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OFFICE OF THE GOVERNOR
STATE CAPITOL
AUSTIN, TEXAS 78711

May 23, 1985

Mr. Benard C. Rusche, Director
Office of Civilian Radioactive Waste Management
United States Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

RE: STATE OF TEXAS COMMENTS ON NUCLEAR WASTE POLICY ACT DRAFT ENVIRONMENTAL ASSESSMENTS FOR DEAF SMITH COUNTY SITE, TEXAS (DOE/RW-0014) AND SWISHER COUNTY SITE, TEXAS (DOE/RW-0015): ADDENDUM TO COMMENTS SUBMITTED MARCH 19, 1985

Dear Mr. Rusche:

The enclosed addendum to our March 19, 1985 comments on the subject draft Environmental Assessments constitutes our final submission of comments in accord with the review procedure established in my letters of February 5, 1985 and March 19, 1985, and your response. The comments are final only to the extent of our ability to review these documents and the other seven Environmental Assessments within the constraints of time and availability of reference documents.

The enclosed comments are a combination of reviews submitted to this office by various affected state agencies, contractors to this office, and personnel within the Nuclear Waste Programs Office. This is a result of this office having responsibility for both the coordination of state activities relative to the DOE repository program and oversight of the DOE program as it relates to Texas.

The remainder of this letter contains a spectrum of comments on the Environmental Assessments, much of which is noted in other parts of our two packages of comments. The intent is to highlight some of the issues of interest and concern. The following paragraphs are not intended to serve as a comprehensive summary of the State's comments, but rather as augmentation of the enclosures submitted on March 19, 1985 and along with this letter.

Comments of the Nuclear Regulatory Commission: We have reviewed the comments of the U.S. Nuclear Regulatory Commission regarding the two Texas site EAs and are hereby incorporating the substance of those findings into the comments of the State of Texas. We do not fully subscribe to the recommendations of the NRC regarding the extent of needed revisions in the final EAs, but by incorporating the comments we are endorsing the observations of the NRC regarding the factual presentations in the draft EAs.

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Monitored Retrievable Storage: With recent presentations by the DOE regarding the intent to propose an MRS for Congressional authorization in January 1986, it has become necessary for the EAs to incorporate that concept and facility into the EAs as an alternate for consideration in all appropriate evaluations and comparisons. Since the approach is essentially new to the EAs, it should be presented in a draft supplement to the EAs for review and comment before becoming a part of the final EA. Our understanding of the MRS concept as it is being developed by DOE indicates that it will have considerable influence on a number of the evaluations necessary to the EA, therefore, it should be fully reviewed in draft form as it relates to the siting decisions that are ultimately to be supported by the final EAs.

References: Even at this late date, we are still finding that the references provided to the State by DOE are incomplete for review of the Draft Environmental Assessments. This not only makes our reviews of various assertions of the EAs impossible, but adds further uncertainty to the interpretations, findings and proposed conclusions of the EAs. For example, only one of the 33 cited references on transportation was provided among the EA references forwarded to the state, and we were able to readily obtain only seven others from DOE sources. It is difficult to conceive of the references being unavailable when they are cited in the text of the documents, and our confidence in the overall worth of the documents has continued to erode as we acquired some "missing" references, only to find that they were misapplied and misinterpreted in support of their use in substantiating points in the EAs. The whole matter of EA references and their availability, or lack of availability, makes us question the extent to which DOE is concerned about the technical worth and validity of the repository program to date.

Economic Risk Evaluation: We and other affected states and tribes have pointed out in various presentations that the EAs should contain an economic risk evaluation for each site under consideration. This type of a study would certainly add a necessary dimension to the effort in the EAs to compare the sites and rank them, yet we find no information or analyses that respond to this issue. We are aware that there are plans for such a study, but it is not intended by the DOE to be incorporated in the final EAs. The deferral of this issue is unacceptable to the State of Texas.

Defense Wastes: We specifically requested that defense wastes be included in the waste inventories to be considered in all appropriate portions of the EAs. What little information that is included is inaccurate and misleading, and in no way reflects the extent of defense waste impacts on such factors as repository design and performance, transportation, and amounts of wastes to be managed and disposed. With the President's April 30, 1985 affirmation of commingling, it is imperative that the final EAs respond fully to the fact that defense wastes will be incorporated into the repository system.

Transportation: For more than two years, we have strongly encouraged that the repository program provide a more definitive analysis of transportation relative to each site under consideration for a repository. The generic analyses are inadequate for purposes of comparing among sites on a national scale, when transportation is an integral component of the repository system. It is interesting to note that the evolving MRS planning incorporates a more comprehensive view of many of the transportation issues than does the EAs. It appears that the conclusion was that the information and evaluations were needed to "sell" the MRS concept to the Congress, but were not necessary in "selling" the EAs to the affected states, tribes and the general public. A much more specific and detailed evaluation of transportation issues as they relate to repository siting must be included in the final EAs if they are to serve their intended purpose under the Nuclear Waste Policy Act.

Site Characterization and Repository Facilities: The draft EAs completely fail to describe the proposed projects to be carried out at the site during site characterization and later repository activities. The entire description of shafts for site characterization at the Texas sites is obsolete, and was, even prior to issuance of the draft EAs. The repository development described does not reflect the plans for phased development, nor does it account for the emplacement of defense wastes. The hypothetical plans and designs for both site characterization and repository facilities and activities are inadequate and inaccurate to the point that it is impossible to evaluate the range of potential impacts that must be assessed in order to arrive at a "reasonable comparison" among sites. We know of no other program of the federal government that contemplates actions even at the cost level of site characterization in which decisions and approvals can be reached without an accurate and comprehensive understanding of the proposed project and its projected impacts. The current effort of the EAs to avoid description of the proposed projects is a blatant circumvention of the vital principle of accountability in government decisions, and is in total disregard of the letter and intent of the Nuclear Waste Policy Act when its consequences are assessed. It is not sufficient to characterize the EAs as "bounding" the projects because in many areas of impact analysis, the information is not sufficient in the EAs to establish bounds nor can the average values presented be verified from information presented. The EAs must describe the proposed site characterization and repository projects in sufficient detail to assess impacts both on and off site, as required by the Nuclear Waste Policy Act. Failing to do so brings into serious question the extent to which the EAs are in compliance with Section 112 of the Nuclear Waste Policy Act.

Impacts to the Primary Economy of the Area: The EAs for Texas sites are totally inadequate in their evaluation of the local agricultural economy and the expected impacts of both site characterization and repository activities. Site specific data could have been collected to determine the importance of the sites and counties in which they are located in the area economy, and some analysis of expected impacts undertaken that reflected the great importance

of agricultural production and marketing in the area. The site data presented are largely inaccurate through both errors and omissions and the national importance of the sites and counties is totally ignored in the EAs. There are assertions that represent pure conjecture regarding the extent of impacts to the agricultural economy and markets that are quite apparently just ludicrous responses to the serious concerns of the affected local citizens. A notable example of this offhand response is in the assertion that after 13 years, the perception of contamination of local products would diminish to a point of having no influence on the marketability of local products. This cannot be substantiated, yet is presented as an authoritative, serious fact at an unusual level of precision relative to other information provided in the EAs.

Recent agricultural production data for the nation, for the year 1982, are available from the U.S. Commerce Department. Some data of interest regarding the Texas Panhandle and the counties of interest are contained in the report, which indicates such facts as Deaf Smith County ranking 12th among counties in the nation in value of agricultural products sold, and ranking 2nd in the nation in value of cattle and calves sold. The contiguous counties of Deaf Smith, Parmer, Castro and Swisher figure high in the national rankings, accounting for over \$1.3 billion in value of agricultural products in 1982. And of the top 27 counties in the nation in sales of cattle and calves, these four counties along with six other nearby Texas Panhandle counties are included. Review of the EAs would not lead a reader to suspect the importance of the agricultural economy in the area and at the sites, and certainly would not reveal the extent to which the repository program could disturb or upset this economy. This serious failure of the EAs represents yet another in which the EAs totally miss the mark of compliance with the Nuclear Waste Policy Act. A simple screening of the area relative to its national importance in agriculture should have been sufficient to eliminate this area from further investigation a number of years ago, yet no effort has ever been made by the DOE to assess the primary economy of the affected area with its vast acreage of prime farmland and other highly favorable natural conditions for agricultural production.

Impact on Water Supplies: The EAs provide an inaccurate and incomplete evaluation of the available water supplies and the potential impacts of the program on those water supplies. The water use projections for site characterization and repository activities can be no more accurate than the descriptions of the project activities noted above, yet an effort is made to indicate that the entire project is no more consumptive of water than farmland irrigation. Errors in the calculations, pointed out elsewhere in these comments, and the hypothetical nature of the project description make such a conclusion not only erroneous, but impossible. In addition, such a comparison has no merit when considered in light of the finite nature of the water supply from the Ogallala Aquifer and its current highest and best use. The EAs do not state whether the project water supplies will be pumped from the Ogallala or the Santa Rosa Aquifer, although the effort is made to indicate that the drawdown

from this use would be negligible. How can such a conclusion be reached when the impacted aquifer has not been identified, there are no data presented for the hydrologic characteristics of the Santa Rosa Aquifer, and no attention is given to the rights of adjacent landowners to draw water for irrigation and domestic use? It is not even recognized that a major Santa Rosa well, within the 9 square-mile Deaf Smith site has been contracted by the City of Vega as a future municipal water supply, and currently serves as the major source of irrigation water for a large, specialized seed farming operation. Failure to consider such water supply factors constitutes yet another example of the blatant lack of compliance with the Nuclear Waste Policy Act exhibited by the EAs.

Environmental Radiation Protection Standards (40 CFR Part 191): The Environmental Protection Agency Radiation Protection Standard for high-level nuclear waste repositories (40 CFR Part 191) is still in proposed rule form, yet the rule has been incorporated in the DOE repository site recommendation guidelines, and the working assumption of the EAs is that the requirements of the proposed rule will be reflected in the final rule, whenever it becomes final. It is questionable whether the Guidelines are valid for application in the draft EAs absent the incorporated final rule since an integral part of the DOE siting guidelines does not yet exist. In addition, recent EPA working papers regarding the EPA rule suggest that the standards of the proposed rule may change greatly when they appear in final form. Of particular importance is the location of the boundary of the controlled area (or restricted area) and the extent to which underground waters may be permitted to be contaminated by radioactive materials. Both of the parameters of regulation are currently uncertain, yet the EAs assert that the standard will be met. Without knowing the requirements, that assertion is completely without basis. Furthermore, the State of Texas has consistently objected to the regulatory structure, including the DOE site recommendation guidelines, permitting any level of radioactive contamination of the underground water supplies at and around the site. This position is not reflected in the Guidelines, nor is the potential ability of DOE to meet such an objective elaborated in the EAs. It is unacceptable to the State of Texas to permit the repository program to result in any level of contamination of the valuable and irreplaceable underground water supplies of the site or Texas Panhandle area.

Host Rock Characteristics: As noted in other parts of these comments, the geomechanical characteristics of the proposed host salt bed are essentially unknown at the site, to the extent that it is not demonstrated in the EAs that the host salt is of sufficient thickness to safely or feasibly house a repository. Data on the mechanical properties of the proposed host bed, taken from cores distant from the site are scanty and of questionable validity since the characteristics and thickness of non-salt interbeds and poor quality salt beds are largely undetermined, and the contrived definition of a "thick salt bed" provides no assurance that the physical requirements for repository

construction and performance can even be met at the site. The geomechanical data on the salt itself is misleading in that the suggestion is that the proposed host rock anomalies and inhomogeneities are overshadowed by, and insignificant relative to the characteristics of the limited section of "good" salt. The relatively high creep rates of the salt are also underemphasized to the point that it is highly uncertain whether existing standards of retrievability can be met in a safe or feasible manner. The EAs also understate the fact that shaft sealing under the conditions expected to be found at the Texas sites is highly uncertain, and cannot be assumed to be possible from examples known to the mining industry. Technology may exist to serve as the basis for shaft sealing experiments, but without existing successful demonstration of the ability to seal shafts such as would be constructed during site characterization and repository activities at a Texas site, the State of Texas cannot condone any full-scale experimentation that may result in risks to either the quantity or quality of the underground waters of the area.

Salt Management and Disposal: The EAs, as pointed out in other of our comments, are deficient in their discussion of the management and disposal of excavated salt during site characterization and repository activities. The amounts of salt to be stored on the land surface are not adequately defined because of the hypothetical nature of the facility designs and work plans. The ultimate disposal of the excess salt has not improved in its planning in the two year period during which we have expressed concerns over the matter, and the assurances of available disposal sites are unconvincing and without substantiation. The option of stabilizing a salt pile on site is totally unacceptable to the State of Texas, as this merely constitutes storage and the salt will ultimately be redistributed over the farmlands of the Texas Panhandle. The analyses of salt pile management described in the EAs are largely inapplicable because of a wide spectrum of conditions in these analyses that are not even similar to those existing in the Texas Panhandle. Furthermore, the EAs are not consistent in their presentation of expected impacts of the salt on surrounding farmlands. A primary flaw in the conclusion that salt impacts will be insignificant is first in the understatement of the potential for the windblown distribution of the salt away from the site, and second in the assumption that the salt from the DOE facilities that impacts farmland is the only salt burden that the surrounding farmland will, or must bear. The soil is already burdened with salt as a result of natural conditions and irrigation, and the DOE cannot assume its right to consumption of the full capacity for salt assimilation in the surrounding soils. The suggestion that farmers may wish to grow more salt-tolerant crops does not take other growing or marketing factors into account, and the suggestion of using other salts to flush the DOE salt out of the soil does little to mitigate the damage to the farmer whose prime farmland has already been degraded unexpectedly and must be withdrawn from production until remedial actions may, or may not restore the productivity of the soil. These ludicrous presentations of mitigative measures presented in the EAs not only make a mockery of the spirit of the Nuclear Waste Policy Act but are representative of the DOE's disregard for the rights, concerns and well-being of the citizens of the area affected by the repository investigation and siting program.

Mr. Benard C. Rusche
State of Texas EA Comments
Page 7

Comparisons Among Sites are Flawed: These comments contain a critique of the site comparison methodologies that essentially points out their invalidity. In addition, the unevenness of data, in both level and amount, among the nine sites under consideration in the EAs, has led to the not-surprising conclusion that sites cannot be rated relative to each other on the post-closure factors of the DOE siting guidelines. It is further not surprising that pre-closure factors can result in almost any ranking desired, depending upon the subjective judgements of the operator of the methodology and the arbitrary application of various weighting schemes. What should have been obvious from the ranking exercise is that there are insufficient amounts and levels of information available for the nine sites to make any level of competent comparisons that provide even a minimum amount of confidence in asserting the relative potential suitability of the sites or even the potential individual suitability of any particular site. The only possible defense for the current proposed ranking of the sites in the EAs is that all sites are assumed by DOE to be potentially suitable according to DOE's subjective standards and that significant technical factors played little, if any role in determining the preferred ranking. In spite of the claims of DOE staff, the EAs provide no certain means of reproducing the proposed site rankings, and the EAs do not provide a sufficient basis to verify the rankings as they are proposed in Chapter 7.

Conclusion: For the numerous reasons stated in this letter and the other components of our comments submitted to you regarding the subject draft EAs, it is our general conclusion that the substance of the EAs as presented is insufficient to demonstrate compliance with the requirements of the Nuclear Waste Policy Act. In addition, the documents contain a very large number of errors and omissions of fact that further erode our confidence that the DOE repository program is dedicated to achieving a level of technical excellence in its critical phase of selection of sites for nomination and recommendation for site characterization. As we have encouraged in the past, there should be a thorough re-evaluation of the site investigation and selection program to date with the goal of expanding the screening process to include seeking sites that have a realistic potential of meeting the requirements of licensing and the tests of credibility and acceptability, based upon a thorough and competent analysis of appropriate amounts, levels and kinds of data.

We appreciate the opportunity to review these documents, although the imposed constraints of time and availability of reference and supporting materials permitted a less than complete review from our standpoint.

If you have questions about the comments of the State of Texas on the subject draft Environmental Assessments, please do not hesitate to contact me.

Sincerely,



Steve Frishman, Director
Nuclear Waste Programs Office

enclosures: H-Q

see memo to Ruesche
from Frishman
5/23/85 106-2

Encl. H

State of Texas Comments
on
DOE/RW-0015
Draft Environmental Assessment
Swisher County, Texas
December, 1984

Executive Summary

Page 3, paragraph 2 -- In this paragraph and numerous other paragraphs in the DEA it is stated that DOE must recommend not fewer than three sites for characterization as candidate sites. In fact the NWSA states that DOE must recommend three sites for characterization as candidate sites.

Page 6 & 7 -- The mileage to the nearest railroad is given as 6 miles on page 6, paragraph 2 and as 5 miles on page 7, paragraph 6. Which is correct?

Page 9, paragraph 3 -- Vertical dissolution rates and interior dissolution rates along fracture zones should also be addressed in the paragraph.

Page 9, last paragraph -- Last sentence states that no surface discharge has been identified from the deep brine aquifer. However, on page 2-5, it states that discharge from the lower aquifer units occurs primarily to the east of the site. Which is correct?

Page 10, Figure 3 -- This cross section does not even include Swisher County as stated in the caption (see Figure 3-3); a reference map should be included. The Ogallala and Dockum Formations are not identified in the figure. Since they are an integral part of this study, they should be included in this figure. The cross section line starts in Oldham County goes to northern Randall County and then to northern Swisher County. The nearest point to the site along the cross section line is about 5 miles.

Page 12, paragraph 5 -- How is the 260 acres calculated? What are the components and how much acreage is required for each?

Page 13, paragraph 4 -- The last sentence states that the quality of ground water will not be significantly affected during excavation of the shafts but does not mention quality of ground water after excavation.

Page 14, paragraph 3 -- The mine sites within 100 miles of the Swisher site should be specified. Also, what will be the impact of windblown salt on the immediate vicinity of the site and what will be done to mitigate the impact? The uncertainties of the disposal site given in later sections should be reflected here also.

Page 15, paragraph 2 -- In earlier reports it has been stated that the surface would possibly be leased back to farmers for normal use. If this is the case, there would be draw down of the aquifer from irrigation of crops in addition to that connected with repository construction. This is not considered in this paragraph or elsewhere in the report.

Page 15, paragraph 6 -- This paragraph assumes that the locations of the sources of waste will always be the same. Is that a certainty or could the locations change over the life of the repository?

Page 17, paragraph 1 -- This paragraph summarizes features of the Swisher site that contribute to its ability to isolate waste. It lists many characteristics of bedded salt which pertain to all bedded salt, not just Swisher salt beds. This should be made clear so that it is not misunderstood to mean that Swisher only has these characteristics.

CHAPTER 1

Page 1-3, paragraph 3 -- The Act also requires the DOE to prepare site-characterization plans for State and public review as

well as NRC review. It also requires review of updates.

Page 1-18, Figure 1-2 -- From this figure it is impossible to determine if Deaf Smith and Swisher sites are in the High Plains or the Nonglaciaded Central Region. This figure is also different from Figure 3-5 which should show the same thing.

Page 1-20, paragraph 2 -- The geohydrologic system should include the Triassic Dockum Group including the Santa Rosa aquifer. The Triassic Santa Rosa aquifer is not a minor aquifer at the site and it has high quality water within the site area. This omission must should be corrected throughout the DEA.

CHAPTER 2

Page 2-2, Figure, 22-1 -- The source cited for this figure is incorrect. It was in DOE/CH-10140-2.

Page 2-5, paragraph 7 -- The first sentence states "Recharge of the High Plains aquifer is principally from precipitation collected in playa lakes." This is only theorized for the Ogallala. Also, this is not true of the Dockum which is included in the High Plains aquifer. The last sentence states that discharge from the lower aquifer is primarily to the east yet on page 9 of the Executive Summary it is stated that there is no discharge. Which is correct? Are the locations of discharge points known? If so, where are they?

Page 2-5, last paragraph -- DOE/NWTS - 33(2) states "Before a site can be determined to be suitable, the information must be complete on the full range of characteristics to allow comparison of chosen sites against all siting criteria." This statement and the above cited paragraph are in disagreement. Please explain.

Page 2-6, Figure 2-4 -- The entry for Triassic Dockum in the last column is incorrect. The Dockum has a large supply and low total dissolved solids at the site.

Page 2-7, paragraph 4 -- The last sentence states that few boreholes have been drilled through the salt in Texas. How many is a

"few" and how does that number compare to the number drilled through the salt in Utah?

Page 2-10, Figure 2-5 -- The source of this figure is incorrect, it was in DOE/CH-10140-2.

Page 2-12, Table 2-2 -- Why is thickness of Host Rock not a discriminator at Palo Duro Location A? Could it be assumed then that it is a discriminator at Location B, or is the table incorrect?

Page 2-15, Table 2-4 -- The Human Interference Guideline-statements are not accurate and do not reflect conditions in the area. Exploration has been conducted in the area and resources have been discovered. Environmental Quality Guideline-statements say that the environment can be protected. Does that mean the DOE will guarantee protection of the Ogallala aquifer. If not, how do you propose to mitigate any releases into the Ogallala? Socioeconomic Impacts Guideline-statements do not adequately address the issue. It is not a matter of comparison with water consumption for the whole county but the impact on the quantity of water available in the vicinity of the site and the possible contamination of the sole water source. Rock Characteristics Guideline-there is no substantial proof that a shaft can be satisfactorily sealed.

CHAPTER 3

Page 3-1, last paragraph -- It is stated that Route 2698 "parallels the northern boundary of the site," yet on Figure 3-1 Route 2698 forms the southern boundary of the site. Which is correct?

Page 3-3, Figure 3-2 -- The site location on this map is different from the location on Figure 3-1. Which is correct?

Page 3-4, paragraph 6 -- According to measurements on the cross section through Swisher County in Figure 3-11, the pre-Permian section is 2200 feet thick (or more), Permian is 6000 feet thick, and the Dockum-Ogallala interval is 700 to 1300 feet thick. These are not the thicknesses listed in this paragraph? Which

values are correct?

Page 3-4, Figure 3-3 -- According to the explanation, the Swisher County site is not shown in this figure.

Page 3-7, Figure 3-4 -- This is a very poor quality figure and basin outlines are not present and, therefore, the figure cannot be used for reference. Faults shown in Figure 3-18 of DOE/CH-10(2) are not shown in this figure. The site location is actually shown in Briscoe County, not Swisher.

Page 3-9, paragraph 2 -- This paragraph states that the youngest structurally offset unit is the Glorieta Formation of Leonardian age, however, there could be unidentified faults that are more recent. The site has not been thoroughly investigated since there no seismic lines across the site.

Page 3-10, Figure 3-5 -- This figure is not consistent with Figure 1-2. Which is correct?

Page 3-11, paragraph 1 -- Figure 3-2 shows Tule Creek being 5 miles away yet this paragraph says it is 9 miles away. Which is correct?

Page 3-11, paragraph 2 -- The reference made to Gustavson et al (1980a, p.78) is incorrect. The publication cited only has 40 pages. What is the correct reference?

Page 3-11, paragraph 3 -- The reference made to Gustavson et al, 1980a, Figure 30, is incorrect. This figure has nothing to do with erosion, it shows a developing salt pan. What is the correct reference?

Page 3-14, Figure 3-7 -- On this time scale the upper Tertiary is termed the Neogene. On pages 3-4, 3-9, and 3-25 the period is called Neocene. Which is correct?

Page 3-17, Figure 3-9 -- A location map reference to this cross section is not given. The figure is useless without one. Also, this

cross section is a considerable number of miles south of the Deaf Smith site.

Page 3-25, paragraph 7 -- The host rock thickness is given as 120 to 130 feet yet in Figure 3-13 it appears to be 130 to 150 feet at the site. Illustrations should agree with the text. Which is correct? By what criteria was the thickness determined. Also the depth to the top of the host rock is listed as 2600 to 2700 feet yet on the figure it appears to be 2550 to 2650 feet. Which is correct?

Page 3-47, Figure 3-23 -- Gustavson *et al* 1980b, Figure 42 also shows salt margins. His figure, however, is slightly different and suggests that the boundary could go through the NW corner of Deaf Smith county.

Page 3-51, paragraph 4 -- The reference to Gustavson *et al*, 1980a, Table 1 is incorrect.

Page 3-52, paragraph 6 -- Reference is made to Figure 3-27 in the last sentence. This figure does not illustrate what is being described in the paragraph and should not be used as a reference.

Page 3-56 paragraph 4 -- This paragraph speaks of several faults near the Swisher site the Potter Fault being 60 miles away. The Burch fault is also about 60 miles away but it is not mentioned. Also, the Altus and the North Fork Faults are even closer but are not mentioned. It should also be noted that there is no seismic profile across the site to show an indication of faulting.

Page 3-56, paragraph 5 -- Reference is made to the Bonita Fault and the Alamosa Fault which are not even on Figure 3-4. Where are these faults located?

Page 3-61, paragraph 1 -- This paragraph admits that the age of the jointing and its relation to tectonic stress are not defined. Jointing and stresses are important clues to the tectonics of an area. This is a subject that needs a great deal more attention than it has received. Published literature provides a much better

coverage of joints and fracturing than is indicated in this paragraph. Fracturing has also been noted in several of the DOE test wells that is not mentioned.

Page 3-30 through 61, sections 3.2.3.3 through 3.2.5.2 -- A complete discussion should be included to provide a complete picture of the relationship between fracturing and dissolution that is apparent in the published literature. Evidence has been offered to suggest that fracturing is relatively close to the both the Deaf Smith and Swisher sites and that it may be associated with fracture trends. If fracturing does extend through the entire salt section and is the locus of dissolution, it is clear that these selected sites should be disqualified.

Page 3-59, Figure 3-28 -- It is interesting that the faults displayed on this map end where available data ends. This is a good indication that if more data were available, more faults would be found. This is a poor geological interpretation.

Page 3-61, paragraph 2 -- This paragraph along with the following two paragraphs states that the Palo Duro Basin has a "very low" level of seismic activity. This is based on little known data and no measured data. The Palo Duro Basin has always been sparsely populated, therefore, there were few reports of seismicity. That does not mean that there has been none. Much more data is needed on this subject and measured data over an extended period is the only truly reliable data. Seismic monitoring of the area should have been initiated at the start of this investigation. Why was this important data acquisition been deferred so long?

Page 3-67, Figure 3-30 -- This figure does not agree with Figure 3-5 in DOE/CH-10(2) at the level of detail represented.

Page 3-65, paragraph 3 -- More needs to be said about uplift in the area. This is a subject which must be carefully studied and understood before selection of a site is in order.

Page 3-66, paragraph 2 -- The last sentence states that the

maximum horizontal compressive stress orientation is consistent with Oklahoma and New Mexico but inconsistent with data from west-central Texas. This could suggest that there is a problem with the available data or the analysis of that data. What is the significance of this inconsistency in data?

Page 3-66, last paragraph -- It is stated in the first sentence that clastics generally become more competent with depth. At what depth do they become competent? A more specific statement is needed here.

Page 3-70, Table 3-2 -- It should be noted that there are no test results for the San Andres Unit 4. Because this is the proposed host rock it would be helpful to know the tensile strength of the formation. Why were no tests performed on the San Andres Unit 4 from this well?

Page 3-73, paragraph 2 -- The first sentence speaks of laboratory creep tests that indicate that Palo Duro Basin salt has a relatively high ductility. What laboratory tests are being referred to in this paragraph? A more complete citation is needed.

Page 3-73, paragraph 3 -- Test data from the Swisher site does not substantiate this statement. Stratigraphic uniformity cannot be assumed at this level of detail.

Page 3-73, paragraph 4 -- In this paragraph a permeability classification is set out. What is this classification based on? Has it been used in the literature before? If it has been used before, a proper citation should be included. If this type of classification has not been used before, a more complete explanation is needed. Is the same classification used for permeability at all other salt sites? If not, why?

Page 3-83, paragraph 1 -- This paragraph says the host rock contains 7 percent anhydrite and 3 percent clay, yet Table 3-8 shows it as 10 percent anhydrite and 9 percent clay. Which is correct?

Page 3-83, paragraph 5 -- Reference is made to Ramondetta (1982). Yet in the Deaf Smith County EA the same reference says Ramondetta (1981). Which is correct?

Page 3-84, Figure 3-35 -- This figure gives depths for sample numbers 5, 6, and 8 which are different from those in Table 3-11. Why?

Page 3-90, paragraph 1 -- This paragraph and subsequent paragraphs indicate that undiscovered resources in Swisher County are hypothetical and subeconomic. However, it should be noted that resources all over the world that are being extracted from the ground today were once thought to be "hypothetical and subeconomic". If the information on projections of oil and gas resources is correct, how can it be reconciled with the current growing interest in oil and gas exploration in the area of the site.

Page 3-94, Figure 3-39 -- This figure (like many other figures in the DEA) is impossible to use because the explanation cannot be deciphered.

Page 3-96, paragraph 2 -- Since clay resources are found in Briscoe County next door to Swisher, isn't it likely that Swisher has that same resource?

Page 3-101, Figure 3-42 -- This figure doesn't completely agree with prime farm land in Figure 3-37 in DOE/CH-10(2).

Page 3-103, paragraph 5 -- Here it is pointed out that the discharge zone of the deep basin brine aquifer is not yet defined. This is a very important point to be considered. If it is true that a downward flow potential exists, the leakage would be into the lower aquifer and then out into the environment at the discharge zone. Where would that be?

Page 3-108, Figure 3-45 -- This figure does not have all the same impoundments marked on it as the Deaf Smith County DEA does. It would be helpful to have all impoundments on each figure.

Page 3-109, Table 3-14 -- This table does not have much recent data on it. Is there no recent data available to make this table more meaningful?

Page 3-115, Figure 3-48 -- This figure is hard to use without geographic references on the map or an accompanying reference map.

Page 3-117, Figure 3-50 -- The flood limits for the playas are the same for the maximum flood and the 500-year flood. Would the playas not flood a larger area in a time of maximum flood than at a 500 year flood?

Page 3-118, paragraph 4 -- Specific yields for the Ogallala are given in this paragraph. There are no data to indicate that specific yields at the site are similar to those given here.

Page 3-118, paragraph 5, last sentence -- Well data from the Santa Rosa exists and generally do not support this presumption.

Page 3-118, paragraph 7 -- Do more recent withdrawal rates support this projection?

Page 3-119, paragraph 5 -- Several things mentioned in this paragraph and subsequent paragraphs indicate that there is water movement through the salt. Because this would be detrimental to waste isolation within the salt, this is a subject that must be better understood prior to recommendation of the site for site characterization.

Page 3-12, last paragraph -- To calculate a flow rate for HSU C, a permeability of 1.0 md was used. Can this value be justified since in paragraph 6 a permeability range of 0.15 to 26.6 is given based on SWEC calculations.

Page 3-131, paragraph 2 -- It is stated that no surface discharge from HSU C has been identified, yet on page 3-1327 paragraph 2, it says in the southern section of the saline spring region, saline springs and shallow saline ground waters may have a component of

deep basin discharge. Are these not related? Has discharge from this lower unit been identified or has it not?

Page 3-131, paragraph 3 -- There seems to be some discrepancy between the value given for depth to water in the paragraph and the value on Figure 3-59. Is the depth to water 185 feet as stated in the text or from 175 feet as illustrated on the figure?

Page 3-131, paragraph 4 -- The last sentence says that porosities based on neutron logs are probably much higher than formation effective porosities. Is there any data available showing the relationship between neutron logs and porosity?

Page 3-131, paragraph 9 -- The effective porosities stated in this paragraph are from a well 65 miles away from the site. Are these better numbers to use than neutron log porosities? If so, why?

Page 3-132, Figure 3-59 -- This figure does not completely agree with Figure 3-12 in DOE/CH-10(2).

Page 3-135, paragraph 3 -- In this paragraph and the following paragraph, many values are given for porosity and permeability for HSU C. The wide range of these values points out that it is very important to actually measure the porosity and permeability of a formation in the precise location being considered rather than estimating from nearby data. Porosities and permeabilities commonly vary greatly within formations.

Page 3-135, last paragraph -- The cross-sectional model also demonstrated that 20 percent of the groundwater flow in the Wolfcamp and deeper saline aquifers could be attributed to leakage through the evaporite aquitard. These results should also be included in this paragraph.

Page 3-137, paragraph 5 -- The last sentence suggests that the data on complexing of radionuclides is incomplete ("Results to date..."). According to previous DOE logic it should be concluded that complexing of radionuclides will be significant.

Page 3-137, last paragraph -- Data for the Dockum exist and have not been used in the DEA. Data sent to DOE for inclusion in the DEA is not used or referenced.

Page 3-138, Table 3-19 -- There is no source given for this table. Where did it come from?

