and analysis that would need to be added to bring the report up to acceptable standards of adequacy. This letter will take the much simpler approach of discussing what the document contains rather than what it omits--noting only the most obvious of the problems to be found in the narrow range of data contained in the final report--and drawing attention briefly, as necessary, to some of the areas of socioeconomic analysis which are neglected entirely or in which the report is so thoroughly inadequate that little purpose would be served by a more detailed discussion.

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First, the geographic coverage remains inadequate both in its extent and in its degree of focus. In extent, the eight-county study area is too small to provide information on the full range of significant impacts likely to take place and already taking place in the state of Mississippi, as has already been pointed out to the Department of Energy (DOE). The clearest example of this problem has to do with the exclusion of the Gulf Coast counties from the study region. As can be inferred from the fact that many of the workers on the Leaf River plant commuted from Gulfport-Biloxi and Pascagoula-Moss Point, a number of the standard socioeconomic impacts likely to be created by a repository will be experienced in the counties to the south of the DOE study area--and the special impacts of the repository along the Gulf Coast could prove to be even more significant. Indeed, DOE's repository-related activities have already created noteworthy impacts in the Gulf Coast counties, as has been noted by numerous Gulf Coast residents and as is shown by the attendance of literally thousands of the residents at public meetings where these concerns have been expressed. The concerns are not without basis, particularly when one considers the importance of tourism to the region, the fact that groundwater flows are predominantly in the direction of the coast, and the fact that DOE has evidently made no effort to obtain representative survey data from Gulf Coast visitors on the possibility that the presence of a repository would lower the likelihood of their returning to Mississippi on future visits. In the Council on Environmental Quality's (CEQ's) regulations, moreover, the existence of controversy is explicitly noted as one of the factors to be considered in determining the "significance" of Federal actions and their impacts.

Even the inclusion of the Gulf Coast counties, however, would not provide a sufficient data base for considering all of the significant impacts of repository-related activities on the state of Mississippi. To note again only the simplest example of other impacts that extend beyond the eight-county area, transportation impacts would be felt along certain corridors that cross the entire state. At the other extreme, the data presented are wholly inadequate in their focus on the many impacts that are likely to be experienced or have already been experienced predominantly in Perry County and/or the immediate Richton vicinity. Certain impacts are not likely to be experienced outside of Perry County, and thus DOE and its contractors would not need to gather data across an eight- or twelve-county area for all impacts; indeed, if DOE were to aggregate these more focused or localized impacts across a larger geographic area, the net result would be a masking rather than a clear identification of these significant impacts, which again would be a clear violation of legislative intent, of CEQ regulations, and of legal precedent. Since those impacts are already being felt in the Richton vicinity, however, it is an even more significant error that the final technical report fails to provide the more detailed discussion of impacts that is needed to understand the ways in which the Richton/Perry County area is being affected by repository-related activities.

The second major problem area is that the final report makes inadequate use of available data. There is virtually no evidence that DOE and its contractors have consulted or considered the many existing studies on the region, its history, people or cultures. There is not even any evidence of the preliminary if superficial step of attempting to strengthen the socioeconomic data base by subscribing to and reading the region's newspapers. The examples of this problem could scarcely be less laudable in what they imply about DOE's efforts

to obtain the relevant data. Page 89, for example, refers to an "expected" increase during 1984 in visitor travel through the state "en route to the World's Fair in New Orleans." Unfortunately, visitors relying on this report would be as badly served as decisionmakers who are expected to use ONWI-499 as a source of information on the socioeconomic impacts of repository development. The World's Fair ended in November 1984, the month before the publication date of the report. In referring to the Leaf River plant, on which all construction had been completed before ONWI-499 was issued, the report refers to "expected" employment on construction (during 1983) and notes that approximately 400 people "will be" employed "once the project is completed" (Page 28).