Page 3-147, paragraph 5 -- The reference to Figure 3-60 is incorrect, the correct range of saturated thickness according to the figure is 20 to 60 feet. Also, the reference is incorrectly cited. The explanation in Figure 3-60 the contour interval is given as 25 Feet (7.6 Meters) therefore the citation should agree with the figure instead of giving the thickness in meters (feet).

Page 3-152, paragraph 8 -- What is radiological background? Is it the same as background radiation?

Page 3-155, Table 3-25 -- The table lists the approximate land area of Swisher as 573 acres. Is that all of the acreage in the county?

Page 3-164, paragraph 6 -- This paragraph says that TSP data excludes concentrations associated with dust storm activity. Since dust storms are of major concern in the area they should not be excluded. The data presented here is based on a study of a five year period. This is hardly enough time to assimilate enough data to make an accurate judgement about pollutants.

Page 3-171, paragraph 3 -- It is unclear what "area" these data represent.

Page 3-173, Table 3-35 -- This table is based on data from 1949-67. The greatest available period of record should be summarized. A more representative summary of area conditions can be compiled.

Page 3-174, paragraph 4 -- Why are values for wind speed etc. used which are not the highest non-tornado recordings? It seems

that the highest recordings should be considered.

Page 3-174, paragraph 5 -- It is unclear what area around the Swisher site is being considered.

Page 3-178, paragraph 3 -- How is it known that the EPA guideline for farmland sound level is met at most places near the site?

Page 3-180, paragraph 2 -- This paragraph says that 18 percent of the site vicinity exhibits a moderate amount of visual variety. This paragraph cannot be reconciled with Figure 3-72.

Page 3-179, Table 3-37 -- This table is based on 3 days of data gathering. Is that enough to provide representative data?

Page 3-182, last paragraph -- It is stated in this paragraph that the dose rates are higher at the site because of the larger contributions from cosmic radiation, which increases with altitude. That would imply that Swisher was higher in altitude than all other sites. That is far from the truth. Give an adequate explanation for the higher dose rates at this site

Page 3-185, Figure 3-74 -- The size of the gas lines and the configuration of electric transmission lines given in this figure are not the same as given in Figure 3-33 in DOE/CH-10(2).

Page 3-1194, paragraph 7 -- This paragraph says that services make up 14 percent of the employment in the 10 county area. On Table 3-47, however, it appears to be 13 percent. Which is correct?

Page 3-197, Table 3-44 -- The source for this table is different from the source listed for the same table in the Deaf Smith DEA. Can they both be right?

Page 3-202, paragraph 1 -- The last sentence says that income for services is 14 percent, yet on Table 3-49 it appears to be 12 percent. Which is correct?

CHAPTER 4

Page 4-1, paragraph 3 -- 40 CFR Part 191 should be identified as being Proposed. The sufficiency of the level of information for expected environmental effects is debatable. Therefore, this judgmental statement should be deleted.

Page 4-2, Table 4-1 -- Environmental and Socioeconomic data collection activities should also be outlined. They will likely have economic effects on the local community.

Page 4-3, Figure 4-1 -- What was the basis for determining facility and borehole locations? With this configuration is the site large enough to comply with all applicable regulations? Without land purchases can access to borehole drill sites be assured?

Page 4-7, paragraph 3 -- The location of potential injection wells should be identified. If nearby injection wells are fully subscribed it may be necessary to permit a new injection well for these brines.

Page 4-13, Table 4-2 -- How were field activity requirements determined? What are the uncertainties in their determination? How will the uncertainties be reflected in expected affects of site characterization?

Page 4-19, paragraph 3 -- This does not accurately reflect the DOE shaft construction decision dated November 29, 1984. This decision must be factored into all determinations in this chapter.

Page 4-27, Table 4-3 -- A comparison of Figure 3-30, 3-49 and Table 4-3 of the DEA does not permit varification of the depth to the shaft stations being 2730 feet. It appears that they would be shallower than indicated. On page 109 of DOE/CH-10(2) the more preferred depth is given as 2650 feet or less. Yet the depth of the in situ site characterization facility seems to be planned for a depth greater than 2650 feet. What is the rationale for this

discrepancy?

Page 4-43, paragraph 5 -- During periods when high wind conditions prevail for long periods, excessive wetting of the salt may cause recharge of brine into the Ogalalla and/or Santa Rosa Aquifers.

Page 4-43, paragraph 6 -- What are the maximum quantities of brine expected during this operation?

Page 4-46, paragraph 1 -- Are the DOE contractors subject to MSHA regulations?

Page 4-51 & 53, Figure 4-13 & 14 -- The figure should have a north arrow so the proposed shafts and excavation can be oriented with respect to the geologic conditions.

Page 4-60, last paragraph -- Does the rehabilitation of the surface include addition of fertilizer to replace nutrients lost while the soil was in stockpile? If so, what will be done to determine the type of fertilizers needed for most efficient revegetation? Will the area be irrigated? If irrigation is used, what quantities of water will be needed and have these quantities of water been included in the overall estimates of water consumption?

Page 4-64, paragraph 4 -- Are there any contingency plans for the event that existing land fills may not be available for waste materials?

Page 4-64, section 4.1.3.1.1 -- How can the impacts of site characterization be determined if these data are not available?

Page 4-65, Table 4-16 -- In the past DOE has stated that there will be no discharge to drainage from the site. Items 8 & 9 appear to represent a change in this position. Explain.

Page 4-67, paragraph 5 -- Since a program will be provided "for

an evaluation of the radionuclide uptake and content in edible crops..." does that mean some contamination can be expected from this operation?

Page 4-74, paragraph 3 -- The location and history of the previously operated salt stockpile sites should be included to provide an evaluation of the impact of the salt on the environment.

Page 4-75, paragraph 21-- How do conditions in the areas where salt contamination has been observed compare to conditions in Swisher County? It would be appropriate to compare wind direction, wind speed, humidity, rainfall, and other parameters between these areas for an accurate appraisal of the potential impact.

Page 4-85, paragraph 4 -- Background meteorological data should be obtained directly from the site. It seems odd that background values for a rural area are obtained from a metropolitan area 30 miles away.

Page 4-85, paragraph 5 -- Dust storm days are excluded from analyses of background concentrations for pollutants. Should dust storm days be excluded when they occur so frequently in the area?

Page 4-88, Figure 4-16 -- The location of the surface facility for exploratory shafts is not in the same place on this diagram as it is on figure 4-1. Which is correct?

Page 4-93, paragraph 2 -- This paragraph says that construction activities are not expected to significantly increase the volume of runoff and sediment from the site. Nothing is said, however, about increased runoff caused by the clearing and covering of the ground by the facility and the roads and pavement that will be there for the next quarter century. This problem should be addressed.

Page 4-93, last paragraph -- In the model used to analyze the impact of ground-water withdrawals it is assumed that privately owned wells both on and off the site were not pumping. Why was this assumption made? If some of the area is returned to

agricultural use as mentioned earlier some of those wells will undoubtedly be pumped. The model should be reevaluated to insure that it is consistent with proposed site operation.

Page 4-94, paragraph 4 -- This paragraph addresses the problem of the dissolution and dispersment of a saline plume in the Ogallala. The cumulative effect of continual addition of salt to the aquifer over a long period of time should also be considered. One saline plume might not have significant effect but continual salt leaching into the ground-water supply certainly will.

Page 4-98, Figure 4-19 -- Once again there is a discrepancy between figures showing the same thing. This figure is slightly different from Figure 3-61. Which is correct?

Page 4-99, Figure 4-20 -- The same comment can be made for this figure as Figure 4-19. It is different from Figure 3-60 which illustrates the same thing.

Page 4-100, paragraph 1 -- If soils are contaminated and must be disposed of, where would it be disposed and would it be replaced by uncontaminated soil suitable to the area?

Page 4-100, paragraph 2 -- Potential salt effects on soils in the site vicinity are compared to soils around salted roads and soil effected by sea spray in a Texas Gulf Coast area. Are the soils and climate similar to Swisher soils and are they used for growing crops as are soils in Swisher? Certainly the soils and climate of the Gulf Coast area have a great contrast to the soils and climate in this area. Contrasting data tends to invalidate conclusions.

Page 4-100, paragraph 4 -- The addition of gypsum to soils to flush sodium will have impacts on the agricultural capability of the soil also. This mitigation method also wrongly assumes as does the evaluation of salt impacts, that the soil is not already subject to a salt burden that affects production.

Page 4-102, paragraph 3 -- The noise of development of an exploratory shaft is considered in terms of people around the site

area but not in terms of the farm and ranch animals around the site. Animals are often adversely effected by loud sudden noises such as explosives. The effects to animals must also be considered.

Page 4-103, Figure 4-21 -- This figure has yet another location for the exploritory shaft. Inconsistancies make these figures impossible to use. Also, this figure gives the percent of "highly annoyed" people. Was there no consideration given to people slightly annoyed or annoyed in any manner? What are the cumulative effects of different levels of noise exposure over differing periods of time?

Page 4-104, paragraph 5, page 4-107 figure 4-22 -- There is no way that the equipment used to construct the exploritory shafts can be considered to be compatable with the character of the area which is essently flat. There is no way that "visual integrity" can be maintained. Also Figure 4-22 is virtually impossible to read and therefore of no use.

Page 4-104, last paragraph -- It is stated that the visual intrusion is similar to that associated with exploratory drilling for oil and gas and therefore not atypical in the region. Yet several times in chapter 3 oil and gas exploration was said to be hypothetical and insignificant. Either there is a visual intrusion dissimilar to any existing sights or oil and gas exploration is more prevelant in the area than stated in Chapter 3. Which is it?

Page 4-110, paragraph 7 -- No consideration is given to the effect of the meteorological tower on crop duster planes and other low flying aircraft.

Page 4-111, last paragraph -- The first sentence states that no impacts on regional or local utilities are expected yet the next sentence states that commercial power will be used. Where will electricity be obtained if not from a public utility? Will land acquisition be necessary to provide needed electrical service to the site?

Page 4-118, paragraph 3 -- This paragraph states that the loss of agricultural revenues due to land being used for site

characterization activities is extremely small when compared to the total crop revenues generated in the vicinity. However, what should be considered in addition is the loss to the individuals whose production is being impacted without compensation, inconvenience, market perceptions, changing costs of services, etc. How much is their loss of revenue?

Page 4-130, Table 4-32 cont. Number 1 -- The second statement gives the agricultural land use in the site vicinity as 0.01 percent of total county cropland. This may appear to be a small amount in comparison to the county as a whole but is not insignificant when the amount of production on the land is considered and what the loss of the land actually means. Comparing the site vicinity to the county is an attempt to dilute the significance. Also, the amount of land around the site vicinity which will become unusable because of drawdown of the water table or salt contamination is not considered.

CHAPTER 5

Page 5-4, Table 5-1 -- Do the surface area land control rights include Railroad right-of-ways? How does the exploratory shaft decision of November 29, 1984 impact this chapter? It must be fully factored in and described in the final EA.

Page 5-8, Figure 5-2 -- Many of the facilities in this figure are in different locations than in Figure 5-1. Which is correct?

Page 5-10, Figure 5-3 -- This is a reverse image view of the waste handling and packaging facility shown in Figure 5-2. It makes comparison of the two figures difficult. Which is correct?

Page 5-19, Figure 5-8 -- In this figure the site appears to be about 12 miles west of U.S. Highway 87. In other figures (for example Figure 3-74) it is not that far away. Why is the location different?

Page 5-26, Figure 5-10 -- There is no reference for this figure. What data are used to construct this figure?

Page 5-33, paragraph 2 -- This paragraph says the highest rate of salt deposition is 190 pounds per acre, per year for 109 yard radius. In Table 5-9 the worst case for the same size area is 563 pounds per acre per year. Is this not the number that should be used? And still a comparison is being made between the salt dispersion at the site and salt dispersion in areas with dissimilar soil and vegetation.

Page 5-36, paragraph 73-- Why is half of the windborne salt expected to enter playas and streams? What data is used for the basis of this estimate?

Page 5-37, paragraph 2 -- The paragraph tells what would happen in the event of liner failure but does not consider what could be done to try to stop the flow of leachate into the water table. This problem should be addressed. And there are engineering methods to collect and monitor leakage which also should be discussed.

Page 5-38, paragraph 3 -- As stated earlier, this projected drawdown does not take into account the ongoing use of wells for irrigation water.

Page 5-36, paragraph 7 -- Why are water requirements for decommissioning and closure activities not yet established? They can probably be estimated to the same degree of uncertainty as site characterization and repository activities, because they are only a result of conceptual design.

Page 5-39, last paragraph -- It is suggested that if harmful levels of salt deposition are being approached, impacts can be avoided by adding calcium to the soil in the form of gypsum to flush excess sodium. What effect would gypsum have on the soil and vegetation?

Page 5-43, paragraph 5 -- Nothing is said about the effects of salt concentrations on aquatic systems over an extended period of time.

Page 5-46, paragraph 5 -- What impact will the chemical stabilizers used to control fugitive dust have on the soil?

Page 5-46, paragraph 8 -- The problem of fugitive dust in the form of salt escaping from trucks as it is being transported away from the site is not addressed in this paragraph. Also, it is stated that most of the salt pile will be covered. This is not consistent with the next sentence nor many other statements in the DEA.

Page 5-58, paragraph 2 -- Several assumptions are made in order to predict the amount of salt likely to be deposited in the area surrounding the site. What in the basis of these assumptions? Is a pile of 60 feet considered to be ground level?

Page 5-58, paragraph 3 -- How will 10 kilograms per hectare per year affect the soil and vegetation at the "receptors" to the north and northeast of the site.

Page 5-61, section 5.2.7 -- No consideration is given to the affect of noise on livestock and farm animals.

Page 5-81, paragraph 4 -- Nothing is said about the soil that will be contaminated if salt is carried out by rail and escapes as fugitive dust.

Page 5-92, paragraph 6--The first sentence says all of the candidate potash mines are believed to presently have rail access. It is important to know for certain if rail access is or is not available. Also, the availability of these mines for disposal has not been established. What about other disposal options?

Page 5-106 paragraph 5 -- This paragraph does not include land removed by railroad right-of-ways, land that cannot be used because of salt contamination, and land that cannot be irrigated because of aquaifer drawdown. Also, there is no basis for the 200 cattle count.

Page 5-136, paragraph 5 -- Exactly what other sources other than the Ogallala could be used to mitigate the strain on the water supply from the repository during construction? The generic

discussion is insufficient in light of current water use needs and sources.

CHAPTER 6

Page 6-14, paragraph 5 -- Reference is made to section 3.4.3.6, but there is no such section. This paragraph makes no mention of tornados that occur several times per year.

Page 6-28, last column -- There is no projected ability to meet requirements for the Texas Clean Air Act. Can DOE meet the requirements?

Page 6-31, last column -- There is no projected ability to meet requirements for the Texas Water Quality Act. Can DOE meet the requirements?

Page 6-38, third column, first item -- What exactly is a "reasonably natural state" and who decides what is reasonable? How long will it take?

Page 6-58, Table 6-7 (page 1 of 12) -- The last entry in column 5 states that a favorable condition is present. On page 6-9 it is indicated that the favorable condition is not present. Which is correct?

Page 6-72, paragraph 2-- Without detailed demographic data on the near-site setting it should be impossible to make a valid decision on radiation exposure.

Page 6-72, paragraph 6 -- Document 40 CFR 191 should be noted as proposed.

Page 6-81, third column -- There are two conclusions in this column that should be in the last column.

Page 6-83, paragraph 4 -- Fracture permeability often is not regional and therefore cannot be derived from regional trends. The

entire issue of vertical permeability has only been slightly acknowledged, yet it is most likely variable in the region. Why is nothing mentioned about vertical travel time through the salt?

Page 6-83, paragraph 5 -- There is no basis to assume that the "single variable pathway" determination is correct given the lack of all relevant data and further it cannot be demonstrated to be the fastest pathway.

Page 6-88, last paragraph -- What about salt dissolution from penetrated Ogallala and Santa Rosa percolating downward around shaft openings?

Page 6-90, paragraph 5 -- Overestimation with an incomplete data base is not equivalent to conservative estimation. Where is the evidence that the criterion is expected to be met even at 300 years?

Page 6-93, item 5 -- The exact amount of clay in the host rock at or near the site is not known. The value of 3 percent is inferred from regional data and is of little value without site specific data regarding interbeds.

Page 6-96, paragraph 6 -- Why are physical phenomena such as changes in density, compressibility, and crystal structure not expected to have any effect on waste containment?

Page 6-96, paragraph 7 -- What will be the effect of moist atmospheric conditions on the host rock where it is exposed from excavation of the shaft?

Page 6-97, paragraph 4 -- Over what period of time is the 2.3 feet of settlement expected and what impact will this have on groundwater travel times due to induced fracturing of the strata surrounding the host rock?

Page 6-98, paragraph 7 -- What sort of recharge is expected for HSU C with a return to pluvial conditions?

Page 6-100, last paragraph -- Instead of the average rates, the

highest possible rates of erosion should be considered. Even the maximum rates are likely to be exceeded during pluvial periods. Why were these factors not given consideration?

Page 6-107, Rates of Peripheral Dissolution -- The rates of dissolution given here are the rates present in the area now. Isn't it likely that these rates would have been higher during Pleistocene pluvial periods and pluvial periods that may occur in the future? Also, Pleistocene dissolution is reported in the literature. What has happened to stop that dissolution?

Page 6-108, section 6.3.1.6.4 -- No consideration has been given to the fact (reported in the literature) that interior dissolution is apparently controlled by structural influence. If structural influence is a controlling factor then interior dissolution is probably not restricted to the upper salt units. Kreitler, *et al* (OF-WTWI-1984-52) indicates that a significant quantity of the water in the Wolfcamp aquifer appears to be migrating through the salt. Evidence presented in Kreitler's paper tends to indicate that transmission through the evaporite aquitard is related to fracturing. This condition would cause dissolution in all of the salt intervals.

Page 6-121, Table 6-9 (page 5 of 15) -- The last comment in column 5 states that the condition is present. On page 6-9 it is stated that the condition is not present. Which is correct?

Page 6-127, Table 6-9 (page 11 of 15) -- The first comment in column 5 states that the condition is not present. On page 6-108 it is stated that the condition is present. Which is correct?

Page 131, Table 6-9 (page 15 of 15) -- This table does not include a Statement of Technical Guideline, Assessment Results, or Findings for the Disqualifying Condition "Ongoing or likely future activities to recover presently valuable natural mineral resources outside the controlled area would be expected to lead to an inadvertent loss of waste isolation" as is found in the Deaf Smith DEA.

Page 6-142, paragraph 7-- This paragraph says that no in situ

characteristics have been identified as requiring unusual engineering measures. This is understandable since no data has even been gathered at the site and, therefore, no in situ characteristics can be identified. The judgement is debatable based upon an assumption that the expected conditions will be found at the site.

Page 6-147 paragraph 1 -- What about faults that could be reactivated by repository construction and operation? This subject should be considered.

Page 6-190, paragraph 3 -- What about water that might flow from the aquifers, down the outside of the shaft liners and then begin dissolving the host rock? This water would not be saturated with sodium and chloride and could readily dissolve the salt, yet nothing is said about this type of dissolution.

Page 6-197, last paragraph -- Expecting the brine to distribute uniformly over the package surface is not reasonable. In order for this to occur, there would have to be a perfectly uniform contact between the salt and the container. Since salt is backfilled around the container, it is unlikely that a perfect contact between the two can be made. Therefore, uniform corrosion is not as likely as pitting.

Page 6-210, paragraph 3 -- In the next to last sentence it states that "faulty shaft seals might affect radionuclide transport". It should say, faulty shaft seals will affect radionuclide transport. There is no way they would not contribute to radionuclide transport.

Page 6-221, paragraph 3 -- The second sentence says, "There is no reasonable basis for anticipating that a repository would be disrupted by the development of new faults or other structures." Of course there is no basis for anticipation of disruption because the data are not available (no seismic profiles across the site) to base any analysis on. All the faults have not been identified yet and therefore the structure for the site is not even known yet. It is hard to form a basis from no data.

CHAPTER 7

See comments on Chapter 7 Deaf Smith DEA.

SUPPLEMENT TO ENCLOSURE B
March 19, 1985

Page numbers refer to the Deaf Smith EA, but most comments are applicable to equivalent statements in the Swisher EA.

Page 3-1, paragraph 2 -- The lack of site-specific data is a major flaw in the EA, resulting in the inability to evaluate impacts of site characterization and a repository. This renders the EA insufficient in regard to the requirements of Section 112 of the Nuclear Waste Policy Act of 1982.

Page 3-5, Figure 3-3 -- The seismic reflection data do not cover the proposed site, therefore the detail described as subsurface characteristics in this EA is speculative and highly uncertain except on the most gross regional basis.

Page 3-41, paragraph 1 -- This is the nearest well to the site, and lithologic logging indicates only about 20 feet of nearly pure salt in the proposed host horizon. Other lithologies have properties that may lead to unpredicted mining problems, and may greatly alter the assumed suitability of the host rock. These inhomogeneities have not been evaluated in any manner that would support a finding of suitability for site characterization, nor has it been demonstrated that a sufficient thickness of relatively pure salt for a repository is even present at the site.

Page 3-11, paragraph 2 -- No information on erosion is provided for the Palo Duro Creek and its tributary, which constitute the nearest streams to the site. It is also possible that these streams are a function of subsurface joint patterns, which could greatly influence their rate of downcutting relative to any more regional rates that are calculated.

Page 3-65, Figure 3-28 -- The scale of this figure is so large that the figure is essentially useless. Information on joints in the Palo Duro Basin exists and should be used to supplement a more comprehensive figure indicating the principal stress directions.

Page 3-49 -- The dissolution rates discussed may not be accurate because there is no consideration given to jointing and fracturing that can greatly increase the hydrologic flow, thus increasing the rate of dissolution on a local and areal basis. Also, the discussion does not deal with the known mineralogic impurities observed in the salt cores that could result in accelerated rates of dissolution in a disturbed zone associated with underground workings. In other program documents, it is recognized that dissolution could have the result of making shaft sealing impossible, and it is admitted that sealing under such circumstances has yet to be demonstrated. This information is not presented and discussed in the EA.

Page 3-58, paragraph 3 -- (a) The known recent seismic events in the near vicinity of the site should be discussed and evaluated; (b) a peak ground acceleration of about 5% gravity does not take into account the expected effects on the subsurface strata relative to existing fractures, the disturbed zone and shaft liners; (c) Schnabel and Seed, 1973, is an inappropriate reference as it deals with only a few events with these being in rocks of very different characteristics from those of the Palo Duro Basin; (d) a maximum

credible event with an annual probability of 10^{-3} to 10^{-4} would not be a rare event for the site during the required containment period of a repository - in fact the projection indicates that there is a high level of assurance that the maximum event will be experienced in the area during the next 10,000 years.

Page 3-72 -- There is a general lack of geomechanical data specific to relevant factors in the proposed host rock, and in fact, what data there are reported in the EA are sufficiently biased in the sample collection to render them useless as indications of the geomechanical properties of the proposed host rock, including its impurities. Regarding Table 3-7, the technique used to collect the data is inadequate to serve as a basis for characterizing the interbeds.

Page 3-128 -- The use of a regional groundwater model at the site is a gross oversimplification and probably has little or no validity. Some data are available for hydrologic properties of the Dockum, and were at the time of writing of the EA, yet they have not been incorporated.

Page 4-44 -- Has the feasibility of maintaining the "ice wall" throughout the shaft construction period been determined? In addition, what effect will the freezing process have on existing fractures? It appears that the freeze process will create an additional disturbed zone that could become a new pathway for increased hydrologic conductivity.

Page 6-140 -- There is no mention of difficulties that could result from scaling where there are roof bolts penetrating interbeds, which will assuredly be the case at the Palo Duro sites.

Page 6-193 -- There is no basis to state that the creep law model is verified for repository conditions at Palo Duro sites through analyses of the Asse salt dome. The salt characteristics are so different at the Asse site that extrapolation cannot be undertaken for purposes of verification.

TRANSPORTATION

General Comments relating to the treatment of transportation issues in the environmental assessments.

The extensive discussion of complex computer codes for risk assessment leaves the impression that a rigorous analyses of the risks associated with transportation of high-level waste and spent fuel underlies the cursory discussion presented in the environmental assessments. The analyses, however, contain gross simplifications and unjustifiable assumptions which represent little more than a crude framework for risk assessment. The transportation evaluation require substantial modification and refinement before they can be used for relative comparison of transportation risks associated with the potential repository sites. Among these assumptions are: (1) rural, suburban and urban population densities are generic; (2) in the event of an accident no exposure occurs within a radius of 10 feet of the accident; (3) within 15 minutes of an accident occurrence in an urban area and within one hour elsewhere the situation will be sufficiently well controlled that no further radiation exposure will occur; (4) accident rates do not vary among transportation links; (5) spent fuel is assumed to be shipped directly to the repository from reactors without any intermediate stop at a storage facility; and (6) urban transportation route for radioactive materials do not have adjacent sidewalks. Many additional questionable assumptions may be found in the details of the transportation risks assessments. The examples cited here are intended to merely illustrate the gross level of assumptions driving these analyses in the EAs, which are insufficient assessments of transportation impacts and risks.

The fundamental goal of the transportation planning which the Department of Energy has conducted to date is to simply minimize the transportation distance. In reality, the ultimate goal of proper transportation planning should be the minimization of radiation exposure which is not necessarily accomplished by minimization of transportation distance. For example, a relative short transportation distance which occurs largely through urban environs could easily place a larger radiation exposure burden on the general population than would a much longer route through rural areas (the assumed urban population density is over 600 times greater than the assumed rural population density). Ultimately, link specific population densities should be utilized to determine the minimum overall exposure burden to the general population.

A serious internal inconsistency within the environmental assessments involves the type of material to be emplaced in a repository. Section 5.1.1.4 indicates that enormous quantities of both remote handled and contact handled transuranics will be deposited in the repository. In contrast, neither the subsequent transportation discussion in Chapter 5 nor the generic transportation appendix even mention transuranic material. The significantly different packaging requirements and consequences of release in the event of an accident require specific analyses and relative comparisons among the potential sites.

A fundamental principle employed in transportation regulation is reliance upon self-enforcement of relevant regulations. Past experience with shipment of radioactive materials in general indicates that self-enforcement does not guarantee strict compliance. Rather than ignore the possibility of occasional non-compliance, a truly credible risk assessment should make a legitimate effort to quantify such occurrences and factor their consequences into the final risk assessment.

The generally abbreviated treatment of the transportation assessments in the EAs necessitated frequent reference to more detailed background documents cited in the list of references at the end of Appendix A. In spite of a commitment by the Salt Repository Project Office to provide copies of all available EA references, only one of the thirty-three documents cited was provided by SRPO. Several additional documents referenced in this Appendix were obtained through other divisions of the Department of Energy and other sources but generally the necessary documents were not readily available in the "comprehensive" set of EA references provided to the potential first repository host states.

SPECIFIC COMMENTS relative to Appendix A, Transportation.

Page A-1, paragraph 1 -- It is explicitly stated that the discussion in this Appendix applies only to transportation of spent fuel and high-level in spite of the fact that Section 5.1.1.4 indicates that approximately 55,000 packages of transuranic materials will be shipped to the repository.

Page A-2, paragraph 4 -- According to this discussion, the Department of Energy is not required to comply with all NRC packaging requirements. The current agreement on shipments which are undertaken under the provisions of the Nuclear Waste Policy Act only requires that DOE comply with packaging requirements relating to matters of health and safety. No justification is offered for the less stringent application of NRC packaging regulations to these DOE shipments. In the absence of adequate justification full compliance with NRC regulations should be required.

Page A-3, paragraph 1 -- Although the Nuclear Waste Policy Act clearly states that DOE must comply with DOT regulations, an agreement between these two agencies is planned. However, its purpose should not be to relax application of DOT regulations for these shipments as was indicated in the comment above regarding compliance with NRC regulations.

Page A-3, paragraph 5 -- The first sentence of this paragraph states that existing regulations minimize the hazard of radioactive material transportation. An unstated underlying assumption inherent in this statement is that the transportation takes place in full compliance with all regulations. In view of the fact that most transportation regulations are self-enforced, it is not clear that anything is minimized by their mere existence.

Page A-16, paragraph 2 -- The basic premise under which the entire transportation analyses has been performed is that the absolute risk of radioactive material transportation is inherently low. Such a fundamental premise does not inspire confidence in the conservatism or even fundamental acceptability of the resulting analyses. As stated elsewhere, the basic premise should recognize the commonly imposed principle of reducing radiation exposure to levels "as low as reasonably achievable" (ALARA).

Page A-16, paragraph 2 -- Utilizing the equation A-1 on page A-17 and the accompanying chart of absorbed dose in conjunction with rail shipment figures presented in Table 5-11, a life of repository exposure to the maximum exposed individual was calculated at over 350% of the exposure cited in this paragraph for 100% rail transportation. Furthermore, the subsequent intuitive statement that the reported exposures are substantially below natural background and therefore are not likely to be excessive assumes that small amounts of radiation exposure are harmless and acceptable. This fundamental assumption about low doses of radiation is far from universally accepted by experts in the field.

Page A-16, paragraph 3 -- The order of magnitude difference in maximum individual exposure calculations for 100% rail vs. 100% truck shipment clearly demonstrates the need for a credible methodology for determination of a realistic mix of the transportation modes.

Page A-16, paragraph 4 -- Numerous substantial uncertainties in the parameters utilized for the risk assessments do not assure that the absolute values of the maximum individual exposure will be low as is stated in this paragraph. The results of the assessments are at best an indication that the idealized situation modeled will result in relatively low exposure to the individual intuitively (but not necessarily correctly) identified as the maximally exposed individual.

Page A-16, paragraph 5 -- The intuitive selection here of the "gatepost person" as the maximally exposed individual is not convincing. A far more plausible selection would be an individual employed at or near a routine stop point on a maximally saturated transport route. Such a person could realistically be exposed for a much longer period of time and to much higher dose rates as a result of closer proximity to the waste package.

Page A-17, equation A-1 -- Substitution of sample values into this equation yields dose per shipment values which appear to be approximately three orders of magnitude higher than the values reported on page A-16. (As in the relevant background documents, the value of $(\exp(-ur))(B(r))$ was assumed equal to 1.0) Also, back calculation of dose rates equivalent to dose rate factors shown results in dose rates at the perimeter of the shipping vehicle which exceed the allowable values by over 500%.

Page A-18, paragraph 2 -- The statement that utilization of simplifying assumptions based on similarities and uniformities over national or large regional scales is justified is insufficiently rationalized by stating that the importance of the calculations lies in relative magnitudes of risk. On the contrary, those simplifying assumptions tend to mask relative differences among the potentially acceptable sites and result in a risk comparison based primarily on the relative transportation distances involved.

Transportation Comments

Page 4

Page A-18, paragraph 4 -- Three significant and unjustifiable assumptions appear in this paragraph alone: (1) the risk analysis was based on a system excluding an integrated monitored retrievable storage facility, (2) the utilization of reactor centroids rather than actual reactor sites is unlikely to yield a representative mix of urban, suburban and rural transportation distances and (3) the number of shipments which will occur is directly related to cask capacity which will almost certainly be greater for the new generation casks but current generation cask capacities were utilized. Subsequent recognition of these assumptions on page A-20 does not justify their use.

Page A-20, paragraph 3 -- The statement that ignoring the defense waste at Hanford Washington and the Idaho National Engineering Laboratory is an approximation which is masked by the overall uncertainty of this risk analysis clearly indicates that the analyses is so crude as to be virtually meaningless.

Page A-20, paragraph 4 -- The statement that "transportation is an important factor in repository siting" is not reflected in the cursory transportation analysis which was performed for the environmental assessments.

Pages A-29 through A-34, Section A.10, Common Questions Regarding Transportation -- Several significant transportation issues are mentioned in this section. The discussion, however, consists entirely of a description of and rationalization for the status quo. With respect to the issue of prenotification for shipments, the observation is made that the Department has in the past offered generic information on types and quantities of shipments without specific times or dates and that DOE "believes" that this approach is suitable but will consider changing it if conditions (the Department's belief?) change.

The discussion of emergency response focuses on initiatives that states and localities may take to provide first response capability. No mention is made of the fundamental concept of the Nuclear Waste Policy Act which states that the cost of high-level waste and spent fuel disposal is to be borne by the generators of that waste. Most of the suggestions offered rely on training programs funded by general revenue appropriation to other federal agencies. Again, the status quo is rationalized with no creative or imaginative suggestions for improvement offered.

The discussion of routing for rail shipments simply observes that there are no regulatory requirements for such shipments and that the route taken is largely a matter of the business priorities among the railroads which are almost randomly involved. In addition, the issue of truck route specification by DOE is ignored altogether.

With respect to insurance coverage for transportation accidents, the rationale presented for not requiring DOE contractors to carry insurance was simply that the insurance premiums would be passed on to the government through the typical cost reimbursement contracts. In view of the funding mechanism for commercial high-level waste disposal activities through the Nuclear Waste Fund, that rationale is entirely irrelevant.

SPECIFIC COMMENTS on Section 5.3.1, Nuclear Waste Transport

Page 5-73, paragraph 4 -- Appendix A is cited as a source for additional details regarding characteristics of the various waste categories. In fact, however, Appendix A contains no discussion of any waste characteristics.

Page 5-74, Table 5-11 -- In spite of the earlier indication in Table 5-3 that transuranic materials will be shipped to a repository site, this Table 5-11 contains no mention of the number of packages or shipments of transuranic materials to be shipped to the repository.

Page 5-80, paragraph 3 -- The final sentence in this paragraph characterizes the EA transportation analyses as preliminary. The selection of three sites for full characterization based even to a limited extent on preliminary analyses is disturbing. After years of virtually no action by the Department in analysis of this issue in spite of constant reminders from potentially affected states and Indian tribes we have little sympathy for the argument that more time is needed for development of the necessary analysis programs and data bases.

Page 5-80, paragraph 6 -- The ridiculously crude methodology for establishing rural, suburban and urban densities in the vicinity of the Deaf Smith County Site is apparently a result of lack of data. However, the calculation of population density along rural roads by simply dividing rural population by rural area totally ignores the obvious inclination of people to live near roadways. It is particularly interesting that the resulting population density for a key segment of interstate highway near the proposed repository site was calculated by this method to be 90% lower than the population density used for the generic transportation analysis in Appendix A. This methodology also yielded equal values for the urban and suburban road segments implying that Interstate 40 through Amarillo traverses no urban areas.

Page 5-83, paragraph 3 -- Reference is made to "actual population density" along railroad routes to the Deaf Smith County site and the accompanying Table 5-16 does, in fact, indicate population densities significantly different from those calculated by the methodology described on page 5-80. If these are, truly, actual data, what was the source and why was not a similar source used for the population density along rural highways?

Page 5-90, Table 5-18 -- Footnote (a) references an earlier Table 3-52 as the source for current daily and peak hour traffic on various highway segments. That Table 3-52 appearing on page 3-195 presents unemployment rates for the nine county area near the Deaf Smith County site and presents no information relevant to traffic densities. The same erroneous citation appears in the footnotes to Tables 5-19 and 5-22. Footnote (b) for Table 5-18 indicates that the methodology for arriving at expected daily increase in passenger vehicle trips is described in Section 5.3.1.1. The discussion in that section is, in fact, totally unrelated to the data presented in this table.

Transportation Comments
Page 6

Page 5-93, Table 5-20 -- Footnote (a) to this table cites the preceeding Table 5-19 as a source for information on site related trips per day when, in fact, Table 5-19 presents percentages of maximum daily service and maximum hourly daily service on specific highway segments.

Page 5-98 through 5-99, Section 5.3.5 - Salt Disposal -- Although this section discusses transportation of excess salt from the site as a possible option for salt disposal, neither the preceeding portions of Chapter 5 discussing transportation impacts nor Appendix A on the same topic even mentions transportation of excess salt. Transportation of the 11 million tons of excess salt away from the site would require either 130,000 train car loads or 400,000 truck loads of salt over the lifetime of the project based on available estimates.

SUPPLEMENTAL EVALUATION OF THE DRAFT ENVIRONMENTAL
ASSESSMENTS FOR DEAF SMITH AND SWISHER COUNTIES

for

Texas Nuclear Waste Programs Office
Office of the Governor

by

James E. Jarrett, Ph.D. and James B. Reed, M.P.A.

Texas Advisory Commission on Intergovernmental Relations

May 15, 1985

Transportation

1. Table 3-42 on page 3-180 has some additional problems that hinder effective impact analysis. One is the lack of precise facility type definition. Does the road provide limited access or not? Is it divided or undivided? Is the terrain rolling or flat? These characteristics have an impact on the level of service volumes, in addition to number of lanes. Another problem is the failure to break the road segments into readily analyzed portions. Thus, the average daily traffic counts range widely. More appropriate breakdowns are needed. A thirty-mile segment might be appropriate for a rural area, while a one-mile segment might be appropriate for an urban area. A final problem is that the figures in the column labeled "Maximum Service Volume" do not conform to traffic volume tabulations made by the Texas State Department of Highways and Public Transportation. If another source is used, it should be specified and justified.

2. Page 4-115. More elaboration is needed on the linear regression analysis performed on the accident data. The conclusion that no correlation was found between vehicle-miles traveled and total accident rates lacks credibility because evidence is missing. Original data should be cited, as well as which tests were performed, any transformations of data, and the actual results, including speci-

fication of coefficients and proportion of explained variance. Also, the experience of major energy projects in the Western US concerning accident rates near construction sites might prove useful.

3. Page 5-26. Since supply trips by truck are predicted to be nearly ten times as numerous as nuclear waste trips by truck, a more detailed breakdown (by day of week, time of day, projected route, etc.) should be provided.

4. The statement on page 5-33 concerning transportation of waste salt, "The resulting transportation impacts, both environmental and economic, are relatively modest," is not substantiated. Evidence for this assertion is missing. The analysis on page 5-98 assumes that the waste salt would be removed in equal increments over 26 years. It is more likely that a majority of the salt would be removed in the early years, thus requiring much more than 5,000 cars per day. Also, the option of truck removal of waste salt should be studied.

In addition, more information is needed on the current capacity and condition of affected rail lines and the existence and condition of rail lines to the candidate potash mines.

5. Page 5-79. The map would be more useful if it were more detailed and showed all of the road segments being analyzed. Three of the eight segments are missing from the map.

6. Page 5-86, Sec. 5.3.2.2. No specific mention is made of potential irrigation and vehicle transportation problems brought about by a railroad line bisecting productive farmland.

7. Page 5-90, Table 5-18. The trip generation figures are probably flawed since they are based on the population allocation (gravity) model. Our previous comments question the accuracy of the gravity model and its bias toward large cities. The amount of traffic between the site and large cities is probably overestimated, while traffic between the site and smaller towns is underestimated. Also, on Table 5-18, footnote (b) refers to a methodology that is not found where the reader is directed.

8. Page 5-93, Table 5-20. The high accident rate for US 385 from Hereford to FM 1062 should be noted and explained. It is almost three times as high as the closest similar road type.

9. Page 5-97. Other local airports besides Amarillo International Airport should be identified and assessed for capacity. The airport at Hereford, for example, is likely to experience a large increase in air traffic.

Specific Comments on Methods of Analysis

Several categories of deficiencies occur throughout the draft EA. The categories are identified below and examples are provided in many of the sections on specific topics.

- (1) Factual Errors -- discrepancies between draft EA language and reality;
- (2) Inconsistencies -- discrepancies within the draft EA document;
- (3) Omissions -- no draft EA language but of importance in reality;
- (4) Outdated Information -- discrepancies between draft EA language and more recently collected data;
- (5) Inappropriate Information -- improper choice for combining data or improper selection of a measure or indicator to represent a variable;
- (6) Unnecessary Information -- draft EA language but of no importance in reality;

(7) Editorial Problems -- excessive referrals to other parts of the document and prior source documents, inaccurate citations, improper attribution to another document, and inability to discern references in tables with multiple citations and footnotes.

Repository Work Force

Because the number of local hires will determine partially the number of inmigrants, and therefore, many of the resulting socioeconomic impacts, accurate information on the repository work force is an important component of the environmental assessment. Examination of the principal source document, Mathews (1983) "Person-Year Estimates for Repository Construction, Operation, and Decommissioning," indicates that insufficient analysis has been performed. The problems are many.

First, the data being adjusted in the July 1983 memo were derived from a December 1982 table which assumed that only some defense waste would be commingled. Consequently, with any changes in the design and size of the repository and with changes in the schedule of receiving waste, repository work force changes will occur.

Second, the repository work force data would be drastically affected if the two-phase repository design is adopted. No mention is made of the two-phase design in the Mathews document.

Third, the Mathews memo basically reports on a May 1983 letter from Stearns-Roger Services, Inc., that contained the person-year estimates. The data, therefore, are at least two years old. Because repository

designs have changed substantially over the last few years, the latest and more precise repository design should be used.

Fourth, adjustments made in the memo with the work force data cannot be assessed for accuracy. In one instance, the construction labor estimates were found to be high by about 20 percent, but no evidence was presented -- no other reason was given except that a conversation had been held with the contractor. In another instance, operation personnel estimates were increased by approximately 15 percent over the December 1982 estimates, but no reason was provided.

Fifth, over and above the adjustments of 15 and 20 percent, all estimates were adjusted upward because of the contingency factors.

According to the Mathews memo, contingencies are always added to the baseline cost and staffing estimates and represent more details that have not been identified in earlier stages of design. For the Deaf Smith repository, the work force estimates were increased, due to this contingency factor, as follows: construction, 35.6 percent; operations, 32.2 percent; decommissioning, 38.9 percent. No specific rationales were provided in the Mathews memo.

Sixth, in addition to the unexplained adjustments of 15 and 20 percent, and the major adjustments from the contingency factors, there is a significant potential adjustment factor due to the accuracy of the estimates. Stearns-Roger Services indicated the interval estimate was

accurate at plus or minus 20 percent. In terms of Deaf Smith, that means the work force could be altered as follows:

	<u>Peak Low Estimates</u>	<u>Peak Medium Estimates</u>	<u>Peak High Estimates</u>
Construction	1,096	1,370	1,644
Operation	1,200	1,500	1,800
Decommissioning	184	230	276

The interval estimate of 20 percent, however, is judged to be too precise in the Mathews memo. It is stated: "Therefore, I believe that 40-50 percent should be used as an indicator of the accuracy of the data presented, herein." If the interval estimate is plus or minus 45 percent, the potential work force at Deaf Smith could be altered as follows:

	<u>Peak Low Estimates</u>	<u>Peak Medium Estimates</u>	<u>Peak High Estimates</u>
Construction	754	1,370	1,986
Operations	825	1,500	2,175
Decommissioning	127	230	333

It is unclear why the accuracy of the estimates was not discussed in the draft environmental assessment and why only the point estimates (peak medium estimates) were given. What is disconcerting is that the peak high estimates and peak low estimates are equally probable and just as likely as the peak medium estimates. And there is some probability that the actual number of workers would not be in the

interval, that is, for the operation phase, the number of workers could be fewer than 825 or in excess of 2,175. The extent of socio-economic impacts could vary as much as, or more than, this large interval estimate.

Locally Hired Workers

Because of the very serious deficiencies in estimating the aggregate number of repository workers, the problem of estimating the locally hired work force becomes even more difficult. What is particularly surprising is the absence of any estimate of which types of positions or levels of jobs would be filled by local residents. In our previous comments on the immigration model (Section 6 of the comments submitted on March 15, 1985), we noted that large errors were probable in the immigration estimates. As a result, the only potential means of obtaining an estimate of local hires would have been from a more micro perspective, a detailed analysis beginning with the number and types of positions comprising the repository work force.

The only information that is available in the Mathews memo is a delineation of the types of crafts and positions, grouped into seven categories, that would be needed during the operations phase. Two examples are:

Group 1	Clerical, Hourly	Man years
	(Bookkeeper, Clerk, Clerk typist, PBX Operator, Receptionist, Secretaries)	1,316

Group 3	Maintenance & Operations Hourly	Man Years 7,774
	Production Scheduler, Production Superintendent, Painters, Mainten- ance men, Electricians, Safety Inspectors, Machine Repairmen, Mechanics, Warehousemen, Shipping/ Receiving Clerks, Laborers, Janitors, Guards, Truck Drivers, Equipment Operators.	

With more detail, and assuming there were no serious deficiencies with the aggregate estimates, such information would be a starting point for deriving reasonable estimates of local hires. Ideally, a list would be prepared of each job until the repository is closed. Barring that ideal situation, information should be collected and developed on (1) number of repository workers in each occupation; (2) the timing for each occupation both in terms of its beginning and its termination dates; (3) the distribution of levels within a particular occupational group and job series; (4) estimated turnover and separation rates for each distinct job class; (5) the total compensation package for each job class; and (6) the extent of job training, if any, that is planned and for which job classes. (Also, two other groups of workers need to be included in labor force studies for the construction phase: highway construction workers off-site and railroad construction workers.)

The demand for repository workers will be affected by the available supply. Therefore, projections will need to be made for the local labor force during the period from 2000 to 2035 A.D. These projections will need to incorporate assumptions about labor force participation rates as

well as a very detailed profile of the current labor force in the potential site areas. Current turnover rates for job classes that would exist at the repository should be examined especially carefully because the rate of in- and out-migration will be an important component in the overall level of socioeconomic disruption.

Overall, the repository work force data, as presented in the draft environmental assessment, are too premature to use in projecting potential socioeconomic impacts. This conclusion pertains to both the overall number of repository workers as well as the number of local workers who could be hired from the local labor force. All conclusions in other sections of the draft EA that rest on the number of likely immigrants also would need to be reconfirmed or derived by different means. In sum, at this time, very little credence should be given to any of the repository work force point estimates in the environmental assessment.

Two-Phase Repository Design Concept

The two-phase design would be a significant departure from the EA reference design. Few impacts are identified in the five-page description, but from the information presented, it appears that the alternative design would create much greater damage to the entire area. For example:

- (1) Construction would be compressed and would occur at approximately twice the rate as in the reference design. More workers and equipment would be needed for a shorter period of time. Twice as much water would be consumed, thereby affecting agricultural and community usage.
- (2) Characterization activities probably would be more disruptive than anticipated because more drilling would be conducted. And because emplacement would begin sooner, there would be less time to plan for potential transportation and community service impacts.
- (3) Transportation of the wastes would be affected several ways because on-site temporary storage of a three-month supply would become possible. There would be transportation effects from the larger amount of excavated salt that would be moved off-site.
- (4) More land would be affected than in the reference design. The surface land restricted zone would double in size, and the underground facility acreage would increase 50 percent to 3,359 acres.
- (5) Migrating salt and its agricultural impacts would increase dramatically. There would be an approximately 102 percent increase in the quantity of excavated salt. There would be a 300 percent increase in the quantity of salt brought to the surface. The size of the salt pile on-site would be enlarged by 70 percent. The pile would be 12.6 billion pounds.

Only two short paragraphs are devoted to socioeconomics and the thrust is "The socioeconomic impacts of a two-phase repository would be greater. . ." (page 5-155). That is insufficient. If the two-phase repository is selected, a new Environmental Assessment should be prepared. The likely and realistic socioeconomic impacts from the two-phase design cannot be assessed in detail now. Because the preclosure impacts will be substantially more severe than in the reference design, detailed analyses need to be conducted prior to the Environmental Impact Statement.

Aggregation Methods and Results

Because of the detailed analysis performed by the firm ECO Northwest for Washington's Joint Legislative Committee on Science and Technology, there is no need for another extensive critique. Our comments will be elaboration of certain of Washington's points and a supplement to Washington's analysis in several cases.

The three ranking methodologies described in Appendix B have serious limitations in both theory and in practice as used to compute site rankings. As several Washington officials have indicated in written and oral comments (e.g., testimony of Senator Al Williams at the March 7, 1985 DOE Public Hearing), the averaging and pairwise comparison ranking methods are technically invalid. The mixing of ordinal and cardinal data has occurred, which is an unacceptable situation. There are also problems in the method of computation. For example, no rationale is provided on page B-3 for why losses are subtracted from wins rather than two other possible pairwise comparison methods: (1) computing the number of wins, not wins minus losses; or (2) computing the sum of wins and ties. This latter method seems particularly worthwhile since there are so many ties. In fact, the sheer number of ties renders the process almost useless. In Table B-1, the comparison between Deaf Smith and Davis Canyon indicates a preference

for one or the other on less than 60 percent of the guidelines -- 8 of the 19 guidelines are considered to be ties.

There are cases also where the application of the method must be in error. Three examples should be sufficient to demonstrate the problems in determining the ordinal ranks. In Table B-1, Deaf Smith is given a superior ranking to Yucca Mountain on site ownership and control, and transportation. Erosion is rated a tie. These judgments are counterintuitive and require further explanation. Many other similar examples could be cited in the same table.

The utility-estimation process is a step in the right direction, but is still insufficient. Scores on particular guidelines cannot be replicated since neither the identities of the raters or the information they reviewed is known. The weights for guidelines, likewise, are given without justification. And the 10-unit scale for each guideline is arbitrary -- Yucca Mountain receives a 10 on population density while Deaf Smith is given a 7, a degree of variation that seems highly constrained. With this type of problem and with the State of Washington's finding that "modest changes in site scores on individual guidelines, coupled with the assignment of greater weights to some guidelines within the post-closure or preclosure groups, produce changes in the rankings," the overall rankings would seem suspect.

The utility-estimation method demonstrates how unscientific and unsound the decision making can be. There are many problems. Some of the problems, such as making guidelines independent from each other, can be overcome. And certain mistakes can be corrected, such as not divulging the information used in assigning scores and not divulging inter-rater reliability or an index of agreement among the group of unknown technical experts. Several other problems will be more difficult to overcome. Almost every one of the guidelines in Table B-3 needs to be reexamined for its scaling. Most do not appear to be true interval scales because they are not based on underlying physical properties. Population density is an exception, but what does it mean to measure a 7 on the scale of socioeconomics? What is a 6 on a transportation scale? Even the population density ratio scale needs adjustment because there is no reason to limit the range to 10 when a density range could be 10 times greater than that.

In conclusion, the aggregation methodology is so technically flawed that there is no objective basis for the nominations. Because the socioeconomic data that was used throughout the draft environmental assessment also was generally flawed, outdated, or unsupportable, any rankings would be based almost solely on faith or randomness.

To correct this situation, a multi-step process is necessary. First, DOE should redo the draft EA with updated, upgraded, and new types of information. Simultaneously, DOE should work with state officials on

improving the overall method of decision making. This might include creation of a panel of technical experts who would be given responsibility for determining which ranking procedures would be employed and by whom. At a minimum, the raters must be known and the process of computing the site scores and ranking must be open to replication, even observation. Then the new draft environmental assessment can be issued.

Devising selection methods for multi-site, multi-dimension, and multi-rater situations when there are few legal prescriptions and precedents will not be easy. Yet there is no alternative. Until the process can be made replicable and understandable to reasonable people, no nominations should be made, for they will lack credibility. There cannot be a perception that the decision-making process was unscientific and biased.

Assessment of Local Impacts by DOE

The draft EAs for the Deaf Smith County and Swisher County sites fail to adequately address local impacts of the proposed repository.

Section 112 (b)(1)(E)(vi) of the NWPA states, "Such environmental assessment shall include . . . an assessment of the regional and local impacts of locating the proposed repository at such site." The draft EAs do not include an adequate assessment of local impacts.

Reasons for this conclusion follow.

* 1. The failure to sufficiently address local impacts is made clear in the Guidelines discussion where conclusions are drawn which lead to site rankings. The Guideline on Socioeconomics, favorable condition (1), ability of area to absorb population, in no way accounts for population impacts on specific communities. The entire area within community distance is considered, rather than specific communities. Thus, because an aggregate 2 percent population increase is projected, a favorable condition is found, i.e., the population increase can be absorbed. The distribution of this aggregate 2 percent increase, however, is ignored. It is likely that communities closer to the site, which happen to be small, will attract a significant portion of the increase, which could result in a large percentage increase. Due to failures of analysis (detailed in our previous comments), potentially large percentage increases in population at

the local level are not detected. The potential increases are further masked by changing the unit of analysis from a specific community to the entire region. Thus, there is no basis for concluding that population increases can be absorbed locally. Local impacts are entirely ignored in this guideline.

2. Flaws in the population allocation model (detailed in our first set of comments) overstate the numbers of people who are predicted to settle in the larger and more distant cities, such as Amarillo. Smaller, less distant cities are overlooked, such as Happy near the Swisher site and Adrian near the Deaf Smith site. Population increases for small cities like Vega and Tulia are understated.

3. Several important local units of government are not analyzed for impacts. Among these are water districts, river authorities, regional councils of governments, hospital districts, and some nearby school districts (Adrian near Deaf Smith, Kress near Swisher). Ignoring these entities contributes to a lack of knowledge of local impacts.

4. Only four cities at each site are analyzed in any depth to ascertain the impacts on housing, education, health facilities, and other community services. These were chosen through use of the flawed population allocation model. The analysis needs to include all potential cities and counties where population might settle. Local unincorporated communities will be affected as well.

Additional Comments

1. Socioeconomic Studies During Characterization.

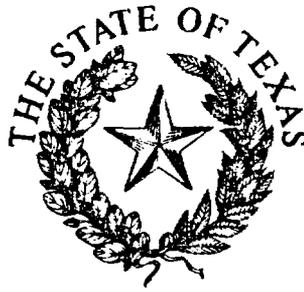
In the initial submission of comments, there were items pertaining to socioeconomic studies during characterization. Additionally, DOE should provide a more precise plan for socioeconomic data collection during characterization. The plan should include the approximate amounts to be expended on each study and a timetable for all studies and projects. The final EA should also include a section that specifically estimates quantitatively the economic benefits, if any, that would occur for the governmental jurisdictions affected by characterization. Another issue that needs to be addressed in the final EA is psychological stress, namely what will be done, beginning during characterization, to cope with citizens' increased levels of stress.

2. Emergency Response and Defense Wastes.

More information needs to be provided in the final EA on the entire emergency response strategy. At a minimum, the respective planned roles and responsibilities of DOE, state government agencies, and local jurisdictions should be designated on both operational and financial matters.

Defense wastes also need much greater attention and discussion in the EA now that it is likely there will be commingling. If defense wastes currently constitute 98 percent of the combined volume of high-level waste and spent fuel, it is difficult to imagine that significant impacts would not occur from commingling. Not only would there be additional transportation impacts, but also perhaps impacts on the size and design of the repository. Additional salt stockpiling may be necessary, and characterization studies may be altered. With a significant increase in waste shipments, there would be additional socioeconomic effects. Unfortunately, until the draft EA is revised and expanded, the extent of impacts from defense wastes cannot be estimated.

Encl. L



CURTIS TUNNELL
EXECUTIVE DIRECTOR

OFFICE OF THE GOV.
REC'D MAY 3 1985
AM 7,8,9,10,11,12,1,2,3,4,5,6 PM

TEXAS HISTORICAL COMMISSION
P.O. BOX 12276 AUSTIN, TEXAS 78711 (512) 475-3092

April 25, 1985

Mr. Steve Frishman
Director
Nuclear Waste Programs Office
Office of the Governor
201 E. 14th Street, Rm. 204
P.O. Box 12428
Capitol Station
Austin, Texas 78711

Re: Deaf Smith County Nuclear
Waste Storage Environmental
Assessment
(DOE-CRWM, A-2)

Dear Mr. Frishman:

A review of the draft Environmental Assessment for the Deaf Smith County site has been reviewed.

In general, the document addresses the requirements of the applicable regulations and laws. The document is weak, however, in defining the way in which indirect impacts will be addressed.

We foresee an increase in site damage and destruction due to increased activity in the area. Impacts due to vandalism and looting will increase and will constitute an adverse effect upon significant resources.

The state of Texas historic preservation plan should be addressed. Although no formal document has been prepared yet for this study unit, the RP3 document published in 1982 by the Historical Commission serves as a basis for the development of regional study units. Thus, regional problems that will enhance a regional research design should be considered.

We also wish to emphasize that archeological survey and assessments of identified sites should be completed well in advance of the site characterization activities. Should significant resources be identified, assessment of effect and mitigation must be completed prior to construction.

Thank you for the opportunity to comment. Should you have any questions please contact Susan Andrews of my staff at 512/475-3057.

Sincerely,

LaVerne Herrington, Ph.D.

Deputy
State Historic
Preservation Officer

The State Agency for Historic Preservation

SA/LH/mes

Encl. M

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SORGHUM SEED PRODUCTION ON THE TEXAS HIGH PLAINS

Darrell T. Rosenow^{1/}

The High Plains of Texas is the premier sorghum seed production area in the United States and the world. The area possesses a unique combination of ideal environmental conditions, along with plentiful underground irrigation water and large expanses of good flat land adapted to irrigation. The area is ideal for the economical production of large quantities of high quality seed.

There are several climatic conditions of the High Plains which make it an ideal site for sorghum seed production. The relatively long frost-free growing season permits flexibility in planting date with assurance of not getting a killing freeze prior to grain maturity. The low relative humidity of the area and low rainfall allow the production of excellent quality planting seed; whereas grain mold and other kinds of grain deterioration are severe problems under high humidity and/or relatively high rainfall conditions. Also, the dry climate and moderate summer winds facilitate excellent movement of pollen grains from flowering heads of the male pollinator parent rows to the male sterile heads in the adjacent female parent rows. The absence of excessively high summer daytime temperatures is a definite plus for the area.

The area has been intensively cultivated for quite a long period, with little

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waste areas present. This contributes to the absence of any serious weedy sorghum (or shattercane) problem in the area. Such weedy-type sorghums, which are quite common in much of the Midwest, are an extremely serious problem in producing pure seed which is free of weedy-type outcrosses. Pollen from such weedy-type sorghums can travel for miles and contaminate an otherwise excellent seed production block. The High Plains area has been the center of sorghum seed production for the United States and much of the World since sorghum hybrids were first developed in the late 1950's. The farmers of the area have a vast amount of valuable experience in procedures necessary to production of seed, such as isolation, rogueing, land preparation, planting splits, timely irrigation, and cooperation with neighboring farmers in controlling weedy-type sorghums and avoiding the planting of sorghums which may provide unwanted pollen close to the production fields. The area has no major disease problems which might be spread as contaminants in the seed. Also, the large acreages of crops and lack of wooded areas contribute to very little if any bird problems.

The abundant amount of excellent quality underground irrigation water is one of the most important traits of the area. This, when coupled with a dry climate, provides an ideal area to produce high yields of high quality sorghum seed.

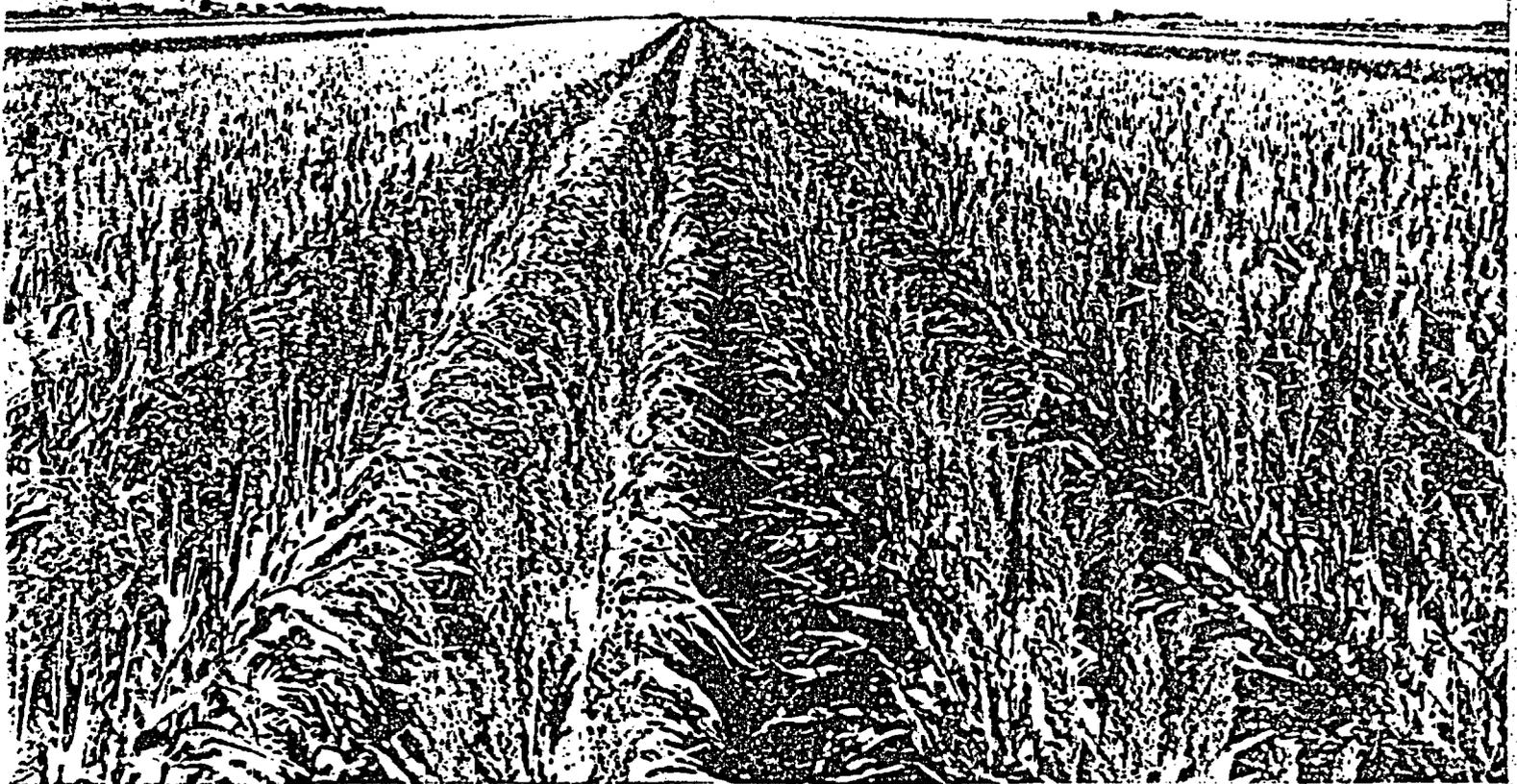
The major seed companies which produce hybrid sorghum seed for the majority of the United States and also for much of the seed for other countries of the World are located in the High Plains area. They possess, in the area, a large investment in seed harvesting, cleaning, processing, and storage facilities.

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Grain Sorghum Production in Texas



TEXAS AGRICULTURAL EXPERIMENT STATION

R. D. LEWIS, DIRECTOR, COLLEGE STATION, TEXAS

IN COOPERATION WITH THE U. S. DEPARTMENT OF AGRICULTURE

Westland and Midland are combine varieties that were distributed in 1942 and 1944 by the Kansas Agricultural Experiment Station. Westland was selected from Wheatland at Garden City by F. A. Wagner and A. E. Lowe. Midland was selected at Hays from a cross between Pink kafir and Dwarf Yellow milo by A. F. Swanson.

HISTORY OF SORGHUM HYBRIDS

Sorghum hybrids were long recognized as a possibility for increasing yields, but their development was delayed by problems of seed production. Hybrid vigor had been studied in Texas as early as 1921 and there were major publications by Conner and Karper¹ in 1927, Karper and Quinby² in 1937 and by Stephens and Quinby³ in 1952. The data presented in these papers showed large increases in yield due to hybrid vigor.

Work with male-steriles, which were visualized as being the answer to the seed production problems, was begun in 1929 after J. C. Stephens found the first genetic male-sterile in a strain of Sudangrass supplied by R. E. Karper. This male-sterile was reported by Karper and Stephens⁴ in 1936. A second genetic male-sterile was found by Stephens in 1935. Glen Kuykendall found a genetic male-sterile in the Day variety in 1943 and discovered that this male sterile produced sterile F₁ plants when pollinated with some varieties, and when crossed to others produced fertile F₁'s. Cytoplasmic sterility was observed, but was not recognized as such, by Conner and Karper in 1923. A search for cytoplasmic sterility that had begun earlier was intensified in 1946 when Director R. D. Lewis suggested an expansion of work on hybrid seed production problems. Stephens suspected the existence of cytoplasmic male-sterility in 1950 and, with R. F. Holland, established its existence in 1952. Stephens and Holland⁵ published on the subject in 1954.

It was proposed by Stephens⁶ in 1937 that the genetic ms₂ might be used for the production of hybrid sorghum seed. Work had progressed by 1946 to the point that hybrid sorghum seed production was almost attempted. However, the discovery of the Day male-sterile caused a loss of interest in ms₂.

After several years of work with the Day male-sterile, it was apparent that the variety could be used for the production of hybrid sor-

ghum even though complete male-sterility had not been obtained. The proposed procedure for the production of hybrid seed by a three-way cross was published by Stephens, Kuykendall and George⁷ in 1952. The Day male-sterile was distributed to plant breeders in other states in 1950. Because of the verification of cytoplasmic male-sterility in 1952, the Texas Station did not put a sorghum hybrid into production using the Day male-sterile and its associated three-way cross system. The DeKalb Agricultural Association, Inc., however, did produce some hybrid sorghum seed by the method in 1955 and continued to use the method to produce one forage hybrid in 1956.