The problems are equally serious when one considers broader areas of analysis. The description of the "local heritage," for example, stops in 1861--January of 1861, to be specific. One cannot imagine that DOE or its contractors would wish to claim that they have been unable to find any information on the region for the past 120 years, nor that absolutely nothing occurring in the region for the past century or more is deemed to be worthy of consideration. Even the economic and demographic components of socioeconomic analysis--those components for which the existing data base, if properly consulted, would have provided the most information--are not given adequate consideration. There is no discussion, for example, of the evidence behind local residents' strong belief that even being considered as a potential repository site has created significantly negative impacts, even though these beliefs appear to be realistic and deserving of consideration. (During much of the 20th Century, Perry County had a history of out-migration and low economic activity, leaving the county with a lower average income in 1969 than any of the others considered in this report except for neighboring Greene County, even though the entire region was well below the national average. The economy and employment situation began to improve markedly in the 1970s, however; Perry County was experiencing in-migration by 1979 and per capita income was growing rapidly by the end of the decade. Unfortunately, according to many persons who are most knowledgeable about the local economy, there appears to be some evidence that DOE's decision to consider the community as a potential nuclear waste repository led investors to avoid the area or to defer investments in employment-producing activities during the past several years.) These concerns need to be taken seriously, and indeed, even the data presented in this report show unemployment in Perry County almost doubling, from 8.4% to 16.1%, between 1980 and 1982, an increase that is essentially double the statewide increase and triple the national increase in unemployment during the same time. Yet rather than presenting the evidence that would be needed to assess these concerns empirically, the report instead concludes inexplicably that the dramatic increase in Perry County's unemployment "may be due to a decline in agricultural employment" (Page 30)--even though the report's own tables (Page 27) show the county's agricultural employment to have experienced a net decline of only 40 jobs during the ten year period of 1971-81.

Third, there are many areas where the available data are simply not adequate to the task, and probably would not be adequate even if those data were to be used more appropriately. As has been pointed out repeatedly--e.g. in the American Association for the Advancement of Science's publication on Paradoxes of Western Energy Development, which summarizes lessons learned about socioeconomic impact assessment in a region where much of the work has been done, or in the National Academy of Science's report on socioeconomic aspects of

radioactive waste management, to mention just two 1984 examples--economic and demographic considerations provide only one aspect of the socioeconomic impacts that need to be considered. But if the consideration given to economic and demographic impacts has been insufficient, the attention devoted to other areas of socioeconomic impact assessment varies between the unacceptable and the nonexistent. Despite the state's explicit criticisms, the final draft of this document still contains virtually no useful information on the other sociological, anthropological, psychological, cultural and related socioeconomic impacts being created by repository-related activities. One can only hope that this major omission reflects not a conscious decision but the difficulty of obtaining data on many of the factors that need to be considered but that simply are not well-represented by the types of data that have been collected with societal bookkeeping, rather than the imperatives of socioeconomic research, in mind. These sociocultural and related issues are inherently empirical and have been studied quantitatively as well as qualitatively in a variety of contexts, but when they are not represented by available data, DOE and its contractors have little choice but to recognize that fact. It is no more appropriate to make inferences about a region's culture and people from available data on population distributions and unemployment than it is to draw inferences about the region's geological characteristics from equally unrelated but "available" statistics on above-ground activities such as gasoline sales.

Unfortunately, however, while the inadequacies of ONWI-499 in the areas of economics and demography are significant enough in their own right, the inadequacies in virtually all other areas of socioeconomic assessment are so substantial, and the informational problems resulting from these omissions are so serious, that one is forced to ask if the staff producing this socioeconomic data base report possesses range of social science expertise that is necessary to be able to produce the kind of information and analysis that are required for informed decisionmaking. On the basis of a careful technical analysis of the report, it must be concluded that, if such persons have been hired, their expertise is not being used. Enough time has passed, and enough money has been invested, that the Office of Nuclear Waste Isolation could already be in possession of the needed data--at little or no additional expense--if ONWI had taken seriously its obligation to obtain the full range of relevant social science expertise and to allow those experts to gather the necessary data. The inadequacies in assessing sociocultural, institutional, social-psychological and several other categories of socioeconomic impacts are so substantial as to be almost overwhelming, and so little useful information is contained about these types of impacts that little purpose would be served by detailed criticisms. There is essentially nothing in the document by way of the data and analysis that would be needed before decisionmakers could be properly informed about the significant impacts of repository development. One can only note that, in the absence of the necessary data, DOE is required to utilize worst-case assumptions; yet the worst-case assumptions that would be considered reasonably possible by persons with the needed expertise, particularly in the absence of the needed data, would be so severe as to preclude any reasonable decisionmaker from devoting any further consideration to either of the Perry County locations as a potential site for a repository. Only with appropriate data and analysis from the full range of the social sciences--and not just in economics and demography--would DOE be able to obtain the needed information and analysis. It is to be hoped that DOE and/or its contractors will hire persons with the necessary expertise so that the needed information can be provided in future documents at the earliest possible opportunity.