By 1953, Stephens had produced cytoplasmic male-sterile Texas Blackhul kafir by using Double Dwarf Yellow Sooner milo as the female parent and Texas Blackhul kafir as the recurrent male parent. This cytoplasmic male-sterile was distributed to interested plant breeders in 1954 and a number of seed companies started sorghum breeding programs at that time.

R. E. Karper pollinated male-sterile Day with Combine kafir-60 and several other varieties in 1949. N. W. Kramer began work at Lubbock in 1950 with Day hybrids and the Day male-sterile and found by 1952 that backcrossing to Combine kafir-60 resulted in offspring that were highly male-sterile. Workers in other states soon made the same discovery. It finally became apparent that the Day variety had milo cytoplasm, and a backcrossing program using Combine kafir-60 as the recurrent male parent resulted in loss of genetic Day male-sterility and the attainment of cytoplasmic male-sterility. N. W. Kramer produced several combine kafir cytoplasmic male-steriles during 1950-53 by starting with genetic male-sterile Day; and J. C. Stephens, starting with fertile D. D. Y. Sooner milo, produced male-sterile Texas Blackhul kafir and several male-sterile combine kafirs.

During the period when the female parents were being sterilized, crosses were being made and the hybrids evaluated. By 1954, several hundred hybrids had been observed and about 10 pollinators recognized as having exceptional combining value.

By the summer of 1954, it was evident that a satisfactory degree of cytoplasmic male-sterility could be obtained in combine kafirs. Enough male-sterile seed were produced to plant 25 acres of parental crossing blocks and almost 200 one-acre apprentice seed-grower crossing blocks in 1955. No serious difficulties were encountered by the Texas Station in increasing the male-sterile or by seed growers in producing hybrid seed. On the basis of that experience, the Texas Station chose seven hybrids for production and seed

¹Conner, A. B. and Karper, R. E. Hybrid Vigor in Sorghum. Texas Agri. Exp. Bulletin 359, 1927.

²Karper, R. E. and Quinby, J. R. Hybrid Vigor in Sorghum. Jour. Herd. 28: 82-91, 1937.

³Stephens, J. C. and Quinby, J. R. Yield of Hand Produced Hybrid Sorghum. Agron. Jour. 44: 231-233, 1952.

⁴Karper, R. E. and Stephens, J. C. Floral Abnormalities in Sorghum. Jour. Herd. 27: 183-194, 1936.

⁵Stephens, J. C. and Holland, R. F. Cytoplasmic Male-Sterility for Hybrid Sorghum Seed Production. Agron. Jour. 46: 20-23, 1954.

⁶Stephens, J. C. Male-Sterility in Sorghum: Its Possible Utilization in Production of Hybrid Seed. Amer. Soc. Agron. Jour. 29: 690-696, 1937.

⁷Stephens, J. C., Kuykendall, G. H., and George, D. W. Experimental Production of Hybrid Seed with a Three-way Cross. Agron. Jour. 44: 369-373, 1952.



FIGURE 8. ONE OF THE 200 SEED GROWER CROSSING FIELDS GROWN IN 1955 IN TEXAS. THIS FIELD WAS GROWN CLOSE TO GARLAND, TEXAS, ON DRYLAND AND THE HYBRID PRODUCED WAS RS 610.

growers in Texas planted 12,000 acres of crossing fields in 1956. Production from this acreage was about 16 million pounds of hybrid seed. The same year, seed growers in other states and the DeKalb Agricultural Association, Inc., in Texas also were in production and the total hybrid sorghum seed production in 1956 was estimated to be about 24 million pounds. This amount of seed probably planted about 3 million acres of hybrids in the United States in 1957. Hybrid sorghum seed were produced in Texas in 1957 on about 25,000 acres.

Seven hybrids were produced in Texas in 1956 by seed growers who used seed stocks from the Texas Station. An additional hybrid was produced in 1957. Seven hybrids were produced in 1957 on male-sterile Combine kafir-60 and one on male-sterile Combine kafir, SA 605. Table 2 shows the parentage of the hybrids produced in 1957.

The male and female parents of the eight hybrids produced in 1957 in Texas are varieties or strains that originated in the breeding program

of the Texas Agricultural Experiment Station. The parents of combine grain sorghum hybrids at present must be of the genetic height of the combine kafir seed parents. A number of strains other than the two combine kafirs now used as seed parents have been sterilized and several of them have been distributed to plant breeders in other states and foreign countries. A list of seed parents used in the production of sorghum hybrids in Texas, or that have been distributed, is presented in Table 3. A list of the eight pollinators of the hybrids in production in 1957 is presented in Table 4.

Recommended Varieties and Hybrids

Texas has been divided into three regions for the purpose of recommending sorghum hybrids and varieties, Figure 9. Region 1 consists of the High Plains. Region 2 consists of the Rolling Plains, the Blacklands and East Texas and the smaller areas between them. Region 3 consists of the Rio Grande Plain and the Coast Prairie from the Rio Grande to the Sabine river. Region 1, the High Plains, differs from the other parts of the State in having greater elevation and lower rainfall. About 1 1/2 million acres of sorghum in region 1 are irrigated. Region 2 contains many different types of farming areas. Nevertheless, varieties and hybrids grow in a similar manner throughout the entire area. Region 3 differs from regions 1 and 2 in planting date. Within region 3, annual rainfall varies from 50 inches in the east to about 18 inches in the Lower Rio Grande Valley. In the Gulf Coast region, planting can be done early enough so that the short days of February and March influence growth of light-sensitive varieties.

TABLE 2. PEDIGREE OF SORGHUM HYBRIDS PRODUCED IN 1957

Hybrid	Pedigree
RS 590	Tx 385 x Tx 386
Texas 601	Tx 385 x Tx 04
RS 610	Tx 385 x Tx 7078
Texas 611	Tx 385 x Tx 74
Texas 620	Tx 385 x Tx 07
RS 630	Tx 36 x Tx 09
RS 650	Tx 385 x Tx 7005
Texas 660	Tx 385 x Tx 7000

elevations above 5,000 feet. Nevertheless, sorghum is a warmth-loving species.

The minimum temperature for germination of sorghum seed is 45 to 50 degrees F. and the minimum temperature for subsequent growth is about 60 degrees F. The most favorable mean temperature for the growth of sorghum is about 80 degrees F. Temperatures above 100 degrees F. are detrimental, but much higher temperatures are tolerated by sorghum plants if ample soil moisture is present.

Sorghum is a "short-day" species, which means that floral initiation is hastened if the nights are long and is delayed if the days are long. Many sorghum varieties are sensitive to photoperiod or day-length, but many others are insensitive or show varying degrees of sensitivity. It is assumed from work with other species that the temperature requirement has not been met if a variety is insensitive to photoperiod. The time of floral initiation in sorghum, consequently, is assumed to be influenced by temperature as well as photoperiod. For this reason, two sorghum varieties at one location may have similar durations of growth, but have dissimilar durations at another location where prevailing temperature conditions are different. Most of the varieties grown in the United States are relatively insensitive to photoperiod, but there are notable exceptions.

Length-of-day changes with the seasons, with 12-hour days occurring at the spring and fall equinoxes on March 21 and September 23. The longest day of the year occurs at the summer solstice on June 22. Temperatures are correlated with the seasons and with elevation above sea level. Sorghum production in Texas extends for more than 700 miles from south to north and from sea level to nearly 5,000 feet. Warm temperatures occur with less than 12-hour days in early March along the Gulf Coast, and 14-hour days and cool night temperatures occur at 4,000 foot elevations on the High Plains in July. The climate of Texas is varied. Varieties of peculiar adaption to the location and planting date are grown, or the varieties grown are relatively insensitive to photoperiod, or to both photoperiod and temperature. Costly mistakes can be made if photoperiod and temperature-sensitive varieties are planted outside their optimum environments.

Reproduction in Sorghum

NORMAL BLOOMING AND FERTILIZATION

Sorghum normally is self-fertilized and has perfect flowers with no known barrier to cross-fertilization. The stimulus that causes anthesis appears as early as midnight in some varieties and as late as 4:00 or 5:00 a.m. in others. Blooming is delayed by cool temperatures and may be as late as mid-morning in cool weather. Bloom-

ing starts at the top of the panicle and normally is completed in 4 to 7 days. The blooming period is longer in cool weather.

Each sorghum stem terminates in a head or inflorescence that may produce as many as 3,000 or 4,000 seed, with 1,500 to 2,500 seed in a typical well-developed head. In the common varieties, each spikelet contains a single perfect flower that contains both female and male organs. The pistil or female structure within the spikelet consists of an egg-shaped ovary with two tiny, feathery stalks or styles at the apex. The styles terminate in bushy stigmas that are receptive to pollen grains. The male structures are the three stamens, each of which consists of an anther supported by a thread-like filament attached to the axis of the flower beneath the ovary. Blooming progresses from top to bottom of the head. In the process of blooming, the glumes are forced open by the swelling of the lodicules, the stigmas fluff out, the filaments elongate and exert the anthers which become pendant at about the time the glumes are fully spread. The anthers or pollen sacks then split at the end. The splitting usually is sudden and a small cloud of pollen is released. Blooming is completed by the closing of the glumes. The stigmas of most varieties are long enough to extend beyond the glumes after the flower has closed and are receptive to pollination for several days. The entire process of blooming of one spikelet may be completed in as little as 20 or 30 minutes, but flowers frequently remain open for 2 or 3 hours. The three anthers of a normal sorghum flower usually contain about 15,000 pollen grains, so a single head of 3,000 spikelets would produce 45 million pollen grains. The staminate spikelets of most varieties do not shed pollen.

Viable pollen that falls on receptive stigmas germinates. Light is necessary for pollen germination and pollen shed during the night does not germinate until daybreak. Sorghum pollen is viable for only a few hours after leaving the anthers. A pollen grain that penetrates the stigma forms a tube that grows down the style, enters the ovary and releases the male gametes that fertilize the egg and endosperm nuclei. Fertilization results in the development of the embryo and endosperm to form the seed. Usually, 90 to 95 percent of normal sorghum flowers produce seed.

Even a gentle wind or convection current will move sorghum pollen across several rows before the force of gravity brings it to earth. When sorghum varieties are grown adjacent to one another, cross-fertilization of 6 percent is average. Under some conditions, the percentage of cross-fertilization may be less or much greater.

MALE-STERILITY AND CROSS POLLINATION

Male-sterility implies normal function of the female and inhibited function of the male flower

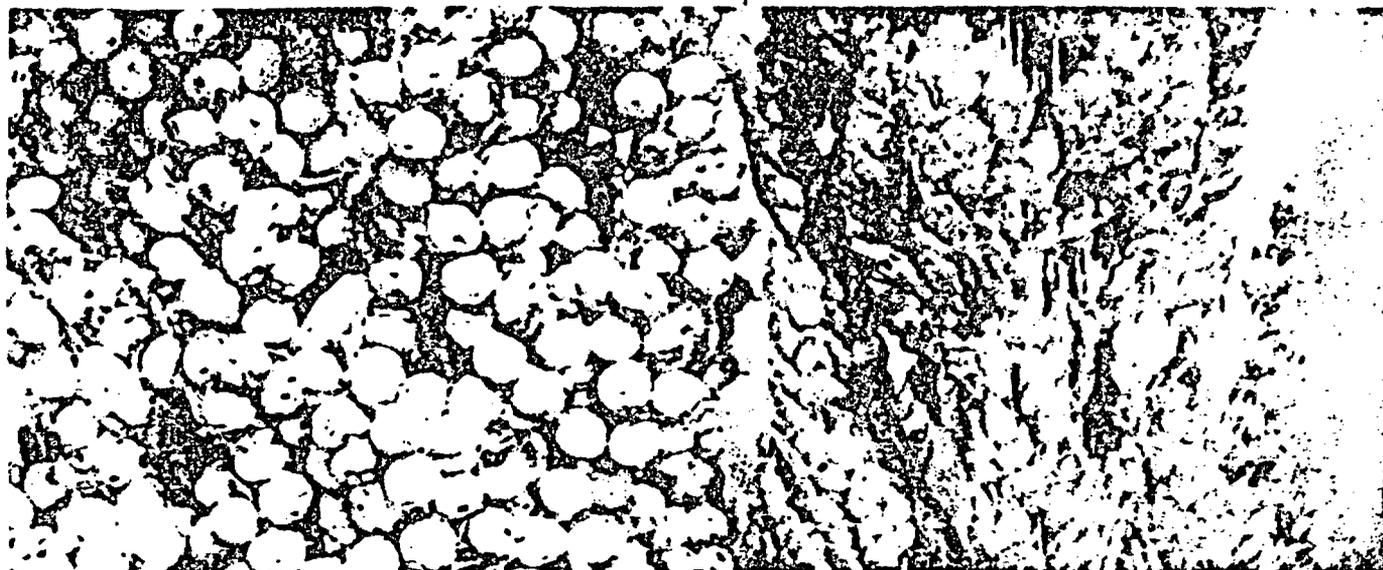


FIGURE 10. NORMAL AND UNFERTILIZED CYTOPLASMIC MALE-STERILE HEADS OF SORGHUM.

parts. The inhibited male function may result from various inherited abnormalities in development or structure, but usually occurs from arrested development of the anthers (Figure 10). In most types of male-sterility, pistils or female structures are normal, and the flowering sequence is like that in self-fertile plants. Since the male-sterile plants do not disseminate viable pollen, such plants can be fertilized only with pollen from other plants that produce pollen. Sorghum pollen is moved about readily by air currents and effective pollination across 12 40-inch rows is normal. Wind movement, however, is not always sufficient to give effective cross pollination in some areas during the short period in the morning that sorghum pollen is viable.

CYTOPLASMIC MALE-STERILITY

Both cytoplasmic and genetic male-sterility in sorghum cause poorly developed anthers and a lack of pollen. The important difference between the two types of male-sterility is their mode of inheritance. Genetic male-sterility is inherited normally and the influence of the male parent is seen in the offspring. Cytoplasmic male-sterility is inherited maternally. All of the offspring of a cytoplasmic male-sterile female plant pollinated by its normal counterpart will be sterile like the female parent. This mode of inheritance allows a cytoplasmic male-sterile to be maintained easily by growing A (cytoplasmic male-sterile) and B (male-sterile producing) lines together in parental crossing fields. Fertile sorghum hybrids can be produced by growing A and R (genetic pollen-restoring) lines together in seed grower crossing fields. These kinds of crossing fields are shown diagrammatically in Figure 11.

Cytoplasmic male-sterility is thought to be caused by an incompatibility between the cytoplasm of the female parent and nuclear factors

from the male parent. Since the male parent passes little or no cytoplasm on to the next generation with the male gamete, the female parent furnishes the cytoplasm to the offspring. When there is incompatibility between the cytoplasm of the female parent and certain genes from the male parent, male-sterility results. Cytoplasmic male-sterility was found in sorghum when the cytoplasm came from milo and the nuclear factors from kafir.

A and B lines are similar in their genetic make-up, but A lines have sterile (milo) cytoplasm and B lines normal cytoplasm. R lines always carry the fertility-restoring gene or genes and frequently, but not always, have sterile cytoplasm.

MANIFESTATIONS OF HYBRID VIGOR

The parents of sorghum hybrids are inbred lines but, unlike corn inbreds, are reasonably vigorous. Several of the parents of hybrids presently in production are widely-grown varieties. There are complementary factors for tallness and late maturity between some strains, and hybrids between them are tall, late in maturity and high yielding. The high yield in such hybrids results from a combination of complementary gene action and heterosis. Grain hybrids that are in production have hybrid vigor without complementary gene action in height or late maturity.

The present grain hybrids are characterized by earliness, a slight increase in height and tillering and a substantial increase in grain production. The eight hybrids in production were grown, along with their parents, in variety tests on dryland and under irrigation in 1957 and observed for time of blooming, height of plant and grain yield. A partial summary of the data obtained is shown in Table 11. The hybrids produced more grain and were earlier and taller

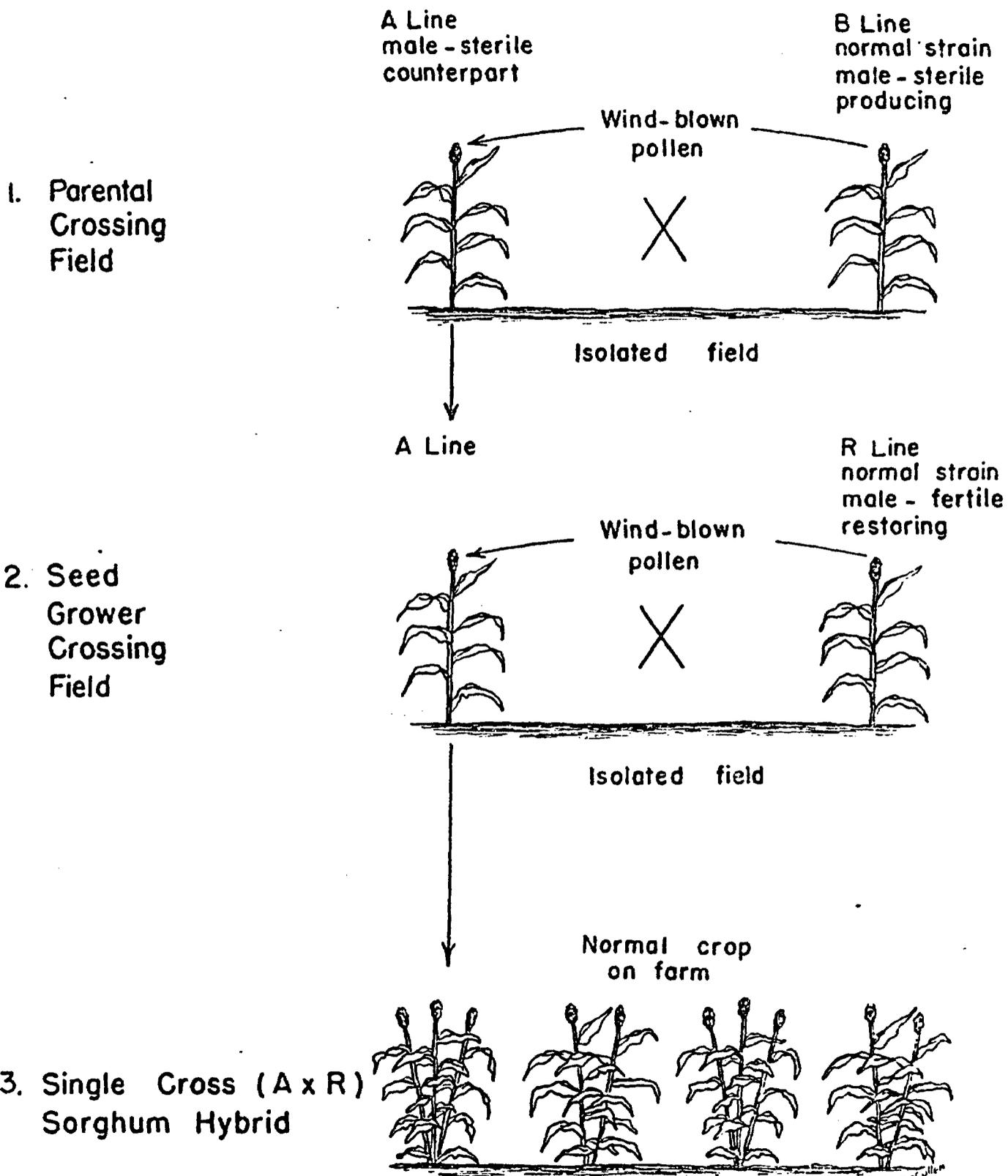


FIGURE 11. METHOD OF PRODUCING SEED OF SORGHUM HYBRIDS.

TABLE 13. YIELD OF F₁ AND F₂ GENERATIONS OF SORGHUM HYBRIDS AND FEMALE AND MALE PARENTS IN DRYLAND AND IRRIGATED YIELD TRIALS AT CHILLICOTHE, 1957

Hybrid	Yield of grain in pounds per acre			
	F ₁ hybrid	F ₂ generation	Female parent	Male parent
RS 610	1500	1240	760	1050
do ¹	2930	2730	2090	2400
Texas 660	1160	1150	770	710
do ¹	2840	2340	2110	2720
Texas 620	1330	1030	770	1340
do ¹	2580	2060	2110	2200
Average	2057	1758	1435	1737
			1586	
Increase above average of parents, percent	30	11		
¹ Irrigated				

in yield over the parents was lost in the F₂ generation.

SORGHUM SEED PRODUCTION

Production of Seed of Varieties

About 10 pounds of seed are required to plant an acre of sorghum. Usually planting rates are not as heavy as 10 pounds per acre, but some fields are replanted due to excessive rains, cold soil, hail and other catastrophes. The average amount of seed required to plant a 6-million acre sorghum crop is about 60 million pounds. At a production of 2,000 pounds per acre, 30,000 acres would be required to produce the seed to plant the usual Texas grain sorghum acreage. A large part of the seed planted by farmers is purchased.

The varieties of grain sorghum grown in Texas are either of dwarf or combine height. The dwarf designation indicates two recessives among the four height genes that have been reported in sorghum, and the combine height designation usually infers that three of the height genes are recessive. Some of the short varieties differ in the genes that are recessive for dwarfness, and hybrids between these varieties are tall. Also, some first-generation hybrids are extremely late as well as tall. For these reasons, seed harvested in fields adjacent to another variety may produce numerous hybrids which are not only unsightly, but also interfere with mechanical harvesting. These objectionable hybrids have stimulated interest in seed grown with adequate isolation.

Fields of sorghum grown for certified seed must be on areas not planted to any other sorghum variety the year before and must be isolated from other sorghum varieties. Field inspections are made to enforce isolation and varietal purity standards and seed samples must meet certain minimum standards for germination and purity. Seed certification regulations are

enforced by the State Department of Agriculture, Austin, Texas. Certification standards can be obtained from that agency.

Varietal purity can be maintained in a number of ways. It is a wise precaution to bag heads so there will be no offtype plants if the first increase of a variety or strain is made from seed from a breeding block. Tall mutations that appear in some varieties should be removed before they bloom, which is about as soon as they can be recognized. Seed harvested from the middle of a large field should be sufficiently pure to maintain the purity of a variety with a minimum of roguing. Precautions must be taken to see that there is no mechanical contamination in threshing and seed-cleaning equipment.

Production of Hybrid Seed

A commercial sorghum hybrid is the result of crossing a male-sterile stock with a normal strain that restores male fertility in the next generation. Sorghum hybrids have been produced by two methods. One method uses a genetic male-sterile and requires a three-way cross. Only one private firm has distributed seed produced this way and this practice has been discontinued. The other method uses cytoplasmic male-sterility and requires only a single cross.

Commercial hybrid seed are produced by growing a male-sterile strain (A line) in the seed rows and a fertility-restoring strain (R line) in the pollen rows of a seed grower crossing field. All seed set on the male-sterile rows result from fertilization by wind or insect-borne pollen. Hybrid seed are those harvested from the male-sterile seed rows, Figure 11.

Experience in the commercial production of hybrid seed has been too limited to recommend definite ratios of seed to pollen rows. The most common practice to date has been to use a ratio of 3:1 with either 6:2 or 12:4 seed rows to pollen rows, depending on whether 2-row or 4-row harvesting equipment was available. Several pollen parent border rows on each side of the field provide a concentration of the desired pollen at field edges.

Pollination is a greater problem under some conditions than others, and undoubtedly hybrid seed production practices will vary among growers and at different locations. When seed and pollen rows bloom at the same time, when growing conditions are ideal, and when an early morning breeze occurs daily, practically full sets of seed may be expected on the male-sterile rows. When any of these conditions are not met, fertilization is incomplete and the yield of the seed crop is reduced proportionally.

Preventive measures for poor pollination sometimes are possible. If it is known that one parent is earlier than the other, the planting dates can be separated the appropriate number

of days to allow the parents to bloom at the same time. This practice is called split planting and is not done if it can be avoided. When the pollen parent has some tendency to tiller, thin stands will permit increased tillering and a longer period of pollen production. The period of pollen distribution has been spread experimentally and in commercial seed fields by cutting off part of the plants in the pollen rows to force out tillers and side-branches that bloom later than main heads. The stalks must be cut below the growing points or the mutilation will be ineffective. The growing point usually is only 1, 2 or 3 inches above the crown 20 to 30 days after planting, and by 30 days the small heads of some varieties will have been formed. Some seed growers have devised simple wheels to cut part of the stalks. Short blades that operate like the blades of a rolling stalk-cutter are welded to the wheels, and the wheels are attached to a cultivator like rotary hoes. Any practice that does not destroy, but does mutilate part of the plants enough to retard blooming, will spread the effective pollination period. Withholding irrigation water from one pollen row frequently will delay heading and is an effective method of lengthening the pollen-shedding period.

Extremely hot and dry weather shortly before or during the flowering period causes a number of abnormal conditions that decrease effective pollination. Sometimes heads may not be fully exerted; spikelets may open only partially and then close without extruding anthers and stigmas; pollen grains may be empty or anthers fail to dehisce; and stigmas may be wilted and nonreceptive. When these conditions develop in dryland plantings, there are no effective counter measures.

Since the seed and pollen rows usually are about the same height, gravity alone will not effect pollination. Some wind movement or convection currents are necessary to distribute pollen to the seed rows. In the absence of sufficient wind for satisfactory movement of pollen, tractor-mounted blowers and crop dusting planes have been used successfully to create the necessary turbulence for pollen distribution. The time of actual blooming should be observed because mechanical disturbance before blooming occurs or after pollen is dead would be ineffective. During the summer, the bulk of flowering in Texas should be over by 7:00 or 8:00 a.m., but after cool nights or in the fall, pollen shedding might be delayed until 9:00 or 10:00 a.m., and occasionally even later.

Production of Seed of Parents

FEMALE PARENT

Male-sterile seed are produced in crossing fields similar to those used by seed growers to produce hybrid seed and most of the production problems are the same. Instead of a restorer strain (R line), the pollen rows are planted to

the B line (normal counterpart) of the particular male-sterile to be produced, Figure 11. The A and B lines are genetically alike and bloom simultaneously at Lubbock and Chillicothe. At College Station, however, A line rows begin to bloom 2 or 3 days before B line rows begin to shed pollen.

MALE PARENT

Male parents of sorghum hybrids (R lines) and the B lines used to maintain male-sterile A lines, are normal strains and several of them are widely grown varieties. Maintaining seed of R lines is no different from the increase of ordinary varieties. Usually bagged seed are used for the first increase and henceforth the seed are produced in proper isolation. R lines usually are maintained in isolated fields, but could be maintained by harvesting seed from self pollinated (bagged) heads from R line rows in crossing fields. B lines can be maintained by harvesting seed from B line rows in parental crossing blocks.

Sources of Parental Seed for the Seed Grower

When sorghum hybrids went into production in 1956, certified seed growers obtained seed stocks from the Texas Agricultural Experiment Station. The Foundation Seed Division of the Station sells seed of A and R lines, but no seed of B lines. B lines are available to seedsmen after it is evident that the hybrids produced from the corresponding A lines will find a place in the agriculture of the State. New combinations or new hybrids will be put into production from time to time as their superiority is recognized. It is anticipated that the number of hybrids will increase in the early stages of getting hybrids into production, but ultimately there will probably be a hybrid dropped for every new hybrid that goes into production.

Several established seed companies now have sorghum breeding programs of their own and maintain their own seed stocks. Since the profit in a seed business comes from selling hybrid seed and isolation is such a problem in its production, many growers prefer to purchase foundation seed rather than produce them. A sound and permanent hybrid seed production program depends on the availability of adequate and dependable supplies of pure seed of the foundation seed stocks to be used in making hybrids.

Isolation of Parental and Seed Grower Crossing Fields

Adequate isolation is a major problem in the production of hybrid sorghum seed. The absence of contaminating pollen is particularly important in the maintenance of male-sterile lines. The wrong kind of pollen on an A line will produce fertile plants in the seed rows of the seed

grower's crossing fields the following year, which will contaminate hybrid seed production unless the fertile plants are destroyed before blooming. Parental crossing blocks, therefore, should be isolated as well as possible and provisions should be made to have ample supplies of pollen. To increase the supply of pollen, a higher proportion of B line rows can be planted.

Foreign pollen also is a problem in the seed grower's crossing fields because rogues are as objectionable in hybrid fields as in fields of pure varieties. Apparently, the best protection against contaminating pollen is an adequate supply of the desired pollen combined with a certain minimum amount of isolation.

The minimum isolation required by the certification regulations in Texas is 220 yards, with modifications down to 110 yards permitted under certain conditions, depending on the number of R line rows at the edge of the field and the source of contaminating pollen. The required isolation from Johnsongrass is 220 yards. Sudangrass pollen is known to get into the air more readily than ordinary sorghum pollen and Sudangrass is a serious contaminant. The required isolation from Sudangrass and broomcorn is 440 yards.

Offtype Plants in Sorghum Fields PLANTS DUE TO CROSS POLLINATION

Several kinds of offtype plants appear in sorghum fields. The most objectionable are due to contamination with pollen from an undesired source. Objectionable hybrids have parents with complementary factors for height or late maturity and are tall or late, or both. Crosses between any of the hegaris or Dwarf Yellow milo with combine varieties such as Plainsman, Caprock, Combine kafir-60, Combine 7078 and Martin are very objectionable.

If Sudangrass is the source of contaminating pollen and the female parent is a grain sorghum variety, the hybrids will be tall, have several stems and have lax heads that produce seed that do not thresh from the glumes. At harvest, part of the tall plants are left standing in the field because the reel of a combine pushes the tall stalks away from the sickle and they pass uncut beneath the combine. Seed with persistent glumes left in the field will be scattered by stalk shredding equipment and may volunteer the next year. The resulting plants are troublesome, grassy weeds.

Johnsongrass crosses infrequently with sorghum because they are different species and because there usually is such a preponderance of sorghum pollen. In crossing fields, there may be times when no such preponderance exists, chances of out-crossing are increased and male-

sterile plants will produce a considerable number of Johnsongrass hybrid seed if exposed to pollination from Johnsongrass.

Sorghum-Johnsongrass hybrids are of two similar types and both are objectionable. The first type results from fertilization of ordinary ovules of sorghum. The resulting hybrids are grassy, not vigorous, produce heads with very few seed and have rootstocks that grow close to the soil surface. These plants will persist if the roots are undisturbed, but they are easily destroyed when uprooted. The second type of Sorghum-Johnsongrass hybrid apparently results from the union of an unreduced female gamete (two sets of chromosomes instead of one) from the sorghum parent with a sperm from Johnsongrass pollen. These rogues are male-sterile but female-fertile, less grassy than the former type and have rootstocks that are shorter and larger in diameter. Such plants in a farmer's field would be expected to produce few if any seed unless pollinated by Johnsongrass. Like the first type, these grassy hybrids may persist if the roots are not disturbed. Sorghum-Johnsongrass hybrids have been described recently by Hadley¹⁰.

ABNORMAL PLANTS NOT DUE TO CROSS POLLINATION

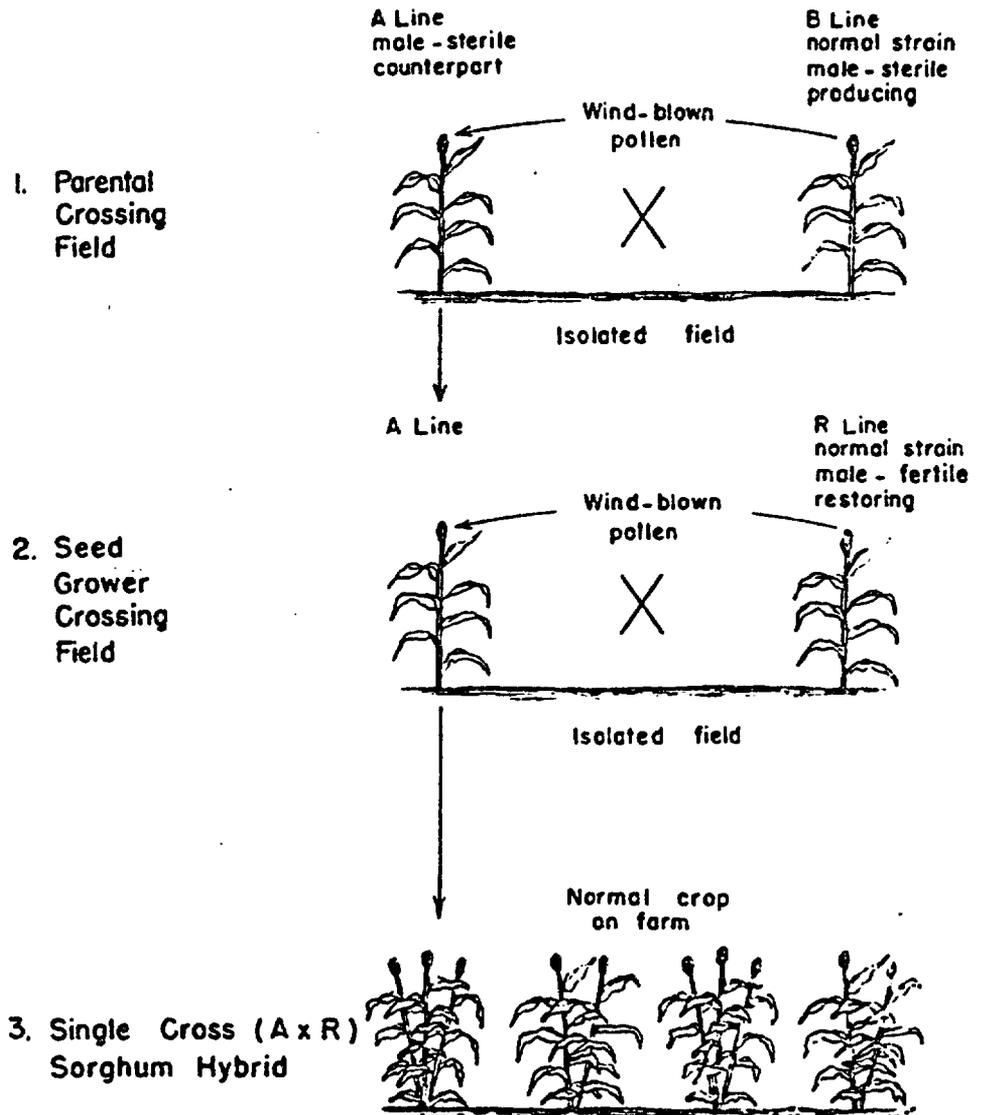
The instability of one of the genes producing dwarfness in sorghum results in the spontaneous occurrence of tall plants without contamination by foreign pollen. Tall plants resulting from this instability appear at a rate of about 1 out of 1,200, or 20 to 80 tall plants per acre. These tall plants are a continual source of embarrassment to sorghum seed producers. The varieties of dwarf or combine height that have kafir in their parentage carry this unstable gene for height. Early hegari also is unstable. Other hegaris and the milos do not contain the instability. A plant breeding program is underway to change the height genotype of several combine varieties to that of Double Dwarf Yellow Sooner milo. If the instability for height can be eliminated, grain sorghum fields planted with pure seed will be uniform.

In fields of sorghum hybrids, it is not unusual to find plants with heads that contain only a few seed. These plants are triploids and result from the fertilization of unreduced gametes, which have double the ordinary chromosome number, by sperms from ordinary pollen grains. Apparently, male-sterile sorghum has an unusual tendency to produce unreduced female gametes. Since there is an unbalanced chromosome number in the triploid plants, they are almost completely sterile.

An unfertilized female gamete occasionally develops into a seed and such a seed develops into a plant that is called a haploid. Haploid plants in varieties are small counterparts of the variety that produced them. Such plants are almost completely sterile since their cells contain

¹⁰Hadley, Henry H. Chromosome Numbers, Fertility, and Rhizome Expression of Hybrids Between Grain Sorghum and Johnson Grass. *Agron. Jour.* 50: 278-282 1958

FIG. 1. Procedure to maintain A-lines and produce hybrid seed of sorghum under field scale operations (number of A-line rows vary from 4 to 16 for each set of 2 rows of pollen source; either the B-line or R-line).





PIONEER HI-BRED INTERNATIONAL, INC.
SOUTHWESTERN DIVISION

BOX 788 • PLAINVIEW, TEXAS 79072 • PHONE (806) 293-5231

March 21, 1985

TO WHOM IT MAY CONCERN:

My name is Duane Griffith. I am Production Manager for the Southwestern Division of Pioneer Hi-Bred International, Inc. My responsibilities involve the production of all United States produced sorghum seed for Pioneer. I have served in this job function for twenty two years and have extensive experience in sorghum seed production.

The High Plains area of Texas has an environment that is very conducive to sorghum seed production. Under irrigation the critical items of climate, isolation, yield, economic competition, etc. come together to make seed production more feasible on the Plains than any other known location. If for any reason this area was to be damaged or lost, severe complications would arise for the sorghum industry. This statement is readily provable by the very fact that approximately ninety-eight percent of all grain sorghum seed is now produced in the area. Sorghum Sudangrass is slightly less, perhaps ninety-five percent or so. Almost without exception, sorghum seed producing companies produce their seed on the Plains. This amounts to thousands of acres of seed production and is the source of planting seed for millions of acres of commercial sorghum production.

I have searched for other locations in which to grow sorghum seed. Most are either too humid, have no irrigation, are contaminated with genetic off-types or have some other problem. Thus, I have never felt it practical to produce outside of the Plains area.

Naturally, the High Plains area must be protected as a viable area for the benefit of sorghum seed production. As normal, there are many connecting items that work together. The grain industry, the livestock industry, farmers, employees such as myself, etc. are all affected. Losing any part could damage the other parts.

Yours truly,

Duane Griffith
General Production Manager

DG/bp



United States
Department of
Agriculture

Agricultural
Marketing
Service

Washington,
D.C.
20250

High Plains Hybrid Sorghum Seed:

Statement by: Donald W. Ator, Chief
Seed Branch

The major production of top quality hybrid sorghum seed is concentrated on the "High Plains" of Texas. There are many valid reasons why over ninety percent of this important seed crop is produced in the area. The reasons include:

1. The necessary isolation to avoid contamination from foreign pollen;
2. The necessary topography and prevailing winds to provide for controlled cross-pollination from male parent plants to female parent plants;
3. A naturally fertile soil which provides the nutritional balance necessary for the development of healthy vigorous seeds;
4. The necessary semi-arid climate of low humidity and cool temperatures during the maturation phase of the seed crop (i.e. seeds are perishable organisms! Heat and humidity are extremely damaging to seed viability and seed crops are more susceptible to damage from warm and humid conditions during the maturation and harvesting phases of the seed production season than at any other time); and
5. Adequate water supply to irrigate the crop during the growing season which avoids any severe stress on the seed parent plants during development of the seed embryo.

Although some hybrid sorghum seed is occasionally produced elsewhere, no other area quite measures up with the Texas "High Plains" in the production of top quality hybrid sorghum seed.

Seed production for all important crops tends to be concentrated in the most optimum area for best quality production. Florida's highly ranked vegetable production for fresh markets and processing is a good example. Virtually all of the State's vegetable seeds come from more favorable seed production areas because Florida's warm, humid climate is not conducive to top quality seed production. Another example is the tremendous grass seed production industry of the Northwest (Oregon, Washington, Idaho). Grass seeds produced in the Northwest are distributed throughout the United States and around the world. The Northwest's superior quality grass seed prevails even with the considerable additional costs (freight) over what seed costs would be if it were produced close to the area of use.

Sincerely,

Donald W. Ator
Chief, Seed Branch
Livestock and Seed Division

TO DOE OFFICIALS

The following statement is in response to the question asked by Mr. Bennett at the DOE hearing in Hereford February 28, 1985. In which following my testimony, Mr. Bennett concurred with my statement saying DOE does not understand the complexities of hybrid seed production and he wished to be further informed. In this statment I will attempt to state the facts involved with hybrid seed production, its importance to the world, and why the Panhandle of Texas is the only unique place in the world for this kind of production.

The isolation for such kind of production is extremely important. It must be located several miles from any kind of contaminating source of pollen (ie, shattercane, johnsongrass, broomcorn, sudangrass) or any other kind of foreign pollen. Since this type of pollen can travel for miles and still remain viable, the area surrounding the production field must also be clean ground and free from these foreign contaminants. Thus, the cooperation of neighboring farmers is very important. In the Texas Panhandle there are several of these isolated areas in which this seed production is done. One of which surrounds the DOE's potential site for a nuclear waste dump. If this site is chosen not only for the dump, but even for further characterization, the potential loss for hybrid seed production would be enormous.

One of the biggest and probably the most important advantage the Texas Panhandle has is yield. The climatic conditions in the Panhandle are the most favorable for optimum yields than any other place in the world. It is a semi-arid region, which allows the development of disease free plants, which will produce a more healthy, vigorous seed. If this production is done in a high humidity, high rainfall area then the disease factor would set in, bringing about the deterioration of the plant and the developing embryo of the seed. Hybrid sorghum production has been tried in other states, as well as other countries. But the end result is always the same, low yields and poor quality seed. Thus, the buyers find it is more economically feasible to purchase the seed from the Texas Panhandle and import it, than to attempt to produce it themselves. This way they can assure their company and their customers that they are getting the best quality product at the

best price the world has to offer.

At a time when sorghum breeders are breeding hybrids which are more suitable for feed and human consumption, and the demand is on the increase for these sorghums it could be a very big economic loss for the whole United States to eliminate or even consider endangering 85% of the worlds hybrid sorghum production.

The females that are used in this production are very delicate and sensitive, to heat and high humidities. An excess of either one of these two things will bring about complete sterility of the female. At the same time the viable pollen from the male plants can not travel or stay viable under these same conditions. These two factors alone would eliminate much of the United States for hybrid production. Couple these factors with the isolation requirements, yield differential and the disease factor and it will be found that there is one and only one place or area in the United States inwhich hybrid sorghum production can be done to meet the quality, the quantity and the economic requirements that the United States farmer and the foreign exporters have come to know, expect and even demand of hybrid sorghums and their producers.

In conclusion, I would again like to invite the DOE officials to come to the site they have chosen and see what is really on the site and the surrounding area. I feel sure that if the proper study would have been done, that neither of the Texas Panhandle sites could have even been considered. There is no way anyone can justify taking the risk of contaminating the water supply for eight (8) states and so very many people.

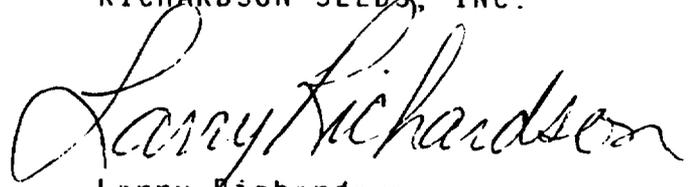
I sincerely hope that DOE officials will re-evaluate their decisions, and study in depth the hybrid sorghum seed production aspect. Not only the Texas Panhandle would suffer a great loss, but also the state of Texas, the United States and foreign countries as well, if even further testing of the Texas site should occur and the site eventually be chosen for the first high level nuclear waste repository.

If there should be any questions about hybrid sorghum production, I would be glad to answer them, obviously though I cannot give a complete genetics, plant physiology, seed processing and technology, soil chemistry and applied science, seed law and standards, and an economics course in just a few pages, so feel free to COME BY or contact me at Richardson Seeds, Inc., Drawer b, Vega, TX

3.

79092 or phone 806 267-2379, 267-2528 for my business or at my home phone 806 267-2237 and I will attempt to answer any questions.

Respectfully,
RICHARDSON SEEDS, INC.

A handwritten signature in cursive script that reads "Larry Richardson". The signature is written in dark ink and is positioned above the printed name and title.

Larry Richardson
Production & Research Manager



Encl. N

OFFICE OF THE GOV.
 REC'D MAY 1 1985
 AM
 7, 8, 9, 10, 11, 12, 1, 2, 3, 4, 5, 6 PM

Texas Department of Health

Robert Bernstein, M.D., F.A.C.P.
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Robert A. McClean, M.D.
Deputy Commissioner
Professional Services

Thomas L. Miller
Deputy Commissioner
Management and Administration

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April 29, 1985

Mr. Steve Frishman, Director
 Nuclear Waste Programs Office
 Office of the Governor
 General Counsel Division
 P. O. Box 12428, Capitol Station
 Austin, Texas 78711

Dear Mr. *Steve* Frishman:

Staff of the Bureau of Radiation Control, Texas Department of Health have reviewed the documents "Draft Environmental Assessment, Deaf Smith County Site, Texas" and "Draft Environmental Assessment, Swisher County Site, Texas." The documents provide the basis for the U.S. Department of Energy's (DOE) finding that the Deaf Smith County site is suitable for site characterization with respect to locating a high-level nuclear waste repository.

Generally, the draft Environmental Assessments (EA's) are well written and thorough (considering the scope and amount of data involved). It appears that a great deal of the more recent data regarding the Ogallala aquifer has been utilized. The draft EA's for Deaf Smith and Swisher Counties are very similar in their content, since both proposed sites are located in the same geologic unit. The differences between the two are small and ensue from site-specific considerations; many sections of the EA are repeated verbatim.

In the Executive Summary and in Chapter 7, only the five sites chosen by DOE for nomination (as required by NWPA-1982/P.L 97-425) are mutually compared and numerically ranked on varying bases. Swisher and three other sites (Lavender Canyon, CO, Vacherie Dome, LA, and Cypress Creek Dome, MS) are excluded from this numerical evaluation, which makes it impossible to determine how these four sites ranked with respect to each other, and which site ranks closest to the nominated five. Another notable observation is that seven of the nine sites selected by DOE for evaluation are in salt formations (either bedded or domal) thus somewhat restricting the spirit of the Nuclear Waste Policy Act which required a diversity of geologic settings to be examined.

Mr. Steve Frishman
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DOE states in their Executive Summary that Dear Smith site was preferred over the Swisher site primarily due to its closeness to population centers, based on radiological safety as a prime consideration (see section 6.2.1.2.2). We agree with DOE's rationale in making this choice; however, substantiating evidence, such as site-specific dose projections, should be included in the radiological data presented in EA sections 5.2.9 and 6.4.1 (Tables 6-14 through 17). We also suggest that more data be included in section 6.4.1.2 relevant to the source term calculations.

The EA's appear to suggest that transportation issues, if any, will be resolved by the time the actual repository goes into operation. However, major problems may arise in the transportation of waste from the present temporary storage locations to the final repository site. Some states such as Louisiana, prohibit transportation of spent nuclear fuel through the state, and Oklahoma and many midwestern states do not have agreement status with U.S. Nuclear Regulatory Commission (NRC). It is also noted that the states will be responsible for accidents occurring within their boundaries, and the precise steps required and recourse available in the event a high-level waste (HLW) transportation accident occurs may be presently either unknown or unclear. These and other factors may raise potential transportation problems that will require judicial review and a long time to resolve. It is, therefore, suggested that HLW transportation be addressed at the environmental assessment stage so that no surprises are encountered later during actual site characterization.

We suggest that in situ emplacement and pilot testing of the actual HLW be carried out in the Exploratory Shaft Facility (ESF) as a part of the characterization studies. This may be done with one or two packages of the most critical waste - commercial high-level waste (CHLW) is recommended. The testing will remove the uncertainties of indirect studies, and will serve to raise (and demand resolution of) unforeseen site-specific questions of a technical and non-technical nature at the early site characterization phase, rather than during operation of the first repository. The in situ testing of actual HLW should include (1) actual performance testing of a waste package in the repository environment, and monitoring of radiological and other effects, (2) overpack development and testing, and preparation of the HLW package for emplacement, (3) development and testing of waste handling procedures and movement within the ESF, and resolution of any unique site-specific problems requiring special safety measures or controls, (4) testing and demonstration of the retrievability of buried HLW package, and (5) test transportation of the HLW from the point of origin (to be chosen) to the ESF site by the most likely route, and the assessment of technical, tactical and political problems of waste transportation.

Various methods of disposal of excavated salt are given in the EA's. Putting the excavated salt into abandoned potash mines may be a solution to the sticky problem. One additional method of small scale utilization that may be considered

Mr. Steve Frishman

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is the generation of electric power on site through the use of salt gradient solar ponds - a technology that DOE and the U. S. Department of Interior are helping develop through research and development funding, and which is in use at the Dead Sea in Israel.

Although 10 CFR Part 960 specifies an area within 10 km (6.2 miles) of the repository boundary as the control area, the EA's state (in section 5.1.1.5) that the areal extent of the "control area" will be established upon completion of site characterization. As far as possible, for the purpose of near/long-term post-closure monitoring, no reduction should be allowed in the control area below the 10 CFR Part 960 limit. There also seems to be an inconsistency in the definition of control area. While 10 CFR Part 960 requires the entire control area to be marked by suitable monuments, the EA's (in section 5.1.5.2) indicate that passive barriers only will be required at the boundary of the outer control zone, i.e., the land owned by DOE (9 square miles).

The document contains superficial information on the site and regional ecology (section 3.4.2). A referenced document (NUS, 1984e) is supposed to present "A detailed characterization of the ecological resources of the region..." but in the same paragraph it is stated that "...no site specific ecological surveys have been conducted." Also, it is reported that prior to significant land disturbance, site-specific ecological surveys are to be made; with respect to site characterization, when will this be performed?

On-site archaeological surveys should have been performed as part of the determination that a site is a suitable candidate for characterization. (Note: This could be important in differentiating between the Deaf Smith County and Swisher County sites.)

At the Deaf Smith site, a natural gas pipeline (owned by Pioneer Gas Co.) is shown passing right through the proposed ESF site, running east-west and parallel to FM 2587 (Figure 3-70). It is, however, not referred to in the text. There is no discussion of whether any right-of-way violation could occur in locating the ESF; reference to its possible interference with the construction and development of the disposal facility is only implicit in section 6.2.1.5.1.

Background radiological data should be presented in more detail (see Table 4-20); a summary of the data from NUS 1984f and 1984k should be included in the Final EA.

More information should be provided on the seal rings (section 4.1.2.2.2.) since communication exterior to the shaft is a major concern. Upgrading Figure 4-12, to support the statements on seal rings and watertight linings would help.

Mr. Steve Frishman

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In the Deaf Smith Assessment, Table 5.1 indicates a daily average water use of 0.7E6 gallons per day during construction, and then calculates a total of 182E6 gallons during the 7-year construction phase. No documentation is provided to support this number, but simple multiplication indicates that the total figure is approximately an order of magnitude low; i.e., it should be 1,820E6 gallons. The 182E6 gallon figure is used in subsequent sections. Further, in section 5.2.2.2.1, it is stated that 172E6 gallons will be used during the first year of construction. This leaves 10E6 gallons for the remaining 6 years, or 4500 gallons per day. This appears to be unrealistically low. It is important to be accurate in this section since DOE attempts to relate water consumption to irrigation acreage. Basically, it is not clear what the water usage figures are, or should be, or the basis for the calculations. Similar calculations are performed in the Swisher County Assessment (where 33E6 gallons per day yields a total consumption of 97E6 gallons).

Table 6-2 should be amended under Hydrology and Water Quality to include the Texas Department of Water Resources' regulations: Chapter 361, Drilled or Mined Shafts. Since it will impact shaft construction, it should be relocated from Table 6-3.

In the EPA-prepared "Draft Environmental Impact Statement for 40 CFR 191: Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste" (EPA 520/1 82-025), a risk assessment for various geologic repositories was presented. Table B-5 (attached) indicates that the major projected health impact will result from human intrusion. We strongly recommend that Chapter 7 contain an update of this table which places the sites in practical perspective based on health risk. Section 6.4.2.6 does evaluate the probability of intrusion with subsequent release to the surface.

The proposed site in the Texas panhandle is in one of the world's greatest food-producing areas. The regional farmers and the facilities of national corporations in the food-processing business are highly interdependent. To avoid an adverse image of their products, the corporations may relocate their food-processing facilities elsewhere if a HLW repository were to be located in the region. Those farmers now growing vegetables and sugarbeets will find a lack of markets for their products. Farmers growing grains will find their products at a reduced price advantage because transportation costs will be added to the price of the grain if shipped out of the region.

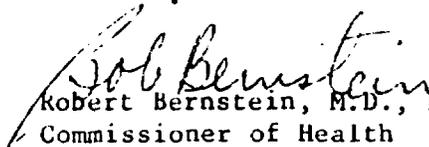
Siting of the HLW disposal facility in Deaf Smith County (or Swisher County) would constitute a great gamble with the regional economy. The real socioeconomic impact cannot be ascertained until after the fact. An accurate assessment of potential socioeconomic impact is, of course, not feasible and any outline of expected or anticipated impact should qualify it as such.

Mr. Steve Frishman
Page 5
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NRC is adopting a rigorous review process as part of its licensing of the site characterization and ESF to DOE (based on their Generic Technical Position, Issue-Oriented Site Technical Position, Site Characterization Analysis, etc.). NRC's Standard Review Plan for Draft EA's includes checking the validity and appropriateness of DOE's overall conclusions regarding site suitability. NRC's review plan does not, however, make specific mention of sociopolitical and related factors that may grow in the interim period (from now until licensing decision time) due to public opinion and involvement, and which may influence the results of application of some siting guidelines. The guidelines which are susceptible to such change are (1) human interference, site ownership and control, (2) socioeconomic impacts and (3) transportation. In our opinion, NRC should be informed by you of this eventuality.

Thank you for the opportunity to review and comment on this document.

Sincerely,


Robert Bernstein, M.D., F.A.C.P.
Commissioner of Health

Attachment

cc: Ms. Donna Morrison, Office of the Governor
Nuclear Waste Programs Office

Table B-5

Projected Population Risks Over 10,000 Years:

Reference Cases*

<u>Repository Type</u>	<u>Routine Release</u>	<u>Faulting</u>	<u>Drilling</u>		<u>Breccia Pipe</u>	<u>Volcano; Meteorite</u>	<u>Total</u>
			<u>(No hit)</u>	<u>(Hit)</u>			
Granite	10	+	750	+	--	+	760
Bedded Salt	0	+	180	8	+	+	190
Basalt	1,400	3	3,000	2	--	+	4,400

* From Table 7-4, SMC 82

"No hit" means the drill does not hit solid waste but only repository water while "hit" indicates the drill does hit solid waste.

+ = Less than 1 projected fatal cancer

-- = not applicable

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April 16, 1985

APR 17 1985

Mr. Steve Frishman, Director
Nuclear Waste Program Office
Office of the Governor
201 East 14th Street, Room 204
Austin, Texas 78711

Subject: Draft Environmental Assessments for the Deaf Smith
County Site and the Swisher County Site, Texas as
Possible Locations for Nuclear Waste Repositories

Dear Mr. Frishman:

Our review of the two Texas Environmental Assessments indicates that the Deaf Smith and the Swisher County sites have similar ambient environmental conditions. The location of each site is in an area that meets the national primary and secondary air quality standards for carbon monoxide, nitrogen dioxide, sulfur dioxide and particulates (TSP) and is, therefore, in a designated "attainment area" for these criteria pollutants. Deaf Smith and Swisher counties have been designated "unclassifiable" for ozone. There has been no designation established for lead.

Currently, the Texas Air Control Board (TACB) does not have statutory jurisdiction over radiation sources. However, asphalt or cement batching plants involved in the initial construction activity would require TACB permits or exemptions. In addition, any processing or handling facilities installed to support the ongoing operation of a nuclear waste repository would require permits or exemptions if emissions of air contaminants were involved. Our review would ensure that best available control technology was applied to all such emissions including any radioactive material which might be included in the particulate emissions.

We are also concerned that state-of-the-art dust control measures be employed to insure a minimum amount of dust is emitted into the air during site clearance, surface construction, underground development and, finally, operation of the site. During the life of the Deaf Smith project, over



Mr. Steve Frishman

-2-

April 16, 1985

25 million tons of excavation will result in approximately 11 million tons of excess soil (primarily salt) which must be handled to prevent particulate pollution in the atmosphere. The Swisher County site would have comparable conditions.

When the necessary TACB permits or exemptions have been applied for, the project, as described, will be consistent with the Texas State Implementation Plan.

Thank you for the opportunity to review this document. If we can be of further assistance, please contact us.

Sincerely,



Steve Spaw, P.E., Director
Central Regulatory Operations

cc: Mr. Gerald W. Hudson, P.E., Regional Director, Lubbock

Encl. P

TEXAS DEPARTMENT OF WATER RESOURCES

1700 N. Congress Avenue
Austin, Texas



Charles E. Nemir
Executive Director

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APR 9 1985

Mr. Steve Frishman, Director
Nuclear Waste Programs Office
Office of the Governor
General Counsel Division
Post Office Box 12428
Capitol Station
Austin, Texas 78711

Dear Mr. Frishman:

Re: Draft Environmental Assessments
Deaf Smith County Site, Texas,
DOE/RS-0014 and Swisher
County Site, Texas, DOE/RW-0015

This is in response to your February 26, 1985, letter requesting our review of the referenced reports. Our comments and a list of reviewers are enclosed.

If you have any questions, please do not hesitate to contact us.

Sincerely,

A handwritten signature in cursive script that reads "Tommy Knowles".

Tommy Knowles, PhD, P.E.
Director
Data and Engineering Services Division

Enclosures (6)

Texas Department of Water Resources
Comments and/or Questions on
Draft Environmental Assessments
Deaf Smith County Site, Texas
DOE/RW-0014 and Swisher County Site,
Texas, DOE/RW-0015

The following comments were provided by Bob Price and Tommy Knowles, Data and Engineering Services Division.

From both Draft Environmental Assessments DOE/RW-0014 and DOE/RW-0015, it appears that not enough time has been spent on details of the Dockum Group and on the relationship between the Ogallala Formation and the Dockum Group. Where both of these units contain potable ground water and are in hydraulic continuity, they have been designated by the Texas Department of Water Resources (TDWR) as the High Plains (Ogallala) aquifer. Both of the subject documents state that the Ogallala Formation and the Dockum Group are unconfined (p. 9, paragraph 6 - Deaf Smith County and p. 9, paragraph 7 - Swisher County). Figures 11 and 13 of Texas Department of Water Resources' publication LP-196 (Duffin, 1984) suggest that the Dockum Group underlying both sites is confined and has its own water level.

Both documents contain other statements relating to the above referenced condition which are also incorrect. In the Deaf Smith County report, such statements will be found in Section 3.3, p. 3-98, paragraph 3, line 2; and in paragraph 2 of p. 3-115. In the Swisher County document, incorrect statements are noted in Section 3.3, p. 3-103, paragraph 3, line 2, as well as in paragraph 2 of p. 3-118.

Even though the gradient for vertical flow is downward from hydrostratigraphic unit B (HSU B) above the Deaf Smith site to hydrostratigraphic unit C (HSU C) which lies below the repository site, the following conditions for upward flow exist. The potentiometric surface of the Pennsylvanian (in HSU C) is at approximately 2,300 feet above sea level (Figure 3-51, p. 3-124 - Deaf Smith County report). The potentiometric surface of the Wolfcamp (also in HSU C, but above the Pennsylvanian) is at about 2,100 feet above sea level (Figure 3-50, p. 3-123 - Deaf Smith County report); therefore, the potential for upward flow exists between these two HSU C horizons. Figure 3-27 (p. 3-61 - Deaf Smith County report) indicates that the elevation of the Lower San Andres-Unit 4 (repository horizon) is at 1,500 feet above sea level. If for some reason the repository area is breached from below due to basement movement without the units above Unit 4 being affected, then flooding of the repository would be possible by ground water from both the Pennsylvanian and Permian. Have the impacts of such a breaching been considered? Admittedly, flow rates established in surrounding DOE core tests and in oil tests suggest that flows in these units may be low, but a fault could increase these rates.

It is believed that the precautions which are to be taken for the protection of soils and ground water in the vicinity of mined salt storage areas as set out in the proposed procedures on p. 14, paragraph 3, which deal with the surface storage of the large amounts of mined salt involved, are inadequate. Greater damage will probably be incurred than that which is discussed.

The DOE cites test data gathered at the arid Gnome site near Carlsbad, New Mexico, (Section 4.2.1, p. 475, Deaf Smith County report) as being indicative of the insignificant amount of salt contamination of soils and vegetation which will result from salt dispersion by wind at the Deaf Smith County site. At Gnome, there has been only one documented location of the contamination of soils; however, it is significant in that it indicates that it will probably occur at other sites; namely, a Texas site.

By comparison, Deaf Smith County is located in a semi-arid area, which is a mixing area for violent tornadic summer winds. These sudden violent winds could disperse newly mined salt stockpiles over much wider areas than anticipated if these piles were not properly protected. Additionally, the rainfall is greater in the Deaf Smith County area. It has approximately 17 inches of average annual precipitation vs about 12 inches at the Gnome site (Larkin and Bomar, 1983, p. 18). Sudden torrential rains could make saline water runoff management from such a large salt pile (4.3+ acres, Section 4.2.1, p. 4-75, Deaf Smith County report) more difficult than the evaluated conditions.

The presence of interior dissolution in the uppermost salt units of the Salado and Seven Rivers Formations (Section 3.2.3.3.2, p. 3-49, last paragraph - Deaf Smith County and Section 3.2.3.3.2, p. 3-52, paragraph 1 - Swisher County) in DOE test holes suggests that vertical leakage from above and/or movement of less saline (meteoric) ground water from the west has occurred. This condition must be investigated further as it could affect the site selection. Additionally, meteoric waters could be moving downward along presently mapped faults (and possibly any unmapped as well) shown on Figure 3-25, p. 3-55 of the Deaf Smith County report and on Figure 3-28, p. 3-59, of the Swisher County report.

In Section 3.3.3.1, Water Users, on p. 3-135, paragraph 1 (Deaf Smith County), it should be mentioned that well inventory data collected by Knowles and others was for selected wells only and was not intended to be considered complete. All wells within the proposed site area should be located and inventoried. Figure 3-59, p. 3-137, also may not reflect a complete inventory and this should be so noted. Additionally, Table 3-22, p. 3-138, requires a notation and a later update. In the Swisher County report, Section 3.3.3, p. 3-139, paragraph 3, line 2 should also state that the location map reflects only selected wells and does not represent a complete inventory. In the same county report, Figure 3-59 (p. 3-137), Table 3-20 (pp. 3-143 and 3-144), and Table 3-22 (p. 3-138) also may not reflect complete inventories.

All water-use data included in Section 3.3.3.2 (p. 3-135 and the following pages) of the Deaf Smith County report and that included in Section 3.3.3 (p. 3-139 and following pages) of the Swisher County report should be checked and/or revised using new data recently supplied to DOE's contractor by the Texas Department of Water Resources.

In the Deaf Smith County report on p. 4-4, Site Restoration, in the last paragraph, it is mentioned that test wells will be plugged in "accordance with appropriate regulations." Should not special consideration above and beyond the regulations for ordinary test holes be given to the plugging of these tests? The concern is with the deeper hydrostatic unit test wells and the stratigraphic confirmation boreholes. This comment also applies to p. 4-7, paragraph 9, of the Swisher County report.

Question: What is the expected life span of the casing that is to be used in the drilled shaft and in the conventionally mined shaft, both of which are to serve as a water barrier? Is the life span sufficient to protect ground water and prevent the downward vertical movement of meteoric ground waters (pp. 4-35, 4-36, 4-40, and 4-44-Deaf Smith County report; Section 5.2.2.2, p. 5-36 of Swisher County report)?

On p. 6-47, Section 6.2.1.7.3, Analysis of Potentially Adverse Conditions, (3) Evaluation, an analysis of the impact of water use during the existence of the repository is made using 1980 data. The same analysis should be made using projected availability data to show the expected impact at that time. The same analysis should be made under Section 6.2.1.7.4, Analysis of Disqualifying Conditions, p. 6-48, paragraph 2. Similar analyses should be made and included in the Swisher County report (pp. 6-48 and 6-49).

The following comments were provided by Sandra Anderson, Enforcement and Field Operations.

Dissolution front rates for the deep hydrologic unit (hydrologic unit C) are not well established, especially in light of: (1) thermal gradient, and (2) change in climate.

Above ground salt pile storage is likely to result in salt contamination of soil and surface water, and perhaps of ground water also. Disagree that a liner failure would result in only 10 ppm increase of TDS in the High Plains Aquifer. Soil and surface contamination could result not only from runoff but also from wind storms.

Comments submitted by personnel of other agency divisions are enclosed.

Following comments provided by Bill Klemm, Permits Division:

The Draft Environmental Assessments for Deaf Smith and Swisher Counties, Texas do not provide the critical information necessary for a true comparative evaluation of the Texas sites versus the other proposed sites; for example:

1) Interior Salt Dissolution. There is evidence to suggest that surface drainage, since the late Pliocene, and ground-water movement in the deep basin aquifer are in part the result of leakage of meteoric waters through the evaporite section. This evidence supports the conclusion that interior salt dissolution is not confined to the uppermost salt, but also, includes dissolution within the salt section along lineaments, joints, and fractures. These meteoric brines pose a dissolution threat to the sites and would provide large ground-water inflows to the repository through the interbedded clastics of the host rock.

2) Shaft Construction. DOE proposes to use approximately 20 to 28 freeze holes to establish an "ice wall" for stabilization of the Ogallala and Dockum aquifers at the sites prior to sinking the 22-foot shafts using drilling and blasting excavation techniques. At Gorleben (West Germany) and at Mol (Belgium), the "ice wall" for these shafts required up to 42 freeze holes and were developed in aquifers that were similar to the Ogallala. DOE's engineering design of the "ice wall" should consider the use of multiple freeze hole rings and additional freeze holes.