Fourth, there is a great deal of evidence of carelessness and lack of attention to significant details. While some of the errors contained in the preliminary draft have been corrected, many others remain and new ones have been introduced. Examples include a reference to "a percent increase" that should presumably refer not to a 1% but a 150% increase (page 28), missing cells and other missing information in tables (e.g. Tables 4-1 and 5-5), a student-teacher ratio being presented as a teacher-student ratio in Table 4-8, portions of Table 5-3 being unreadable, and so forth. "Non-sentences" remain from the first draft, including one on page 43 that has been revised but is still presented in non-sentence form, along with a number of other grammatical errors that have no place in a final report. Inexplicably, while section 4.4.2 of the final report drops the discussion of "medically underserviced areas"--this being terminology that at least has an accepted meaning--the report retains the assertion on page 40 that "Underserviced facilities (such as schools) may be revitalized" due to the impacts of repository development. This comment would be considered meaningless by most technical specialists, let alone by decisionmakers who have little training in the social sciences, and the context of the term does little to clarify it. The intent appears to be to have implied that some such facilities have excess capacity and thus might be "underutilized" (rather than "underserviced") at present, but even with this interpretation it is not clear what the report means to convey by claiming that such facilities would be "revitalized." Given the general consensus that reports for decisionmakers should at least be written in a language closely approximating English, one can only hope that if DOE documents mean to refer to facilities with excess capacity, they will say so.

This list of examples could be expanded, but the nature of the major as well as minor problems is such as to raise a larger and more disturbing question, and the nature of that question needs to be noted directly. It is at times difficult to escape the impression that the focus of effort in this technical report has been to produce bulk rather than to provide information for decisionmaking. One wonders what relevance for decisionmaking can be found in knowing that certain counties have an "even distribution" (i.e., roughly equal numbers of people) in the 5-14 and 15-24 age brackets, or in knowing the number of members who serve in the House and Senate of the state's "bicameral" legislature, particularly since at last count 49 of the 50 states had bicameral legislatures. Yet while the report manages to devote attention to these topics and to others that have equally little relevance to informed decisionmaking on nuclear waste repository siting, its discussion of "life-style" is as close as the report gets to important impacts on culture and the region's ways of life. While those impacts clearly need to be considered, they are currently "discussed" in a section that is still less than a single page long--and that devotes most of its insufficient space to a listing of the locations of the region's museums, libraries and galleries. Even DOE employees who are not social scientists, if they have even visited the region, surely could not fail to realize that profound impacts have already been created in the hostility and loss of credibility that DOE's own actions have inspired in the local populace, and yet no mention is made of these impacts, nor of the problems that would follow from these impacts if a repository were to be located in the region. Also ignored altogether are such matters as values, community cohesion, trust in institutions, the cultural significance of the land and the networks of support and control that are so important to the local ways of life that one could not hope to understand the locality without giving them careful consideration--and this is only a partial listing of the omissions. With all

due respect to DOE and its contractors, one cannot help but wonder if this and many of other problems noted above--e.g., failing to mention the connection between repository-related activities and Perry County's increase in unemployment--could even be the result of a deliberate attempt to avoid identifying the full range of impacts associated with DOE's activities.

The questions raised here cannot be settled by the state alone, but the problems are frankly so substantial as to create doubts about DOE's willingness even to consider the legitimate concerns that have been raised both by social scientists and by knowledgeable local residents. While these deeper questions cannot be answered here, however, it is possible to summarize in a single sentence the judgment that needs to be made about the final technical report: ONWI-499 clearly fails to provide evidence of a good-faith effort to assemble the types of information that will be needed if decisionmakers are to be able to consider even the most significant of the impacts of repository-related activities, and equally clearly, one can only conclude that the report provides a thoroughly inadequate basis for making properly informed decisions.

I hope these comments will be of assistance to you; please feel free to contact me if I may provide you with any further information.

Sincerely,

William R. Freudenburg, PhD
Director, SSRA