3) The "ice wall" stresses the aquifer and causes a zone of weakness to develop around the shaft after thawing. Construction details for the 22-foot shafts do not provide for a seal ring to be placed at the Ogallala/Dockum (Santa Rosa) aquifer contact; thus, hydraulic communication between the units could cause intermixing of waters of different quality. The shaft at Mol (May 1984) was experiencing large unexpected ground-water inflows which in part were related to the "ice wall" problem.

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In summary, interior salt dissolution could endanger the host rock at either the Deaf Smith or Swisher County sites. Shaft sinking through the Ogallala and Dockum aquifers would require extreme engineering measures to establish the "ice wall" and a seal between the Ogallala/Dockum contact. Therefore, DOE's ranking of the Texas sites with respect to the other candidate sites is optimistic.

REVIEW COMMENTS BY DR. ALFRED J. D'AREZZO, PLANNING & DEVELOPMENT DIVISION
 RELATIVE TO THE
 U.S. DEPARTMENT OF ENERGY DRAFT ENVIRONMENTAL ASSESSMENT (DOE/RW-0015)
 ON SWISHER COUNTY SITE, TEXAS (NUCLEAR WASTE POLICY ACT, SECTION 112)
 DATED DECEMBER 1984

INTRODUCTION

The captioned draft environmental assessment (DEA) was reviewed from the standpoint of the functions, responsibilities, and interests within the purview of the Planning & Development Division (PPD) of the Texas Department of Water Resources (TDWR). This review focused primarily on Chapters 6 and 7, pertaining to the results of application of the federal site suitability guidelines and criteria for the evaluation of the Deaf Smith site; and the results of the federal methodologies adopted and used for the comparative evaluation of the five sites nominated for site characterization, and the consequent further selection of the first three priority sites including the Deaf Smith County site.

REVIEW COMMENTS

1. Reference is made to Tables 6-2 and 6-3, pages 6-20 to 6-34 relative to applicable federal and state laws and regulations.

The first State of Texas statute listed under Water Quality on page 6-34 should be revised as follows:

Water Wells and Drilled or Mined Shafts
 Texas Water Code, Chapter 28, Subchapter C (Drilled or Mined Shafts)

Below this statute should be listed the following important recently-adopted implementing regulation governing the permitting by the Texas Department of Water Resources of drilled or mined shafts in Texas (a copy is enclosed):

Drilled or Mined Shafts (Permits)
 Texas Administrative Code, Chapter 361, Subchapter A (Drilled or Mined Shafts, General Provisions)

Findings and evaluations made in the DEA relative to the Deaf Smith site should be reexamined from the standpoint of the requirements and policies contained in the above-cited, recently-promulgated enclosed regulation, and appropriate results of the reappraisal should be included in the final environmental assessment (FEA).

2. Clarification should be furnished in the FEA whether the State of Texas agency review comments submitted on the following draft documents of the Office of Nuclear Waste Isolation (ONWI) were considered in the preparation of the captioned DEA under review, or considered in the current investigation and study programs of the Department of Energy, Salt Repository Project Office (DOE, SRPO) and the Battelle Office of Nuclear Waste Isolation: (ONWI)

- a. ONWI, 1984. Identification of Sites Within the Palo Duro Basin: Volume 1-Palo Duro Location A, BMI/ONWI-531 (DRAFT), Battelle Memorial Institute.
- b. ONWI, 1984. Identification of Sites Within the Palo Duro Basin: Volume 2-Palo Duro Location B, BMI/ONWI-531 (Draft), Battelle Memorial Institute.

This matter cannot be readily discerned from the DEA. However judging from the progress report for the Work Breakdown Structure (WBS) Study Project No. 1.3.5.3 (NEPA AND NHPA ENVIRONMENTAL COMPLIANCE), contained in ONWI Report: ONWI-9 (84-4): SALT REPOSITORY PROJECT, TECHNICAL PROGRESS REPORT FOR THE QUARTER 1 JULY-30 SEPTEMBER, 1984 (pages 66-68), it is inferred that the review comments submitted by TDWR were considered in the preparation of the DEA. And this appears to be reasonably evident in U.S. Department of Energy Report DOE/CH-10(3): IDENTIFICATION OF SITES WITHIN THE PALO DURO BASIN: VOLUME 3--RESPONSES TO COMMENTS (November 1984).

3. Reference is made to Tables 6-4 through 6-13 of Chapter 6, and Sections 2.2.1 to 2.2.7, inclusive. It is believed that the results obtained by applying the DOE technical site-suitability evaluation guidelines using only selected, currently-available data and information as the comparative evaluation data base seem to indicate that considerable subjective or inferential judgment has entered the site-evaluation and comparative analysis processes. The findings of the comparative evaluation of the Deaf Smith and Swisher county sites are virtually uniform, and with presumed differences (reference: Section 2.2.3.) barely differentiated. The tabulated results and the related narrative basically indicate or infer that every potential impact is either minor or if it is significant is amenable to mitigation; there are no disqualifiers; there are no anticipated adverse residual impacts; and that in effect, there are no major risks involved and there are no cost restraints. Generally, the rhetoric used in the findings is so flexible and qualified that relaxing all cost considerations, it could easily be used to find any remotely-located site suitable. It seems that the Swisher County site could be substituted for the "preferred Deaf Smith County site in the comparative analyses of Chapter 7 with equal facility.

Given the adverse events and continuing problems which have plagued other phases of the U.S. nuclear power programs and projects, a deep public skepticism regarding the proposed Texas nuclear waste repository sites in Deaf Smith and Swisher Counties, has been already fully and emphatically communicated to DOE by officials of this State. It is believed that the seemingly-benign, undifferentiated, uniform findings presented in the tabulated comparative evaluations in Chapters 6 and 7 aggravate this deeply-engrained public skepticism. Regardless of all DOE reasoning, assurances, and risk assessments presented to-date, the people and elected officials have indicated they do not want the site in Texas. There appears to be a widespread and growing public aversion to perceived risk-taking in the fields of toxic, hazardous, and radiological wastes. The long site "study-search-screen" process for the selection of nuclear waste repositories appears to have further contributed to the public anxiety and in turn, increased the public aversion to perceived risks and uncertainties pertaining to all toxic and hazardous waste disposal programs, plan, projects, and related activities, particularly the nuclear waste disposal programs (including both high-level and low-level radioactive wastes).

It is our opinion that the captioned DEA will not dispel the existing deep public aversion to the perceived risks of establishing a high-level nuclear waste repository site anywhere in Texas, regardless of the proposed evaluations, assessments, and assurances presented therein, or regardless of the determined advocacy exhibited by DOE. In fact, the proposed DEA has raised further the anxiety level of the people in the candidate rural areas of the State to the point of aggravating existing adverse economic conditions and events affecting the Texas High Plains agricultural regions and the related agri-business economic sectors. This anxiety is increased because of the increasing loss of confidence in the current process which appears to have resulted in a report that inadequately recognizes and minimizes the scope of actual technical uncertainties, unknowns, problems, and risks.

It has been generally recognized over the years that probably the most important issue in waste management is public acceptance. No matter how technologically sound a solution may be, a system that is socially unacceptable will not be given an opportunity to be deployed. In fact, it has been predicted by some that should nuclear energy ultimately prove socially unacceptable, it will be primarily because of the public's perception of the waste-disposal problem. Also, it has been noted in the literature, that waste disposal is the area where the largest gap exists between perceptions of the technical community and those of the general public. And there will continue to be a good deal of uncertainty about the risks taken and about what measures of surveillance and circumspection will be necessary on a time-scale of millennia to ensure against injury to future generations. The inherent main difficulty encountered in the general public participation process in a technology as rigorous and demanding as permanent nuclear waste storage, is that the public is being asked now what it will need at a later date regarding particular phenomena which might occur at yet later dates. Given the vital importance of public acceptance, it is suggested that:

- a. The criterion of "public acceptance" be made a clearly identifiable guideline for site-suitability evaluation;
- b. Rather than some of the circumlocutions used in the evaluations and comparisons presented in the tabulations of Chapters 6 and 7 of the DEA, it might be more realistic to state where it is appropriate to do so, that supporting data are presently unavailable or unknown, or that a given matter is being investigated or studied by the DOE Salt Repository Project Office and/or the Battelle Office of Nuclear Waste Isolation (ONWI) under the Salt Repository Project work program. (Reference: ONWI Report: ONWI-9 (84-4), Salt Repository Project, Technical Progress Report for the Quarter 1 July-30 September, 1984).
- c. Mention should be made of the State of Texas special permit requirements (see Comment 1, above) to indicate that sharper differentiations may be possible using the criteria of Chapter 361 of the Texas Administrative Code in the comparative evaluations among candidate project sites in Texas.

- d. Further emphasis be given to Study WBS No. 1.3.3.2.3 (Generic Data Sociometric Characterization), as described on pages 27 and 28 of previously-cited ONWI Report: ONWI-9 (84-4), regarding the development of appropriate mechanisms to achieve public consensus in support of the implementation of waste management technology on a generic basis. Appropriate findings should be included in the final EA.

Attachment -- Chapter 361, TAC

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Subchapter A
General Provisions
§§361.1-361.19

The following rules are promulgated under the authority of Sections 5.131 and 5.132, Texas Water Code.

§361.1. Purpose, Scope, and Applicability.

- (a) The purpose of these rules is to implement the provisions of Chapter 28 of the Texas Water Code as it applies to drilled or mined shafts, consistent with the policies of the Water Code as stated in §1.003, §5.011, and §28.030.
- (b) This chapter applies to all drilled or mined shafts and associated facilities within the department's jurisdiction.

§361.2. Definitions. The definitions contained in §28.001 of the Texas Water Code shall apply to this chapter. When used in this chapter, the following words and terms shall have the following meanings, unless the context clearly indicates otherwise:

"Aquifer" - A geologic formation, group of formations, or part of a formation that is water-saturated, water-bearing, and yields water in sufficient quantities to provide a usable supply. Texas aquifers are classified as either major or minor ground-water aquifers and are defined in the most current edition of Texas Department of Water Resources Report No. 238.

"Area of Review" - The surface area and the subsurface area extending horizontally not less than 2000 feet in all directions from the maximum extension of a proposed or existing shaft.

"Borehole" - A drilled penetration or an artificial opening in the ground where the depth is greater than its largest surface dimension and is located within 2,000 feet of a new shaft and penetrates a major or minor aquifer.

"Casing" - Material used to seal off strata at and below the earth's surface, and to maintain the structural stability of shaft opening.

"Contaminant" - Any physical, biological, chemical or radioactive material or matter in water.

"Formation" - A body of soil or rock characterized by a degree of lithologic homogeneity that is prevailing but is not necessarily tabular and is mappable on the earth's surface or traceable in the subsurface.

"Existing shaft" - A shaft constructed before the effective date of these rules (the use of which remains unchanged after the effective date of these rules), or an abandoned shaft.

"Formation Fluid" - Fluid present in a formation under natural conditions.

"Ground Water" - Water below the land surface in a zone of saturation.

"New Shaft" - Any shaft which has not been constructed as of the effective date of these rules, or any existing shaft or

abandoned shaft which is modified or converted to a new purpose for which it was not being used on the effective date of these rules.

"Pollution" - The contamination of water or the alteration of the physical, chemical, radioactive, or biological quality of water:

- (A) that makes it harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to public health, safety, or welfare; or,
- (B) that impairs the usefulness or the public enjoyment of the water for any lawful and reasonable purpose.

"Resident Inspector" - A person or persons who is designated by the executive director to remain on-site to oversee and inspect the ongoing construction and operation of the drilled or mined shaft.

"Seismic Reflection Survey (Geophysical Survey)" - Any surface based geophysical method which can accurately measure a response at depth of physical phenomena either artificial and/or natural, directly and/or indirectly which is related to the underground geological conditions.

"Shaft" - Any vertically oriented excavation whether constructed by drilling or mining techniques, where the depth of the excavation is greater than its diameter, the excavation penetrates into or through the base of the uppermost water-bearing strata, and the primary purpose of the excavation is the transport of workers and materials to and from a destination, at depth, for purposes of geological studies, access to existing and planned subsurface mine workings, safety, or for ventilation of those workings.

"Surface Facilities" - The structures, equipment, appurtenances, and other fixtures associated with the drilled or mined shaft used for storage, processing, or operation, that are above the ground, but not including the shaft collar.

"Stratum" or "Strata" - A bed or layer, regardless of thickness, that consists of generally the same kind of soil, rock or material.

"Test Hole" - A drilled and/or cored hole used to determine the type, nature, and characteristics of the subsurface materials and the extent and conditions of the various materials as they exist.

"Uppermost water-bearing strata" - A major or minor aquifer as recognized and described in the most current edition of Texas Department of Water Resources Report 238.

"Well" - An augered, bored, drilled, or driven penetration or an artificial opening in the ground made by digging, jetting, or some other method, where the depth of the well is greater than its largest surface dimension, but the term does not include any surface pit, surface excavation, drilled or mined shaft, or natural depression.

§361.3. Severability. If any provision of this chapter, or the application of such provision to any person or circumstance, is held invalid, the remainder of this chapter, or the application of such

provision to persons or circumstances other than those as to which it is held invalid shall not be affected thereby.

§361.4. Construction and Use Prohibited.

- (a) Unless excluded under subsection (b) of this section, the construction, use or operation of a new shaft is prohibited unless authorized by permit of the commission.
- (b) The following penetrations are not within the scope of subsection (a) of this section:
 - (1) Penetrations whose primary purpose is the production of ground water;
 - (2) Penetrations or boreholes authorized by Texas Department of Water Resources under the Underground Injection Control program (31 TAC §353.1 et seq. of this title (relating to General Provisions));
 - (3) Shafts incident to surface mines for oil and gas, iron ore, lignite, coal or uranium recovery regulated by the Texas Railroad Commission;
 - (4) Sanitary sewer lift stations and otherwise approved water and sewer collection, storage and distribution structures;
 - (5) Penetrations authorized by the Texas Railroad Commission of less than 36 inch diameter whose primary purpose is the ventilation of underground workings or structures;
 - (6) Penetrations authorized by the department or Texas Railroad Commission whose purpose is the transmission of fuels, concrete slurries, muds, electrical lines, communications, wires or structures, or other utility transmissions, or bulk materials to, or recovery from underground storage facilities or mine workings;
 - (7) Penetrations which would otherwise be defined as shafts, but which, due to local conditions, do not penetrate into or through a major or minor aquifer; and
 - (8) Existing shafts.
- (c) The receipt, storage, and disposal on site of any wastes not expressly authorized by permit and not generated by construction, is prohibited.

§361.5. Pre-permit Determination

- (a) Prior to submission of an application for permit, persons considering the construction of a new shaft which may be defined as a shaft subject to this chapter must contact the executive director and obtain a determination whether or not the proposed activity is subject to this chapter.
- (b) The following information must be submitted for this determination:
 - (1) The proposed or existing location of the shaft;
 - (2) The activity proposed, and if applicable, the existing activity; and

- (3) The proposed or, if applicable, existing depth of the shaft;
- (c) An applicant may provide information supporting its position that the new or existing shaft, due to local conditions, will not penetrate into or through an uppermost water-bearing strata for the purposes of this determination.

§361.6. Pre-application Activities.

- (a) Persons who are determined to be proposing a new shaft subject to this chapter must obtain executive director approval of plans for the drilling of an engineering design test hole on center or offset to the shaft and a proposed seismic reflection survey (geophysical survey) for the purposes of site characterization, shaft and seal design, and shaft decommissioning prior to submitting an application for permit. Plans submitted for approval shall contain specific information which will address the following:
 - (1) Test hole - location, drilling, completion, testing, closure, surface cleanup, and mud pits; and
 - (2) Seismic survey - location and number of lines, velocity control and accuracy of resolution.
- (b) An applicant may provide results of previous exploratory drilling and geophysical surveys to support its position that the engineering design test hole and seismic reflection survey (geophysical survey) are not necessary.
- (c) After an appropriate review of the matters submitted under subsections (a) and (b) of this section, the executive director:
 - (1) may allow the results of previous exploratory drilling and geophysical exploration to be substituted for the engineering design test hole and seismic reflection survey;
 - (2) will determine the requirements of §361.9 of this title (relating to Procedures for Application) and the area of review;
 - (3) will determine the fee necessary to compensate the Texas Department of Water Resources for reviewing the application; and
 - (4) may require mechanical integrity investigation for existing shafts which may be modified or converted to a new purpose.
- (d) Persons required to drill an engineering design test hole and/or conduct a seismic reflection survey must first obtain the written approval of the executive director.

§361.7. Test Hole and Seismic Reflection Survey.

- (a) A test hole will not be required to be drilled in conjunction with modification or conversion of use of an existing or abandoned shaft.
- (b) Current department and Texas Railroad Commission rules shall be used to determine requirements for the mud pit construction, surface cleanup and test hole closure requirements.
- (c) A seismic reflection survey (geophysical survey) will not be required in conjunction with modification or conversion of use of an existing or abandoned shaft.

§361.8. Application for Permit.

- (a) A technical report prepared either by a registered professional engineer, or by a qualified person who is competent and experienced in the field to which the application relates or who is thoroughly familiar with the operation or project for which the application is made, shall be submitted as part of the application for new permit. At a minimum, the report shall include the following:
 - (1) A general description and intended purpose of all facilities and systems proposed to be used for, or in connection with, construction and operation of a shaft by mining or drilling.
 - (2) A surveyor's plat showing the exact location from property lines and survey lines, and giving the latitude and longitude of the shaft and a map(s) showing the location of the shaft for which a permit is sought, and the applicable area of review. Within the area of review, the map(s) must show the number, name and location of all boreholes and other pertinent surface features.
 - (3) A tabulation of data of all boreholes within the applicable area of review. Such data shall include a description of each penetration's type, construction, date drilled, location, depth, record of plugging and completion, and any additional information the executive director may require.
 - (4) Maps and cross-sections, as necessary, indicating the general vertical and lateral limits of aquifers within the applicable area of review, their positions relative to the formation, or formations, or stratigraphic units the shaft is constructed to reach.
 - (5) The text of the report shall discuss the geology, hydrogeology, and ground-water use and development within the applicable area of review; and with respect to the shaft: design, construction, sealing, decommissioning, mechanical integrity, operating procedures and monitoring.

- (b) After an appropriate review, the executive director may modify the requirements for application of this section if he finds that additional information is required to evaluate the shaft, or that information required herein is not reasonably available and is not necessary for a full evaluation of the application.

§361.9. Procedures for Application.

- (a) An application is administratively complete when received with all the information as required by Chapter 341 of this title (relating to Consolidated Permits), as appropriate, and this chapter.
- (b) Application for a drilled or mined shaft permit shall be submitted with six copies of the completed application including all reports and statements.
- (c) The following shall be included in an application for a drilled or mined shaft permit:
 - (1) the manner in which financial assurances will be attained;
 - (2) an environmental assessment or environmental impact statement, if required by §28.038 of Water Code;
 - (3) a decommissioning and closure plan;
 - (4) a fee, based on estimated cost of application processing and review, of not less than \$10,000 which shall include but is not limited to consultants' fees, lab work, personnel salaries, support services, travel expenses, computer time, and informational services;
 - (5) a letter from the Texas Railroad Commission stating that drilling or mining of the proposed shaft and use of the proposed shaft will not endanger or injure any oil or gas formation or significantly limit the potential for future recovery of or exploration for oil or gas; and
 - (6) a statement of the current status of any litigation involving the project or proposed siting of the shaft.
- (d) The executive director will submit to the Texas Railroad Commission, Texas Department of Health, Texas Air Control Board, Texas Department of Parks and Wildlife and to the Commissioners Court of the affected county a copy of the application including all amendments.
- (e) The provisions of Chapter 357 of this title (relating to Permit Application) do not apply to the processing of new shaft applications under these rules.

§361.10. Permit Required.

- (a) All shafts subject to these rules shall be specifically authorized by permit. Shafts serving the same underground working, or built as part of a single comprehensive ore

body exploration or evaluation program, may be included in one permit. Additional shafts to be added after the permit is issued may be authorized by permit amendment after a demonstration as in §361.11(b) of this title (relating to Construction Standards for Shafts).

- (b) A permit shall include terms and conditions reasonably necessary to protect the major and minor aquifers from pollution. The permit shall include requirements regarding the construction, operation, and decommissioning of a new shaft and corrective action, if necessary, to prevent pollution resulting from inadequately constructed, completed, and abandoned boreholes within the area of review. In the event that, after construction of a new shaft has commenced, evidence indicates that a well within the area of review of a shaft might pose a hazard to a major or minor aquifer, the executive director may prescribe a corrective action plan and compliance schedule to remedy such hazard as a condition for continued construction, use or operation.

§361.11. Construction Standards for Shafts.

- (a) The provisions of this subchapter apply to new shafts within the department's jurisdiction.
- (b) All shafts shall be constructed to prevent migration of fluids that may cause or allow the pollution of aquifers. Construction materials used in each shaft shall be designed for the life expectancy of the shaft.
- (c) Appropriate surveys, logs and other tests shall be conducted during the construction of shafts. All surveys, logs and tests shall be interpreted by qualified persons.
- (d) Any proposed changes or alterations to construction plans after permit issuance shall be filed with the executive director and approval obtained before incorporating such changes.

§361.12. Resident Inspector. The executive director may designate a resident inspector to oversee all phases of shaft activities. The resident inspector shall monitor compliance with the terms of the permit for all testing, construction, completion, and operation of the shaft and report to the executive director.

§361.13. Operating Standards.

- (a) The construction, use, and operation of a new shaft shall be as authorized by the permit.
- (b) All shafts must have mechanical integrity:
 - (1) A lined shaft or lined portion of a shaft has mechanical integrity if there is no significant leak or physical deterioration in the casing, liners, and seals, and if there is no detectable fluid movement through vertical fluid channels adjacent to the shaft which could cause pollution of an aquifer.

- (2) An unlined shaft, or unlined portion of a shaft, has mechanical integrity if there is no detectable deterioration of the wallrock which could cause pollution of an aquifer.
 - (3) In the event that a lined shaft, unlined shaft, or portion of an unlined shaft may have inflows of ground water, the executive director may require a shaft and mine water management plan be submitted as part of the shaft permit application.
 - (4) Mechanical integrity of the shaft (wallrock or casing, liners, and seals) must be demonstrated as required by the permit, during the life of the shaft and shall be accomplished by a method approved by the executive director.
- (c) Shafts lacking mechanical integrity shall undertake corrective maintenance actions:
- (1) The permittee shall notify and obtain the approval of the executive director before commencing any corrective maintenance that is necessitated by failure to achieve or maintain mechanical integrity.
 - (2) The notification shall be in writing and shall include plans for the proposed work. The executive director may grant an exception to the requirement for prior written notification when immediate action is required.

§361.14. Monitoring and Reporting Standards.

- (a) The permittee shall submit daily construction chronology reports to the executive director and to the resident inspector, if applicable, providing data for each day during the drilling or mining, and casing or lining of the shaft. The data shall be presented in tabular form and shall report date, thickness and lithology penetrated, material settings and volumes, and problems.
- (b) Within ninety (90) days after the completion of the shaft, the permittee shall submit an engineering drawing showing the "as built" construction details of the shaft, liners and seals, including the depth, thickness and lithology of the rock units penetrated in constructing the shaft.
- (c) The permittee shall, prior to commencing construction, provide written notice to the executive director that a copy of the permit has been filed with the commissioners court for the county where the shaft is located.
- (d) The permittee shall notify the executive director in writing of the anticipated first date when the shaft will be used or operated for its stated purpose at least 30 days prior to commencing use of the shaft. Compliance with all pre-operation terms of the permit must occur prior to beginning operations.

- (e) The permittee shall notify the executive director within twenty-four (24) hours of the discovery of any unplanned leakage or other failure of the shaft or associated chambers.
- (f) Within ninety (90) days after the completion of a corrective maintenance action, a report shall be filed with the executive director providing the reason for the shaft corrective maintenance action and the details of all work performed and results of remedial action.

§361.15. Surface Facilities. Surface facilities must be constructed, maintained and operated in compliance with applicable permits and rules governing that facility.

§361.16. Certification of Construction and Completion. Prior to commencing operations, the permittee must certify that the shaft was constructed and completed in compliance with permit requirements.

§361.17. Additional Requirements.

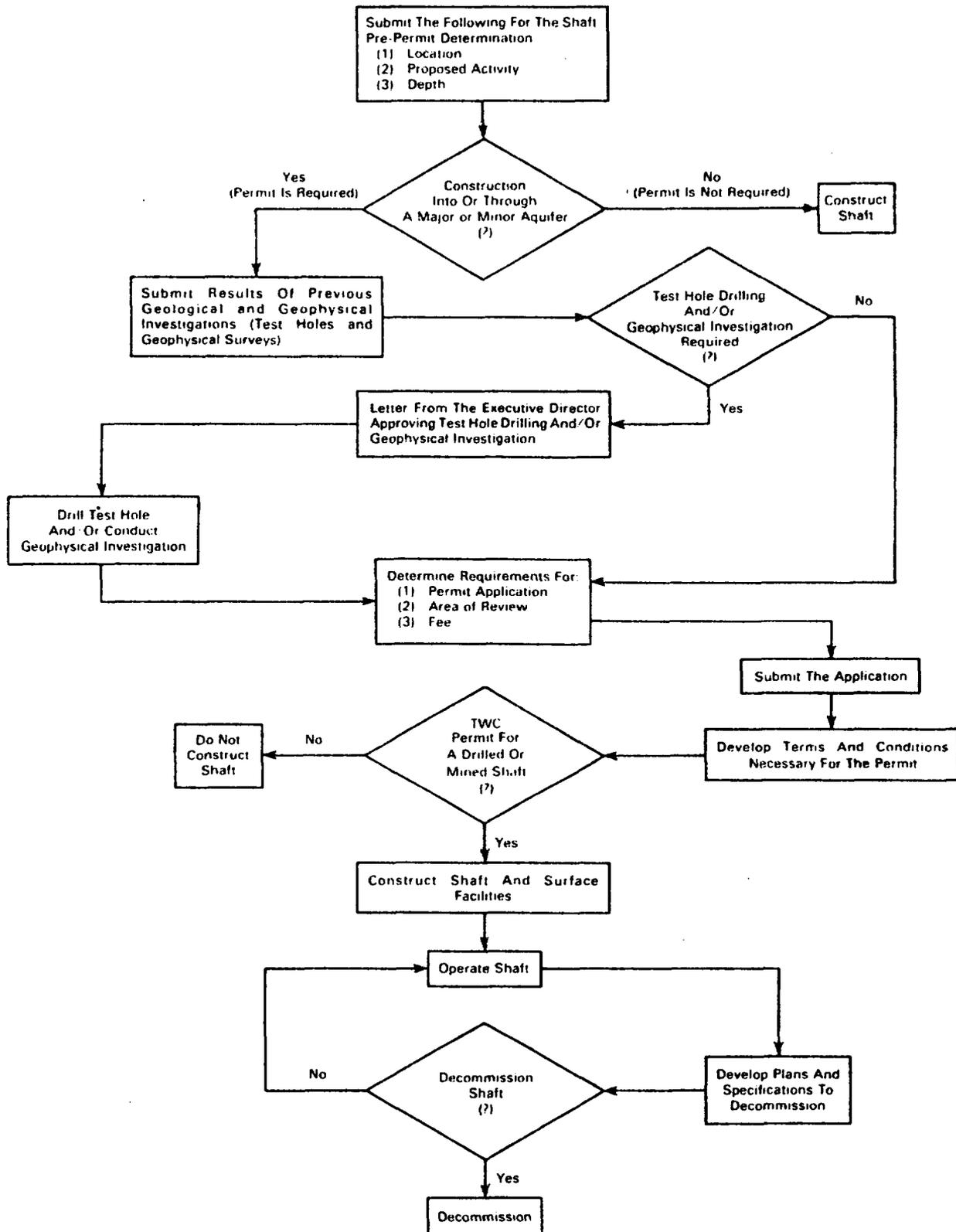
- (a) The permittee shall keep complete and accurate records of:
 - (1) all construction records;
 - (2) mechanical integrity testing;
 - (3) geotechnical testing;
 - (4) water level and water quality testing;
 - (5) record of post-construction operations;
 - (6) corrective maintenance actions; and
 - (7) any additional information that the executive director determines might reasonably affect the construction and operation of the shaft.
- (b) All records or copies of all records shall be filed on-site and made available for review upon request by a representative of the department.
- (c) The permittee shall retain, for the lifetime of the shaft and for at least five (5) years after decommissioning, records of all information concerning the construction, use, and operation of the shaft.
- (d) The permittee may be required, prior to commencing operations, to secure and maintain a performance bond or other equivalent form of financial assurance or guarantee, approved by the executive director, to assure:
 - (1) the costs to the department of monitoring and of on-site, full-time surveillance; and
 - (2) the cost to ensure the safe decommissioning and closure of the shaft.
- (e) A permittee may satisfy the conditions of subsection (d) of this section by demonstrating as required by §341.193(c) through (o) of this title (relating to Financial Responsibility).

§§361.1 - 361.19

§361.18. Decommissioning. Shaft decommissioning and closure shall be in accordance with plans and specifications approved by the executive director. Decommissioning seals shall be placed in the shaft so as to prevent the migration of fluids into a major or minor aquifer. Shaft seal mix designs shall be compatible with existing lining, if applicable, and adjacent strata.

§361.19. Appendix A. Appendix A is a flow diagram of the procedures to obtain authorization for a drilled or mined shaft.

Texas Water Development Board 361.19
 Drilled or Mined Shafts Appendix A



ABBREVIATED BIOGRAPHICAL SKETCHES OF REVIEWERS

Sandra Anderson - Geologist

Functional Title - Geologist, Field Operations and Enforcement Division

Degree: B.S. Geology, University of Nebraska, 1976. Has completed course work for M.S. Geology at University of New Mexico, Albuquerque, New Mexico.

Employed September 1984 by TDWR. Has been involved in ground-water contamination investigation and enforcement cases.

Dr. Alfred J. D'Arezzo - Registered Professional Engineer

Functional Title - Environmental Sciences Analyst and Intergovernmental Reviews Coordinator, Planning and Development Division

Degrees: B.S. Engineering, U.S. Military Academy, West Point, N.Y., 1938; M.S. Civil Engineering, Texas A&M University, College Station, Texas, 1950; M.S. International Affairs and Economics, George Washington University, District of Columbia, 1966; Ph.D. Civil Engineering, University of Texas, Austin, Texas, 1970.

Employed November 1971 by the former Texas Water Rights Commission, later merged in the TDWR. Has been involved in environmental analysis to present.

William B. Klemt - Certified Professional Geologist

Functional Title - Chief, Underground Injection Control Section

Degree: B.S. Geology, University of Texas, Austin, Texas, 1957.

Employed 1965 by TDWR. Has since been engaged in studies of ground-water availability and ground-water quality protection.

Dr. Tommy Knowles - Registered Professional Engineer

Functional Title - Director, Data and Engineering Services Division

Degrees: B.S. Agricultural Engineering, 1970; M.S. Civil Engineering, 1971; Ph.D. Civil Engineering - Water Resources, 1972; all from Texas Tech University, Lubbock, Texas.

Employed January 1973 by TDWR. Has since been involved with studies of ground-water quality, quantity, and availability.

Richard D. Preston - Geologist

Functional Title - Head, Ground Water Studies Unit

Degree: B.S. Geology, Baylor University, Waco, Texas, 1965.

Employed July 1965 by TDWR. Has since been involved in ground-water availability studies.

Robert D. Price - Certified Petroleum and Professional Geologist
Functional Title - Assistant Head, Ground Water Studies Unit

Degree: Bachelor of Geology, School of Engineering, University of Tulsa,
Tulsa, Oklahoma, 1955.

Employed August 1966 by TDWR. Twelve years experience as a petroleum
geologist. Has since been involved in ground-water availability studies.

SELECTED REFERENCES

Duffin, G.L., 1984, Ground-water conditions in the Triassic aquifer in Deaf
Smith and Swisher Counties: Texas Dept. of Water Resources LP-196, 95 p.

Larkin, T. J., and Bomar, G. W., 1983, Climatic atlas of Texas: Texas Dept. of
Water Resources LP-192, 151 p.

Encl. Q



May 20, 1985

Mr. Steve Frishman
Director
Texas Nuclear Waste Programs Office
Sam Houston Building, Room 204

Dear Steve:

I am enclosing additional documentation to be included as part of the State of Texas' review of U.S. Department of Energy Draft Environmental Assessments for the proposed nuclear waste repository sites in Deaf Smith and Swisher counties. The following materials are included: "Panhandle Residents' Views of High-Level Nuclear Waste Storage," dated May 1985; and "Primary Survey Forms for Telephone and Mail Surveys: A Supplement to Panhandle Residents' Views of High-Level Nuclear Waste Storage." These documents provide detailed information about the background, methodology, and results of surveys conducted by TDA and the Governor's Office last year.

Results of three surveys are included in the report: a telephone survey of 605 residents of the Deaf Smith, Swisher, and southern Oldham county areas, a telephone survey of 236 residents of the Crosby and Moore county areas, and a mail survey of 564 Deaf Smith and Swisher county farm operators. Participation rates for all three surveys were excellent, so results are broadly representative of local views about the repository.

Results of these studies clearly indicate that the socioeconomic effects of building a high-level nuclear waste repository in the Texas Panhandle could be quite substantial and that DOE Draft Environmental Assessments understate potential negative effects. A few of the research findings most closely related to the environmental assessment process are reviewed here:

--Local residents disagree strongly with Draft EA statements that effects of the repository on the agricultural economy would be "slight." They are particularly concerned about effects of the repository on markets for agricultural products and on land values. Local residents indicated that the repository site-selection process is already having an effect on investments in agriculture and on perceptions of land and mineral values.

--The large number of residents who are considering leaving the area if a repository is built nearby indicates that DOE population models are incomplete.

--The omission of seed production from the Draft EA discussion of the local economy is a particularly serious oversight. Earlier TDA comments indicate the substantial volume of seed sales in the proposed site areas, and the enclosed report shows that a large number of individual farmers are involved in seed production.

Mr. Steve Frishman
May 20, 1985
page 2

--Although the Nuclear Waste Policy Act emphasizes the importance of public participation and "confidence," Panhandle residents expressed substantial doubts about the safety of the proposed repository and the fairness of DOE site-selection procedures. In addition, survey results document that the Department of Energy has been less effective in including Hispanics than non-Hispanics in public information and comment opportunities.

--Panhandle residents believe that the potential social and economic effects of the repository extend beyond the impact area identified in the Draft EAs. A majority of residents of the Crosby and Moore county areas expect negative effects in their own counties if the repository is built in Texas.

The enclosed report includes further details about the results and methods of our research. In addition, I will be happy to provide any additional information that would be helpful in facilitating DOE consideration of these studies in future plans for the repository.

I will be providing additional research results later this summer from a more recent business survey conducted in cooperation with your office. Interviews with owners and managers of 380 businesses in the Deaf Smith, Swisher, and Oldham county areas are now complete. These interviews represent 98 percent of the businesses we were able to contact by telephone, and 92 percent of all businesses in our original sample list. The excellent participation rate for this survey, as for our earlier research, assures that our results reflect a representative sample of local businesses. I will be forwarding detailed documentation about this study to you as soon as it is available, so this information can be considered in the site-selection process.

Thank you for facilitating our participation in the State of Texas review of DOE Draft Environmental Assessments. Please let me know if I can be of any further assistance.

Sincerely,



Julie Brody, Ph.D.
Acting Director
Office of Research and Policy Planning

DEPARTMENT
OF AGRICULTURE

P. O. BOX 12847
AUSTIN, TEXAS 78711

NEWS RELEASE

For information, contact:



Andy Welch
512/475-6346

TDA SURVEY RESULTS SHOW
NUKE DUMP PLANS HURT PANHANDLE

FOR IMMEDIATE RELEASE
Mon., Oct. 29, 1984

(AUSTIN)--A proposal to put the nation's first high-level nuclear waste repository in the Texas Panhandle already is having profound social and economic effects on the area, according to survey results released today by Agriculture Commissioner Jim Hightower.

The survey was conducted by researchers supervised by Dr. Julia Brody of the TDA staff, using standard polling procedures to assure a representative sample and unbiased results. Funding was provided by the U.S. Department of Energy, which is obligated to help states evaluate the department's site-selection methods. A panel of academic experts served as consultants on the design of the survey project.

"Our survey proves that the U.S. Department of Energy's absurd proposal has already cast a dark shadow on this part of Texas," Hightower said. "People are postponing plans to buy land, expand businesses, drill for minerals and pass farms on to their children. They're having to change all their long-range plans because of the threat of having nuclear trash buried in their backyards. More than 40 percent of those surveyed say they've considered moving away because of the dump.

"The survey also tells us that Panhandle people have developed a deep and abiding mistrust of the DOE. They don't feel that DOE is dealing straight with them. And they don't believe that their views on site-selection will be taken into account--60 percent said it's likely that the dump will be built in their county, despite their overwhelming opposition.

"We've demonstrated with scientific methods and hard numbers that people in Deaf Smith and Swisher counties don't want the dump because they fear it would ruin

their health, their land, their livelihoods and their way of life. More than 80 percent would reject the dump if it were up to them. More specifically, this opposition is extremely broad-based and cuts across age, gender, ethnic and occupational groupings. But it is particularly strong among farmers. They know how the dump would threaten their land and water and the outstanding reputation of the vast array of agricultural products grown in this fertile farm country.

"About 80 percent of those surveyed in Deaf Smith and Swisher counties believe the dump would cause farmland values to decline, and 72 percent believe it would cut agricultural production. Nearly 80 percent think it would lead to contamination of food products grown in these counties and shipped all over the world--many sold to health-food markets, which depend on their reputation for wholesomeness.

"A companion survey in Moore and Crosby counties, more distant from the proposed sites, shows that two-thirds of the residents think farmland values in their counties will decline if the dump is built in Texas. About 70 percent think the repository would lead to health problems in their area.

"Health and environmental concerns are their leading reason for opposition to the dump. In Deaf Smith and Swisher counties, roughly two-thirds of those surveyed expect the dump to cause increased rates of cancer, birth defects, miscarriages and other adverse health effects.

"They also expect the dump to create adverse economic effects such as lower home values and an increased cost of living. Although about half think the number of jobs would increase, people expect that the dump would endanger the health of workers and subject the whole area to the threat of contamination. As one person put it: 'It would bring money and the threat of blowing up.'"

The survey was conducted by the Texas Department of Agriculture in cooperation with the Office of Governor Mark White, as part of the state's program of monitoring DOE's site-selection process and its effects on Texas residents. Sites in Deaf Smith and Swisher counties are among nine in the nation

being considered as possible locations for the repository. The others are in Utah, Nevada, Mississippi, Louisiana and Washington.

Researchers for TDA interviewed more than 600 residents in the two counties, using standard polling procedures to assure that the sample was representative of the area as a whole and that all interviews were unbiased. A shorter survey was conducted in Moore and Crosby counties, where opposition also is strong. A third component of the TDA study was a mail survey of more than 500 farmers, to assess the effect of the repository on agriculture.

"Congress wisely provided for federal funding to the states to do independent analyses of DOE's site-selection process," Hightower said. "We feel that the Department of Agriculture has greatly contributed to the Texas effort. We have documented that DOE's meddling has hurt the economy and lifestyle of this area. We've shown that local opposition is broad-based. Business folks have no illusions that the dump will help the economy, for instance. And we've given a voice to the 92 percent of the people we surveyed who said they had never spoken out at any of the public hearings on the dump issue.

"The nuclear dump is not a hypothetical problem that can wait until DOE decides what it wants to do. This is a problem now. I have heard from dozens of farmers who say DOE's nuclear cloud has affected land values, mineral values and important business decisions. One person has postponed plans to build a new sunflower-seed processing plant.

"In addition to documenting these effects, I have joined many other state officials--including Gov. Mark White, Congressmen Kent Hance and Jack Hightower and Texas Sen. Lloyd Doggett--in asking that DOE reconsider its dumb idea of drilling through prime farmland and the precious water of the Ogallala aquifer in order to bury nuclear waste.

"The Texas Panhandle is rich in energy resources--oil, gas, wind, sun and tons of agricultural by-products. These are the energy sources we should be developing for the future. For example, in Hereford, just 19 miles from one of the dump sites, a new company is getting started producing electricity by burning manure from feedlots down

the road. Farmers are actually going to make money from manure, and city folks are going to enjoy a safe, inexpensive source of electricity. That's the kind of technology we need, not an untried and untested dump for the nation's nuclear wastes.

"Our survey showed that Deaf Smith and Swisher residents welcome non-nuclear economic development projects. They generally favor projects such as new feedlots, food processing plants, and power-generating windmills. But they are dead set against nuclear facilities because they know an accident could be devastating.

"About 60 percent think it 'very likely' that radioactive wastes would escape into their water supply, 54 percent think soil contamination is 'very likely' and 26 percent think of nuclear explosion as a probability.

"Farmers think the dump will ruin agriculture and destroy the legacy they had hoped to leave their children. Many said they are making plans to move. Listen to some of their comments:

--This hangs over us like a black cloud. We would have bought more land but don't want to invest in something that is going to lose money. We had just bought 260 acres...and can't sell it at half what we gave for it.

--My husband just reached his 65th birthday, and we want to turn the farm over to our grandson but are reluctant at this time because of farming in this area so close to the repository. It is hard to make plans right now. We don't want our grandchildren to live and work in an unsafe environment.

--We have lived in Swisher County all our lives. Our farm has been in our family for three generations, and we plan to pass it on to our children and grandchildren. If the repository is put in our area, we will move elsewhere no matter what our roots are.

"Nor do the people of the Panhandle trust DOE. They made comments like these:

--There have been so many discrepancies in dealing with the DOE. It makes it difficult to believe anything they say, and it is very disconcerting to think they will be in charge of a high-level waste repository in any area. It is completely ridiculous that the U.S. has a stockpile of nuclear waste and is making more everyday--with nothing pre-designed to do with it.

--If this plant is put in, land will be worthless, the water supply could be contaminated and a lot of good people ruined. Let the government build (the repository) in California on you-know-who's ranch! See how he would like it!

"These farmers want to help their country, but they believe they can best do it by continuing to produce the vast amounts of wholesome food that come out of these two counties. As one farmer told us:

--If this keeps up, and more and more farmland is used for "sewers," our country could start to be a hungry--but nuclear-sufficient--country! Which is the less of two evils?

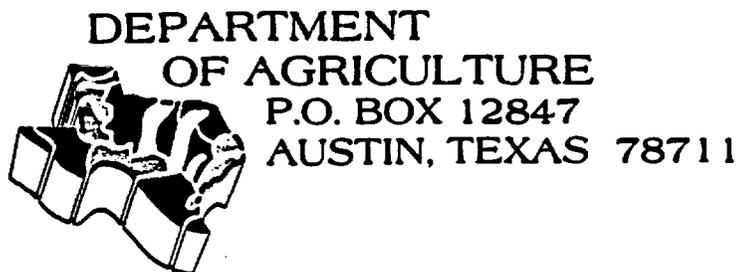
"All the comments that these people made to our interviewers were thoughtful and eloquent in describing the damage that DOE is causing by continuing to press forward with this misguided plan," Hightower said.

Results released today were a preliminary summary of the findings. A more technical report including details of statistical methods will be published by TDA later this year.

PANHANDLE RESIDENTS' VIEWS OF HIGH-LEVEL NUCLEAR WASTE STORAGE

Part I: Summary of Survey Results

**A Report of the
Texas Department of Agriculture
October, 1984**



PREFACE

The three surveys summarized in this report were conducted by TDA in cooperation with the Office of the Governor. Funding was provided by the Texas Nuclear Waste Programs Office, under a federal grant from the Nuclear Waste Fund. The fund was established by Congress to finance costs of high-level nuclear waste management, including state evaluation of U.S. Department of Energy site-selection studies.

A panel of academic consultants is assisting TDA in assessing socioeconomic effects of the proposed nuclear waste repository. Dr. Stanislav Kasl, of Yale University Medical School, was particularly helpful in reviewing early plans for this research. Dr. Kasl previously served on the Behavioral Effects Task Group of the President's Commission on the Accident at Three Mile Island.

Steve Frishman, director of the Texas Nuclear Waste Programs Office provided invaluable assistance in planning these studies.

TDA also thanks the many people of the High Plains who took time to share their thoughtful comments about how the nuclear waste repository program is affecting their lives. A more detailed technical report of survey results, including complete information about research methods and statistical analyses, will be available later this year.

Julia Brody
Project Director
October, 1984

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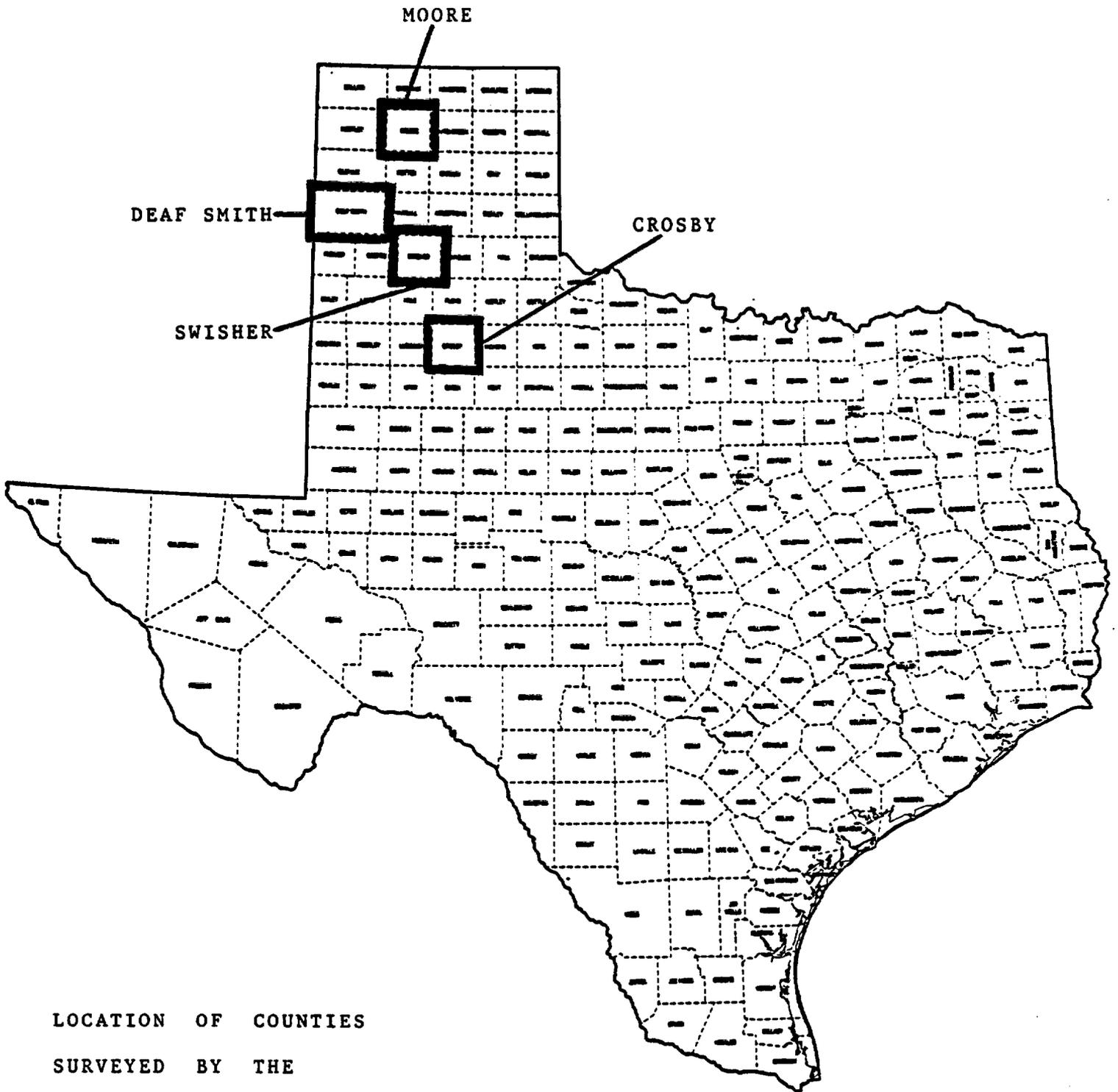
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LOCATION OF COUNTIES
SURVEYED BY THE
TEXAS DEPARTMENT OF AGRICULTURE

EXECUTIVE SUMMARY

Deaf Smith and Swisher counties, in the Texas Panhandle, are being considered by the U.S. Department of Energy as possible sites for the first national high-level nuclear waste repository. The Texas Department of Agriculture, in cooperation with the Governor, surveyed 841 residents of the High Plains to document their views about potential socioeconomic effects of a repository in Texas. Telephone interviews were conducted in the Deaf Smith and Swisher county areas, surrounding the proposed sites, and in the Crosby and Moore county areas, two other Panhandle counties. TDA also did a specialized survey of farm operators in Deaf Smith and Swisher counties.

These are the major results of the studies:

1. Residents of all four survey areas are strongly opposed to putting a high-level nuclear waste repository in Texas. Four out of five residents of Deaf Smith and Swisher counties said they would not allow construction of the repository in their county, if it were up to them.
2. Opposition to building a high-level nuclear waste repository in Texas is broad-based, with strong consensus among diverse groups of Panhandle residents.
3. Concern about health and the environment is the most important factor in opposition to the nuclear repository. Panhandle residents think the repository is likely to pollute their water, soil and air and to lead to health problems for local residents and for repository workers. Moore and Crosby area residents believe health effects will extend several counties beyond the repository site, affecting their own communities.

4. Panhandle residents also think a nuclear repository would hurt the economy and community life of their area.

- a. Survey participants expressed strongest concern about effects of the repository on agriculture. Eighty percent of Deaf Smith and Swisher area residents, and 68 percent of Moore and Crosby area residents expect a decline in the value of farmland in their county if a repository is built in Texas.
- b. Sixty percent of Deaf Smith and Swisher residents think the value of their own homes will go down if the repository is built in their county.
- c. Panhandle residents do not think the repository would lead to an increase in industrial or commercial development in their county, but a slim majority of Deaf Smith and Swisher residents do believe the repository would create more jobs in their county.
- d. Business owners are just as pessimistic as others about the socioeconomic effects of a nuclear waste repository in Texas.
- e. Many farmers reported that the nuclear waste repository program has already hurt them financially and influenced their investment plans.

5. While Panhandle residents oppose nuclear development in their area, they support new development that is consistent with the present economic base in agriculture and natural resources.

6. Although a substantial number of Panhandle residents have some exposure to U.S. Department of Energy information programs, relatively few of them have participated actively in the DOE public hearings process. Telephone interviews reached many people who have not been heard at DOE meetings.

INTRODUCTION

Nuclear power plants have been generating electricity in the United States for 25 years. They have also been generating highly radioactive wastes--materials so dangerous that they must be isolated from the environment for at least 10,000 years. The U.S. Department of Energy (DOE) estimates that there were 8,000 tons of highly radioactive spent fuel in temporary storage in 1981 and that by the year 2000 there will be approximately 79,000 tons of spent fuel from commercial power plants. Defense programs also produce high-level nuclear wastes that are now in temporary storage.

The federal government has taken responsibility for safe and permanent disposal of high-level nuclear wastes. In 1982, Congress enacted the Nuclear Waste Policy Act (NWPA) to set procedures for establishing a national repository for high-level nuclear wastes. NWPA details an elaborate site-selection process and sets a schedule for construction. Selection of the site for the first repository is scheduled for 1987 or 1988 and the repository is to open in 1998.

Texas is under consideration as a possible repository site because of the thick salt deposits found deep in the Permian Basin of West Texas. Other formations under study in other states include basalt, tuff and granite.

Earlier this year, the U.S. Department of Energy proposed narrowing the area under consideration in Texas to two nine-square-mile sites, although this is not yet final.

The Deaf Smith County site is near the Oldham County line, approximately 9 miles southwest of Vega and 19 miles northwest of Hereford. The Swisher County site is approximately 6 miles northeast of Tulia. These two sites are among nine sites under consideration nationwide. Other sites are located in Louisiana, Mississippi, Nevada, Utah and Washington.

The Department of Energy is expected to narrow the site list to five later this year, and then to choose three sites in early 1985 for site characterization, a more exhaustive study period involving extensive drilling at the proposed site. Under the Nuclear Waste Policy Act, the President is responsible for approving selection of the three sites for characterization and of the final site chosen for construction of the first repository. A more detailed discussion of the site selection process is available in the October, 1984, report of the Texas House-Senate Joint Study Committee on Hazardous Waste Disposal.

Anticipating that choosing a site for the repository would be highly controversial, Congress allowed for consultation between the federal government and the state and local governments and individual citizens in the areas being considered. The Nuclear Waste Policy Act encourages public participation in the site-selection process, and it requires extensive study of the potential effects of the repository on the host state and local communities. The act also gives states the right to veto location of a repository within their boundaries, although the veto can be overridden by a

majority vote of both houses of Congress.

In addition to this veto option, the State of Texas also has the responsibility to negotiate mitigation for Texas communities affected by a repository and to assure compliance with the Nuclear Waste Policy Act during the site-selection process. In order to meet these responsibilities, the State has monitored DOE's nuclear waste repository program and coordinated participation by state agencies and Texas citizens. The Texas Nuclear Waste Programs Office represents the Governor and serves as liaison between the State of Texas and the Department of Energy. The Texas Legislature and several state agencies, including the Texas Department of Agriculture, have also contributed to the state review process. The state has held public hearings, filed detailed official comments on DOE documents and initiated independent research to document Texas' perspective on environmental and socioeconomic effects of the proposed repository.

As part of the state's research, the Texas Department of Agriculture, in cooperation with Governor Mark White, conducted a telephone survey of residents of the Deaf Smith and Swisher county areas and of the Moore and Crosby county areas. TDA also conducted a mail survey of farm operators in Deaf Smith and Swisher counties.

Purpose of Surveys

This study serves three purposes. First, it provides an additional avenue for public participation in the site-selection process. Public hearings conducted by the

Department of Energy and by the Governor's Office have been important opportunities for citizens and state and local officials to state their views about the proposed repository. However, the hearings often were held during work hours or in inconvenient locations, which may have limited participation. In addition, some people may feel hesitant to speak out at a formal hearing in front of a large audience. The telephone survey enabled the state to assess the opinions of a representative cross-section of the community, including both residents who did attend public hearings and those who did not. The mail survey provides a closer look at the views of a broad spectrum of farm operators in the site counties.

A second purpose of the survey is to document local expectations about the socioeconomic effects of the repository. These expectations are, in themselves, an important effect of the nuclear waste repository program. Prospects for the future of potential site communities affect current property values and investment decisions that have an economic impact on these communities throughout the site-selection process. A recent National Academy of Sciences report about the high-level nuclear waste repository states, "During the decision-making period, residents in the vicinity of the candidate sites are likely to place less emphasis on property maintenance (Miller, 1971), properties will be hard to sell (Corrigan, 1976), and economic development is often hampered." In addition, uncertainty or fear about the repository may create stress, influencing

health and the quality of life in areas being considered as possible repository sites. The National Academy of Sciences concludes, "The site-selection procedure mandated in the Nuclear Waste Policy Act of 1982 will impose adverse effects (e.g. community conflict, speculation) on the candidate host sites as well as on the site finally selected." The telephone survey is part of TDA's effort to document effects of the selection process that occur before a final decision is made.

A third purpose of the survey is to establish baseline data for monitoring future socioeconomic change throughout the course of the nuclear waste repository program. This survey cannot provide a "true" baseline, since some effects of the nuclear repository program had occurred before the survey began, but it does provide a starting point for future study. Interviews conducted in the Moore and Crosby county areas also allow for comparisons between these Panhandle communities, which are more distant from the repository sites, and the Deaf Smith and Swisher county areas immediately surrounding the sites. If Texas remains on the list of possible repository sites during the coming years, information collected now will be critical to state efforts to document effects of the site-selection process.

In order to meet these three goals--giving local residents a greater voice in the site-selection process, documenting current concerns about social and economic effects and laying the groundwork for ongoing monitoring on this issue--interviewers asked High Plains residents how

a nuclear waste repository would change their lives. The survey answers basic questions about whether Panhandle residents are for or against construction of a high-level nuclear waste repository in Texas. It also provides more detailed information about how they believe a nuclear repository would affect the economic and social profile of their communities, about their concerns for health and environmental effects of the repository and about their knowledge about the nuclear waste repository program.

Characteristics of Survey Counties

The counties included in the study are located in the Texas Plains. All four are nonmetropolitan areas with a substantial economic base in agriculture, particularly in cattle and feed grains. Deaf Smith and Swisher counties are major centers for hybrid seed production and cattle feeding and for production of wheat, sorghum, cotton, corn, sugar beets, potatoes and other vegetables and a number of other crops. They are also home to a variety of agriculture-related businesses, including feedlots, seed companies, meat-packers, a sugar refinery, an agricultural implements manufacturing company, a major health-food supplier and other food processing plants.

Deaf Smith County, located about 20 miles southwest of Amarillo, had a population of about 21,165 in 1980, with its major population center in Hereford. Two-thirds of the county is considered "prime" farmland by the U.S. Department

of Agriculture. The county produced \$248,133,000 in cash receipts from crops and livestock in 1983. Deaf Smith ranks second in the state in agricultural production.

Swisher County, located between Amarillo and Lubbock, had a population of 9,723 in 1980. Like Deaf Smith, it ranks among the top ten in the state in agricultural production. Swisher County reported \$123,402,000 in cash receipts from crops and livestock in 1983. The USDA rates more than four-fifths of the county as "prime" farmland.

Moore and Crosby counties are both rated about half "prime" farmland. In 1983, Moore produced \$104,357,000 in cash receipts from crops and livestock, and Crosby produced \$41,598,000. In addition to agriculture, both counties have significant oil and gas resources and related industries. Moore County, located about 20 miles north of Amarillo, had a population of 16,575 in 1980. Crosby County, just east of Lubbock, had 8,859 people in 1980.

Interviews were conducted in the Swisher and Deaf Smith county areas. The Oldham County towns of Vega, Adrian and Wildorado were included because of their very close proximity to the proposed Deaf Smith County site. Interviews were also conducted in the Moore and Crosby county areas for comparison purposes. Moore and Crosby counties were selected because they are in the same general region as Deaf Smith and Swisher counties, sharing many cultural and economic characteristics with the proposed site counties although they are not in the immediate vicinity of the proposed repository sites and do

not border the site counties. Dumas, in Moore County, is roughly 65 miles from the Deaf Smith site and 90 miles from the Swisher site. Crosbyton, the county seat of Crosby County, is roughly 125 miles from the Deaf Smith site and 70 miles from the Swisher site.

Comparisons between survey results for Deaf Smith and Swisher counties, and those for Moore and Crosby counties are useful for two reasons. First, interviews in Moore and Crosby counties indicate the extent of awareness and concern about the proposed nuclear waste repository beyond the immediate vicinity of the proposed sites. Second, continued monitoring of all four counties will allow future researchers to begin to separate social and economic changes that are widespread in the region from those that are particularly associated with proximity to the repository sites.

Telephone Survey Procedures

Households in the Deaf Smith, Swisher, Crosby and Moore county areas were randomly chosen from local phone books to participate in the survey. Governor Mark White and Texas Agriculture Commissioner Jim Hightower wrote to these households in June to explain the survey. Trained interviewers at the Texas Department of Agriculture then phoned each household to arrange a convenient time to complete the interview.

Standard procedures were used to randomly select one adult from each household to participate in the study. These

procedures assure that men and women and various age groups are fairly represented. Spanish-speaking interviewers and translations of all research materials were available for those who preferred to be interviewed in Spanish. (All four counties have substantial Hispanic communities.) Interviews for Deaf Smith and Swisher county residents averaged 35 minutes in length while Crosby and Moore county residents participated in shorter interviews, averaging about 15 minutes each.

Response rates for both interview forms were excellent, and survey participants are broadly representative of households in the study areas. For the Deaf Smith and Swisher county area, 752 households were chosen to participate in the survey, and 605 completed the interview. Telephone interviewers were unable to reach 13 percent of the households in the original sample list: Five percent of the phone numbers were no longer in service at the time of the survey, and interviewers got no answer after several attempts to call 8 percent of the homes. Among Deaf Smith and Swisher county households that were contacted by phone, 91 percent completed the survey. Local residents who declined to participate in the interviews most often cited poor health or deafness as the reason for their decision.

For the Crosby and Moore county areas, 327 households were chosen to participate in the survey and 236 residents completed the interview. Eight percent of the phone numbers in the sample list were no longer in service and interviewers

got no answer at 9 percent of the homes; 87 percent of the households that were contacted by phone completed the interview. More detailed information about survey procedures and sampling will be included in a technical report to be published in late 1984 by the Texas Department of Agriculture. A summary of background characteristics of survey participants is shown in Table 1.

RESULTS FOR DEAF SMITH AND SWISHER COUNTIES

Opposition to the Repository

Residents of Deaf Smith and Swisher counties are very strongly opposed to construction of a nuclear waste repository in their area. When asked, "If it were up to you, would you allow construction of a high-level nuclear waste repository in your county," 73 percent of the survey participants said "definitely no" and another 8 percent said "probably no." Asked "Do you think construction of the nuclear waste repository would be a good thing for your county," 68 percent said "definitely no" and 9 percent said "probably no." About 60 percent think it is "very likely" or "somewhat likely" that the repository will actually be built in their county.

Opposition to the repository is broad-based, with strong consensus among diverse groups within the Deaf Smith and Swisher county communities. There is no significant difference in the level of opposition to the repository between Hispanic residents of the area and nonhispanics, or between households that own property in the two counties and those that don't. The survey results do show statistically significant differences of opinion among some subgroups of Deaf Smith and Swisher area residents, but these differences

are small.¹ Women are somewhat more likely to oppose the repository than men, a finding that is consistent with many earlier studies showing women more strongly opposed to a wide range of nuclear facilities. Farmers are also more likely than nonfarmers to oppose having the repository in their county, while business owners are somewhat less likely to oppose the dump. Even for the "less opposed" subgroups, however, opposition to the repository is widespread. The average response for all subgroups fell between "definitely" and "probably" opposed to putting the repository in Texas.

Social and Economic Effects of the Repository

One element in public opposition to the repository is concern that a nuclear facility would change the economy and community life of the site area. Deaf Smith and Swisher county residents clearly believe a nuclear waste repository would have negative social and economic effects for their communities over the next 15 years. They expressed greatest concern about effects of the repository on agriculture and on property values. About 80 percent of the survey participants said a nuclear repository in their county would cause a

¹ $p < .05$ is the significance criterion for all statistical tests reported here. A "statistically significant" difference between two groups is a difference that is unlikely to have occurred because of chance fluctuations in survey responses. Complete statistical information will be detailed in a technical report available from the Texas Department of Agriculture this winter.

decline in the value of farmland and 72 percent said the repository would mean lower levels of agricultural production. In addition, 60 percent said the value of their homes would decline if their county were chosen as a repository site.

Many residents also expect negative effects on industrial development, tax rates, traffic and the cost of living. Nearly half expect the amount of industry in their county to go down and the tax rates to go up if their county is chosen for the repository. Sixty percent anticipate increased traffic, and 57 percent expect an increase in the cost of living. In general, Deaf Smith and Swisher county residents expect little change in their own household income, the quality of local services, or the number of places to go for fun or entertainment. Survey participants were divided in their views about effects of the repository on local schools, crime rates and the number of stores and businesses.

A majority of survey participants did expect one economic benefit from the nuclear waste repository. About 52 percent said they expected an increase in the number of jobs in their county if it is chosen as a repository site.

Just as for overall attitudes toward the nuclear waste repository, the generally pessimistic outlook on potential socioeconomic effects of the repository represents a consensus among economic subgroups within the community. Business owners are no more likely than other community members to expect social and economic benefits from the

repository and although farmers are somewhat more pessimistic than nonfarmers, both farm and nonfarm families expect more negative social and economic effects than positive ones.

Attitudes Towards Economic Development

Negative expectations about social and economic effects of the nuclear waste repository do not reflect general opposition to economic development. The survey asked Panhandle residents whether they would favor or oppose several different types of energy- and agriculture-related facilities in their county. Results show that opinions about nuclear facilities are sharply different from views on other types of development. More than half of the respondents said they "strongly favor" or "somewhat favor" each type of development with the exception of a nuclear power plant or a low-level radioactive waste disposal site. The nuclear facilities received less than 15 percent support. A food processing plant, windmills for electric power generation and a new feedlot received the most positive ratings. Approximately two-thirds of the residents of the Deaf Smith and Swisher county areas said they "strongly favor" a new food processing plant in their county, 56 percent "strongly favor" power-generating windmills and 43 percent "strongly favor" a new feedlot. These responses show that Deaf Smith and Swisher county residents support economic development that is consistent with the present agricultural base of the local economy. Men, business owners and nonhispanics were

even more likely than others to favor new economic development.

Health and the Environment

Health and environmental problems associated with the repository were a major concern of Deaf Smith and Swisher county residents. In addition, survey results show that health and environmental concerns are the strongest single factor in overall opposition to the repository.

Interviewers asked survey participants to rate 13 possible health and environmental hazards to indicate, first, how likely they thought it was that each problem would occur if a repository were built in Texas and, second, how concerned they would be in the hypothetical instance that each of the problems did occur in their county. For every one of these possible health and environmental problems, more than half of the Deaf Smith and Swisher county residents said the problem was "very likely" or "somewhat likely" to occur if a repository were built in their county. In addition, more than half of them said they would be "extremely concerned" about each problem if it occurred.

Deaf Smith and Swisher county residents are particularly worried about the possibility of radioactive wastes escaping into their water: 61 percent consider this kind of accident "very likely," and 81 percent said they would be "extremely concerned" if water contamination did occur. In addition, more than half of the survey participants said that they

think contamination of food and soil and health problems for county residents and for workers at the repository are "very likely" to occur if the repository is built in their county. Hispanics and women consider health and environmental problems at the repository to be more likely than do other survey participants. However, these differences are quite small, and nonhispanics and men still rated accidents "somewhat likely" on the average.

Comments by Survey Participants

Comments by Deaf Smith and Swisher residents during the telephone interviews confirm statistical analyses showing that concern about environmental and socioeconomic effects of the proposed nuclear repository are crucial elements in public opposition to building the repository in Texas. Interviewers asked survey participants an open-ended question about why they favor or oppose building the repository in Texas. This question was asked near the beginning of the interview, so responses were not influenced by specific questions about health and economic effects addressed later in the survey. Examples of comments are included here and complete transcripts, with identifying information deleted, are available from TDA.

As in the statistical analyses, safety issues emerge as important concerns in Panhandle residents' comments about why they oppose a nuclear waste repository in Texas.

- This repository is highly dangerous for residents. We've lived so comfortable for so many years and now there's this dark cloud hanging over us. For the sake of everybody, I hope it (the repository) doesn't come here.
- I feel strongly that they've created something they don't know how to harness nor ensure that human error won't cause a major catastrophe.
- (I) spent 20 years in the military working with nuclear weapons. I know what that stuff can do. I am very concerned. Civilian facilities are not as rigidly inspected as military ones. Contractors care only about profit, not quality.
- Nuclear power plants leak. They're shut down because of poor engineering. Management said so. The same problems will occur with the nuclear repository. It will be a continuous problem.
- I have no confidence in the "fact" that it (the repository) could be sealed.

Worries about whether the repository would be safe are often focused on the possibility of contamination of water in the Ogallala aquifer. When asked why they favor or oppose the repository, roughly a third of Deaf Smith and Swisher county residents spontaneously mentioned concern about contamination of their water.

- Anything gets in the water and we're gone. The Ogallala is the lifeblood of this community.
- (The repository) would take up quite a bit of land and drill through our drinking water. Out here, we don't have much water....If the repository screws that up, I don't know where we'll be.
- I don't think they can possibly keep out the water. The site will get wet.

The possibility of an accident at the nuclear repository is viewed as an economic problem as well as a health problem by many Panhandle residents. They fear that their land, water and crops could be contaminated and that agricultural

products will be stigmatized as unhealthy, even if they are not actually contaminated. Many Deaf Smith and Swisher residents see the possibility of harm to the agricultural economy as a fundamental threat to their way of life. They are incredulous that the federal government would even consider building a nuclear waste repository on such exceptionally rich farmland. In answers to the open-ended question about reasons for their views about the repository, approximately 40 percent of the survey participants mentioned agriculture.

- (The repository) would ruin our land. We have lots of cattle. This would ruin our grass. People would have to move away. (I) hope somebody is strong enough to stop this. Why would anybody want to come here (to build the repository) where we have good farmland?
- There's lots of sorry land around, put it (the repository) there. I don't think it's good to put it in an area where people are trying to make a living from the land, or in any populated area. For every reason--health, living, and water--it shouldn't be here. This is agricultural country. Our wheat goes all over the world. It would be a big mess.
- We have beautiful farmland. (The repository) would mess it up and cause people to leave, selling at a loss. Underground water might be contaminated, and we depend on it for family use and for stock. This is the largest cattle feeding area in the U.S. People wouldn't want to eat meat from here if they put the repository in.
- Leakage would ruin crops, water and soil. It would ruin our lifestyle. Our town would regress.
- (The repository) would put farmers out of business. From there, there would be a chain reaction of worsening conditions.
- People are fearful it (the repository) would ruin the economy. We grow a lot of crops for feedyards. What if people won't send cattle here because of the repository?
- It's gonna mess up the economy. Before you know it, no one's gonna be here. They'll move, and it'll destroy our way of life.

- This is the best agricultural land in the world. The world will be hungry one day and look to us for food, but they won't take contaminated food.

Some Deaf Smith and Swisher county residents expressed other concerns about the social and economic effects of the repository on their communities. They are worried about an influx of newcomers from outside the area, about general effects on local business, and about their own jobs in food processing plants.

- I'm against this repository for job security and health reasons. Both my husband and I work in a food company, and I'm afraid we will lose our jobs.
- During the construction phase, the county will be like a boom town in an oil boom. This will cause burdens on local schools and services, but once it is completed, all the construction workers, etc. will leave and the county will be worse off than before....A large number of people are scared to death, and this has reduced the value of land.
- (The repository) would bring a bad element to Hereford. (I'm) worried about the kinds of people that would come in, and I would probably move to another area.
- Hereford is having a hard time getting business. If the repository is brought in, we'd have an even harder time attracting business.

In addition to their concern for the future of their communities in general, many survey participants are worried about the future for their own children and grandchildren.

- We will live in fear. I don't want my children growing up with the repository here.
- We have children and don't want to leave them problems with the land.
- The repository will hurt the people I care about, my grandchildren, my friends and relatives. I'm against it because farming is our livelihood and it will destroy farming in this county.

Deaf Smith and Swisher residents who oppose the repository often express bitterness and distrust towards the Department of Energy. They feel that the site-selection procedure is unfair, and they doubt that public participation will have any effect on the final site decision. They resent the possibility that they may have to receive wastes generated thousands of miles away.

- The federal government is using us as guinea pigs....The feds slipped in here on a pretense of oil and gas exploration, hitting on people in economic difficulties and offering a price. They lie and go to out-of-state owners who do not have community ties. Residents here did not produce wastes and should not be responsible for disposing of them....The feds are sneaky, and if they really knew what they were doing, they would not have to use false pretenses.
- If it was safe, they would keep it where it's at....The thing that gripes me is that when they started building nuclear plants, they didn't consider waste disposal. I don't believe many government projects have gone like they planned.
- If the repository is built, it will be the end of Hereford. I have already sold half of my land. I feel bitter....I feel we are being severely taken advantage of. I am very disturbed because my entire living comes from farming and my son has invested a lot of money in this farm. It's not fair and not right.
- Let them clean their own laundry.
- It kind of angers me that we're getting this down our throat like it or not....Why don't they take our feelings into account?
- The government has a tendency to flub up and then cover up. Why are they picking on us? We've got good water, land, cattle, and farms; and I wouldn't want to live here if (the repository) comes.
- Sometimes a guy feels helpless about this thing because they are going to build it anyway, no matter what people say.

- The DOE has lost our faith. Their drill shafts are crooked and have seepage. They have no guidelines.
- Why don't they build it on 1600 Pennsylvania Avenue? This is being pushed down our throats.

When asked why they favor or oppose building the repository in Texas, 35 survey participants mentioned the prospect of new jobs for their area. Even those who look forward to economic benefits from the repository often expressed ambivalence, however.

- (The repository) will bring money and the risk of blowing up.
- Swisher County is drying up. We don't have very much water, not much industry. We need something. I'm trying to be neutral because I see both sides. If I owned land, my feelings would be entirely different.
- (The repository) will have jobs for the poor. For the benefit of these poor, I would like to see it come to our county. It will not benefit me.
- I could see the county doubling in population. (The repository) could be good for the county even though cost and crime will go up. But people will have a job.

Those in the minority that supports the repository expressed confidence in the safety of the repository and in government decision-making procedures. They stressed the possibility of economic benefits.

- My grandson just came back from being on a nuclear submarine and he says that there is more radiation in the sun than on a nuclear submarine.
- We need the power that the nuclear plants bring us, and we need to get rid of the waste; so if the government thinks this is the best site, they should know.
- I feel like (the repository) will get a little money circulating in the county. Farmers are hurting.

Several supporters of the nuclear waste repository program said they believe opposition to the repository is based on ignorance about nuclear facilities. However, statistical analyses indicate that knowledge about the repository does not significantly affect preferences for or against the repository.

Knowledge About the Nuclear Waste Repository

In addition to questions about Panhandle residents' opinions and expectations, the telephone interviews included 12 factual questions about the nuclear waste repository program. On the average, survey participants answered seven questions correctly, and they said they didn't know the answers to four. Approximately four out of five Deaf Smith and Swisher county residents are aware that the U.S. Department of Energy is investigating their area because of its underground salt deposits and that exploratory drilling has already begun in their county. Seventy-seven percent are aware that exposure to radiation can cause birth defects and about 70 percent know that high-level nuclear wastes must be isolated from the environment for thousands of years and that drilling will be restricted over the nuclear repository.

Deaf Smith and Swisher county residents are not as well informed on some other aspects of the repository program. Less than one out of four correctly indicated that a Texas repository would be built below the Ogallala aquifer. Only 37 percent are aware that the President of the United States

is personally responsible for giving final approval for the nuclear waste repository site, and 38 percent are aware that the Department of Energy would not be able to put all the salt dug out of the repository during construction back into the repository when it is complete.

Many Deaf Smith and Swisher county residents would like to be better informed about the repository. When asked whether they agree or disagree with the statement, "I need to know more" about the nuclear waste repository, 46 percent said they "strongly agree," and 22 percent "somewhat agree." Hispanics were more likely than others to feel that they needed more information.

Actions in Response to the Repository

One source of information about the nuclear waste repository is Department of Energy public information pamphlets and documents. Sixty percent of the survey participants said they had read a government publication about the nuclear waste repository and 28 percent said they had gone to a government meeting or public hearing about the repository. Nearly as many--26 percent--said they attended a meeting of a community group, such as POWER or STAND, about the repository. About 22 percent said they contacted a public official about the repository and 7 percent joined a community group to deal with the repository.

Although a substantial number of Deaf Smith and Swisher county residents have some exposure to DOE information

programs, relatively few have participated actively in the public hearing process. About 8 percent said they testified or spoke up at a government meeting about the repository. This finding indicates that the telephone survey reached many people who had not previously been heard at DOE meetings.

Hispanic residents, in particular, have been inactive in the repository site-selection process. Anglos are three-and-a-half times as likely as Hispanics to have attended a government meeting about the repository. Only one Hispanic who participated in the survey had ever spoken at a government meeting about the repository and none had ever joined a community group to deal with the repository. Clearly, existing site-selection procedures have not succeeded in including Hispanic residents of the proposed site counties.

Some Deaf Smith and Swisher-area residents already have made changes in their personal lives because of the repository. About 8 percent said they had changed financial plans for their family or for their farm or business because their area is under consideration as a repository site. About 44 percent said they have thought about moving out of the area because of the repository.

RESULTS FOR THE CROSBY AND MOORE COUNTY AREAS

Public opposition to the high-level nuclear waste repository extends beyond the proposed site counties to other areas of the Texas Plains. Residents of the Crosby and Moore county areas are aware of the nuclear waste repository issue, they are strongly opposed to locating the repository in the Texas Plains, and they believe a Texas repository would affect their own lives and the future of their communities.

When asked whether they would allow construction of the repository in the Texas Plains if the decision were up to them, two-thirds of the Crosby and Moore county residents said "definitely no" and 17 percent said "probably no." Two-thirds said a repository in the Texas Plains would "definitely" not be good for their county, and 12 percent said it would "probably" not be good for their county. Eighty-one percent of the Moore and Crosby county residents said they had heard about the nuclear waste repository before they were contacted about the telephone poll. About 27 percent of the Moore and Crosby county residents think it is "very likely" or "somewhat likely" that the repository will actually be built in Texas, less than half the proportion of Deaf Smith and Swisher residents who feel this way.

Although Moore and Crosby residents are more distant from the proposed nuclear waste repository sites, the repository is not an academic issue in these areas. Nearly half of thoses polled a repository in the Texas Plains would

affect them or their families personally. They expected negative effects on local health and economics.

Like residents of Deaf Smith and Swisher counties, Moore and Crosby residents are particularly concerned about the effect of a nuclear repository on agriculture. More than two-thirds expect the value of farmland in their own counties to go down if a repository is built in Texas and about half think agricultural production would go down. Roughly a third of the Moore and Crosby residents think the repository would cause an increase in the cost of living and a decrease in population, industry, and stores and businesses for their county; while 40 to 50 percent expected these indicators to remain the same.

People in Moore and Crosby counties are also deeply concerned about health and environmental hazards associated with the repository. Forty percent believe it is "very likely" that a Texas repository would lead to health problems for residents of their own county and 29 percent think health problems are "somewhat likely" for their county. Moore and Crosby residents are also concerned about accidents that could take place at the repository. Interviewers asked about five other possible health and environmental problems, and two-thirds to four-fifths of the Moore and Crosby residents rated each of these problems as "very likely" or "somewhat likely." More than 80 percent said they would be "extremely concerned" or "very concerned" if one of these accidents did occur.

FARM OPERATORS SURVEY

Deaf Smith and Swisher counties, the two Texas counties being considered as possible sites for the nation's first high-level nuclear waste repository, contain exceptionally rich farmland. They consistently rank among the top ten Texas counties in agricultural production, and the U.S. Department of Agriculture rates two-thirds to four-fifths of their land as "prime" farmland.

Because agriculture is so crucial to the economy and community life of the area, the Texas Department of Agriculture, in cooperation with the Governor, surveyed farm operators in the two counties to document farmers' views about effects of a nuclear waste repository in Texas. This survey supplements the TDA study of a representative sample of residents of Deaf Smith, Swisher, Moore and Crosby counties.

The farm operators survey asks how the repository is affecting land values and financial and personal plans now, during the repository site-selection process, and how farmers think a repository would affect them in the future. Public hearings have identified intense local concern about potential effects of a nuclear repository on farming and this survey allows for more systematic study of these fears.

The survey also asks about production of specialty crops--hybrid seeds, health foods and foods sold directly from farmer to consumer--that could be particularly

vulnerable to consumer fears about buying produce grown near high-level nuclear wastes. Consumers who buy health foods may be especially sensitive to where produce is grown, since they are paying a premium for assurance that their foods are uncontaminated. Other consumers also may be influenced by fears of contamination. Studies conducted by the Commonwealth of Pennsylvania after the accident at the Three Mile Island nuclear power plant showed a drop in sales by milk and vegetable producers, especially those who sell directly to consumers. Buyers of hybrid seed might also be wary of products grown near a repository because of the potential genetic effects of radiation. The TDA survey indicates how many farmers would be affected by changes in markets for these crops.

Survey Method

The farm operator survey was mailed to 989 farm operators in Deaf Smith and Swisher counties in mid-September, along with an explanatory letter from Texas Agriculture Commissioner Jim Hightower and Governor Mark White. A reminder letter was sent about one week later and farmers who hadn't returned a survey after three weeks received a telephone reminder encouraging them to mail in their survey. Approximately 530 surveys have been returned.

A full statistical analysis of this survey will be published later this year. A preliminary study of several hundred responses to three open-ended questions has been

completed. The survey asked farmers, "Have you already made any changes in your personal or financial plans because of the nuclear waste repository?" Farmers who indicated that they had made changes were asked, "What were the changes?" The survey also asked farmers whether they anticipated any changes in their plans in the future if their county were actually chosen for the nuclear repository. Farmers who said the repository would make a difference were asked to describe the changes they expected. Finally, the survey invited farmers to add any additional comments they wanted to make about the repository. Responses to these open-ended questions and to questions about specialty crops are discussed in this preliminary report. Additional statistical data will be included in the final report.

Farmers' Comments

Farmers' responses to open-ended questions included in the survey are consistent with the earlier TDA telephone survey of a representative sample of residents of Deaf Smith and Swisher counties. Both surveys indicate strong opposition to building a high-level nuclear waste repository in Texas. Many farmers find it difficult to believe that the federal government would seriously consider such rich farmland as a nuclear waste site. They fear the effects of the repository on their land and water and on consumers' perceptions of their agricultural produce. Some examples of farmers' comments are included here.

- Why would anyone ruin perfectly good farming land for such a thing?
- If nuclear waste is buried under the most productive land in the state of Texas, it will be the most devastating event to take place on the face of this earth, bar-none.
- Anyone with any reasoning abilities should know any place with underground water is not a proper place for this.
- I think this nuclear dump would be the most devastating thing that has ever happened to the whole Texas Panhandle. It would ruin everything my dad and I have worked for 50 years. I am definitely against it coming here as are 100 percent of my neighbors. We need all the help from the state government we can get and really appreciate it.
- I do not think it is very intelligent to place something that has any possibility of radioactivity in an agricultural area where food and farm crops are produced.
- Deaf Smith county depends entirely on the agriculture economy. If this site is put here it would ruin markets for seed, health foods, sugar, food corn and cattle industry.
- This is a very productive area and is a nice place to make a home. It would be a waste and shame to turn it into a poison desert. There are too many unknowns about this nuclear waste and how to store it. We don't have nuclear power here--why should we be the cesspool for others?

Some advocates of nuclear power and of the nuclear waste repository have encouraged local citizens to support the repository out of a sense of patriotic duty to help solve a national problem, but many Deaf Smith and Swisher county farmers see their national duty quite differently. They feel a strong sense of responsibility to protect their farmland as a resource to feed the nation and the world through future generations.

- We, the inhabitants of this country, do not have the right to invade and contaminate the soil and water of the earth, thus leaving for future generations the bleak likelihood of contamination....The issue is the contamination of the earth for thousands of years to come.

- We need our farmland, if not, what are we going to be eating in 15 to 20 years.
- If this keeps up and more and more farmland is used for "sewers," our country could start to be a hungry--but a nuclear sufficient--country! Which is the less of the two evils?

Many farmers expressed anger and distrust towards the U.S. Department of Energy, and many believe that the site-selection process has been unfair.

- I feel that the federal government is not being completely honest about the waste disposal. I feel that they have a hot potato in their hands and are trying to bury it with no thought to the future of a very productive area. I also feel the day will come when the people of the United States will desperately need the food produced in this area.
- There have been so many discrepancies in dealing with the DOE. It makes it difficult to believe anything they say and it is very disconcerting to think they will be in charge of a high-level waste repository in any area. It is completely ridiculous that the U.S. has a stockpile of nuclear waste and making more everyday--with nothing pre-designed to do with it.
- If this plant is put in, land will be worthless, the water supply could be contaminated, and a lot of good people ruined. Let the government build (the repository) in California on you-know-who's ranch! See how he would like it!
- They (federal government) may take our land, but they will know they had one hell of a fight. I am an old World War II vet, but I think I could still fight for my land.
- I hope the people working on the solution (to the nuclear waste problem) are smarter than the ones they send to talk to us, as they can't answer your questions the same way twice. They contradict themselves and each other. They sure don't give us much confidence in the DOE.

For some farmers, uncertainty about whether the repository will actually be built in Texas or not makes planning for the future difficult. Survey participants expressed concern about the future both for themselves and for their children and grandchildren.

- We are afraid to expand our farm and buy new machinery because of not knowing whether the repository will be put here or not. The land may be worthless if the repository site is put here. Four families are provided a living from this farm of 1,055 acres.
- My wife and I had hoped to spend our last years on this land and leave it to our 4 children at death, but are undecided now for fear of being near the waste site.
- This issue has destroyed many local life-long friendships. Our community has been kept on edge--not knowing the decision--and we are afraid that if they decide to put the location site here, it will destroy our lives--income and way-of-life.
- I would probably try to sell (my farm), even though we would have to take a great loss! I do not want to raise my children around this sewer. This farm has been in our family for 3 hard-working generations. It is a shame to have to sell everything you've worked for all your life to pay for--for a big loss! Also, there is no legacy to give your children. I know this does not mean much to you--but it does to me!
- My husband just reached his 65th birthday and we want to turn the farm over to our grandson, but are reluctant at this time because of farming in this area so close to the repository. It is hard to make plans right now. We do not want our grandchildren to live and work in an unsafe environment....If the repository is located in Deaf Smith, we don't think it would be a good idea (to give the farm to grandchildren) as we don't think it would be a safe place to work and raise a family.

Farmers have already made some specific changes in their personal and financial plans because of consideration of their county as a possible repository site. Although final counts are not yet available, preliminary results from several hundred surveys indicate that dozens of farmers have decided not to buy land, drill new irrigation wells, buy equipment or make other improvements on their farms until the nuclear waste repository issue is settled. Several farmers said they had canceled plans to build a new home, made plans to move, or bought land outside the county because of the

threat of a nuclear waste repository moving in. Several others said they were unable to lease mineral rights or to find a buyer for land they want to sell. One farmer said he had shelved plans for a new sunflower processing plant.

- This hangs over us like a black cloud. We would have bought more land, but don't want to invest in something that is going to lose money. We had just bought 260 acres...before it was dug and can't sell it at half what we gave for it.
- I am not going to spend as much money on trying to keep the land in as good shape as I would have.
- We have worked hard and invested our profits in more land and now own 3,000 acres. It is all near...(the proposed site). We feel as if we are being punished for our hard work and investing in land. We had just bought land near...at \$500 per acre and now couldn't sell it at half that price.
- We had been offered \$50 per acre for oil lease along with our neighbors...The oil company was to come to sign the contract but called and backed out because the DOE was in the area. We feel we have already been damaged financially by the DOE.
- I have paid as much as \$375.00/acre for some of my land. Since the repository site was announced, I have had adjoining land offered to me. I told the owner I wouldn't give \$50.00/acre until I knew where that hole was going to go in.
- I have put any expansion plans on "hold" for now until we know where the site is going to be located.
- I did not buy a new combine because I was going to lease my land to an oil company for petroleum exploration when the news of the DOE came that this area was being considered for burial of high-level nuclear waste. The oil company postponed leasing my land until they found out what the government was going to do. Therefore, drilling for possible oil on our land has been squelched.

In addition to farmers who have already been affected by the proposed nuclear waste repository, many more expect to make major changes in their personal and financial plans if

Texas is finally chosen as a repository site. Again, final counts are not complete, but preliminary results show that scores of farmers plan to sell their land and move out of the county if the repository is built in their area. Others said they would quit farming, decrease production, buy land elsewhere, and avoid all new investments in land and equipment. Several farmers said they would encourage their children to leave the area.

- I am very strongly opposed to the location of a repository in Swisher County. If one is located here, it is very likely I will move from this state. I refuse to live next door to it.
- I'll leave Texas. Not only will the nuclear repository affect Deaf Smith and Swisher county, it will affect all of Texas. So wake up Texas. The wind blows down on you and the water underground flows your way also, so all of you will be affected. We don't want nuclear repositories here. Let them stop making the stuff! I sure plan to vote for the people that oppose using Texas for a nuclear dump.
- We have lived in Swisher County all our lives. Our farm has been in our family for three generations, and we plan to pass it on to our children and grandchildren. If the repository is put in our area, we will move elsewhere no matter what our roots are.
- If (the repository) comes here, we would probably sell our house. Since our seven years of marriage, this house is the first home we've ever bought, making it very important to us. I will not bring up my children around nuclear waste no matter how safe some congressman says it is.
- I will change areas if at all possible. I would probably take a lickin' on the farms I am presently paying on. However, I would not subject the health of my family of six to the danger of nuclear waste.

In summary, Deaf Smith and Swisher county farmers, like other residents of the High Plains, are strongly opposed to building a high-level nuclear waste repository in Texas.

Many of them have already limited their investment in agriculture, deciding not to buy new land or equipment because they feel the repository threatens the future of farming in their county. Many more indicated that they would sell their land and move away if Texas is chosen as a repository site. Survey results also indicate that production of hybrid seeds, health foods and crops sold directly to consumers is broad-based, so that any effects of a repository on these particularly vulnerable specialty crops would be felt widely through the two counties. Preliminary survey results show that DOE consideration of Deaf Smith and Swisher counties has already affected farm investment in this area, and future social and economic effects of building the repository in the High Plains could be quite profound.

SUMMARY OF RESULTS

Residents of the Texas Plains--both those who live near the proposed repository sites and those who live farther away--are overwhelmingly opposed to putting a high-level nuclear waste repository in Texas. They believe that a nuclear repository would lead to pollution of their water, soil and air and to health problems for Panhandle residents. They also expect the repository to have negative effects on the agricultural base of the local economy and on property values in general. A slim majority believe the number of jobs in their county will increase if a repository is built in Texas, but they do not expect increases in industrial or commercial development. Many farmers report that the nuclear waste repository program has already hurt them financially and influenced their investment plans.

A substantial number of Deaf Smith and Swisher county residents have participated in government information meetings and public hearings about the repository and many are knowledgeable about the nuclear waste repository program. Some residents said they had already changed their financial plans because of the repository, and nearly half said they have thought about moving away if the repository is built in their area. Only 8 percent of Deaf Smith and Swisher county residents who participated in the phone survey said they had spoken at public meetings about the repository, an indication that the survey succeeded in providing a forum for Panhandle

residents who might not otherwise have been heard on this issue. Survey participants were broadly representative of residents of the counties studied and the survey results indicate a strong consensus about the repository among diverse groups of residents of these areas.

Table 1
Background Characteristics of Survey Participants

<u>Characteristic</u>	<u>Percent of Deaf Smith/Swisher Households</u>	<u>Percent of Moore/Crosby Households</u>
Gender		
Male	46	54
Female	54	46
Ethnicity		
Mexican-American/Hispanic	15	8
White/Anglo	84	91
Black, Other	1	1
Interviewed in Spanish	6	3
Education		
0 to 8th grade	14	10
9 to 11th grade	16	10
High school diploma	34	40
Some college or technical school	21	23
College degree	10	13
Graduate or professional school	5	3
With children under 18 in household	42	57
Owners of property in Deaf Smith/Swisher Counties		
home owners	80	
farm owners	29	
business owners	20	

(Continued)

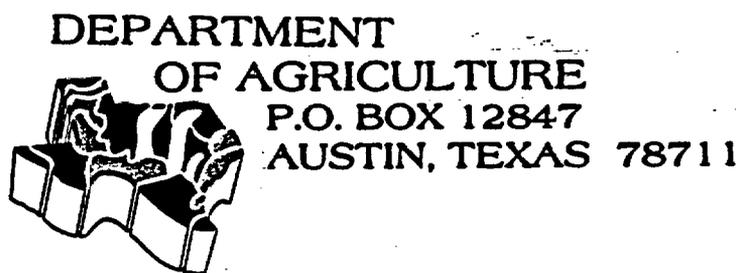
Table 1 (Continued)

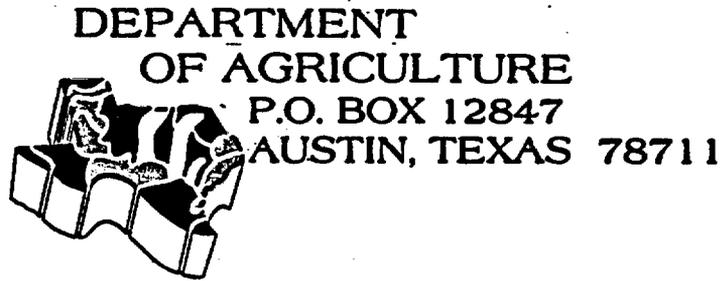
<u>Characteristic</u>	<u>Percent of Deaf Smith/Swisher Households</u>	<u>Percent of Moore/Crosby Households</u>
Occupation		
farmer	15	15
farmworker	3	3
professional, managerial	22	19
clerical & service	16	10
blue collar	10	15
homemaker	15	20
retired	15	14
not employed	2	3
Income		
less than \$10,000	18	13
\$10,000 to \$19,000	24	22
\$20,000 to \$29,000	21	24
\$30,000 to \$39,000	14	18
\$40,000 to \$49,000	6	8
\$50,000 or more	16	15
Income Sources		
farming	35	32
farming largest source	22	8
wages, salaries, tips, commissions	62	69
business ownership	25	22

PANHANDLE RESIDENTS' VIEWS OF HIGH-LEVEL NUCLEAR WASTE STORAGE

Part II: Survey Questions and Responses

**A Report of the
Texas Department of Agriculture
October, 1984**





Deaf Smith and Swisher counties, in the Texas Panhandle, are being considered by the U.S. Department of Energy as possible sites for the first national high-level nuclear waste repository. The Texas Department of Agriculture, in cooperation with the Governor, surveyed residents of the Texas Plains to document their views about potential socioeconomic effects of a repository in Texas. The wording of the survey questions is shown here along with the percent of survey participants who chose each answer. Percentages are based on 605 completed surveys for Deaf Smith and Swisher counties and 236 completed surveys for Moore and Crosby counties, except where otherwise noted. The margin of error is approximately ± 3 to 4 percent for Deaf Smith and Swisher counties, and 5 percent for Moore and Crosby counties. Some questions were asked only in the Deaf Smith and Swisher county interviews, and a few others were asked only in the Moore and Crosby county interviews.

Q. If it were up to you, would you allow construction of a high-level nuclear waste repository in _____ county?

	Deaf Smith/Swisher	Moore/Crosby
DEFINITELY YES	4	5
PROBABLY YES	8	4
NOT SURE	7	7
PROBABLY NO	8	17
DEFINITELY NO	73	66

Q. Do you think construction of the nuclear waste repository would be a good thing for your county?

	Deaf Smith/Swisher	Moore/Crosby
DEFINITELY YES	4	3
PROBABLY YES	9	5
NOT SURE	9	13
PROBABLY NO	7	12
DEFINITELY NO	68	67

Q. How likely do you think it is that a high-level nuclear waste repository will actually be built in _____ county?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	22	15
SOMEWHAT LIKELY	38	13
SOMEWHAT UNLIKELY	14	29
VERY UNLIKELY	16	29
DON'T KNOW/NO OPINION	11	14

Q. If a nuclear waste repository is built in the Texas Plains, do you think that the repository would affect you or your family personally?

	Moore/Crosby
DEFINITELY YES	23
PROBABLY YES	26
NOT SURE	24
PROBABLY NO	20
DEFINITELY NO	8

The next series of questions asks about what you think will happen in your county during the next 15 years if _____ county is chosen as the site for the nuclear repository.

Q. The first item is local tax rates. If _____ county is chosen as the repository site, do you think your local tax rates will go up, stay the same, or go down because of the repository?

	Deaf Smith/Swisher
GO UP	46
STAY THE SAME	29
GO DOWN	13
DON'T KNOW	11

Q. How about the value of your own home? Do you think the value of your home home will go up, stay the same, or go down because of the repository?

	Deaf Smith/Swisher
GO UP	19
STAY THE SAME	16
GO DOWN	60
DON'T KNOW	5

Q. How about your household income?

	Deaf Smith/Swisher
GO UP	13
STAY THE SAME	52
GO DOWN	29
DON'T KNOW	6

Q. The next one is the quality of schools in your county. Will that go up, stay the same, or go down because of the repository?

	Deaf Smith/Swisher
GO UP	13
STAY THE SAME	39
GO DOWN	39
DON'T KNOW	9

Q. How about the amount of traffic in your county?

	Deaf Smith/Swisher
GO UP	60
STAY THE SAME	17
GO DOWN	18
DON'T KNOW	5

Q. How about the value of land in farms and ranches in your county?

	Deaf Smith/Swisher	Moore/Crosby
GO UP	8	4
STAY THE SAME	8	27
GO DOWN	80	68
DON'T KNOW	4	2

Q. What about crime rates in your county?

	Deaf Smith/Swisher
GO UP	40
STAY THE SAME	47
GO DOWN	4
DON'T KNOW	9

Q. Next is the cost of living in your county?

	Deaf Smith/Swisher	Moore/Crosby
GO UP	57	38
STAY THE SAME	32	50
GO DOWN	5	4
DON'T KNOW	6	8

Q. How about the number of jobs available in your county?

	Deaf Smith/Swisher	Moore/Crosby
GO UP	52	27
STAY THE SAME	15	42
GO DOWN	27	23
DON'T KNOW	6	8

Q. What about the quality of local services, like police, fire, and sewage, and so on.

	Deaf Smith/Swisher
GO UP	21
STAY THE SAME	54
GO DOWN	20
DON'T KNOW	5

Q. How about the quality of your life in general?

	Deaf Smith/Swisher
GO UP	6
STAY THE SAME	44
GO DOWN	45
DON'T KNOW	5

Q. How about the number of stores and businesses in your county?

	Deaf Smith/Swisher	Moore/Crosby
GO UP	33	14
STAY THE SAME	24	49
GO DOWN	38	32
DON'T KNOW	4	5

Q. How about the amount of industry in your county?

	Deaf Smith/Swisher	Moore/Crosby
GO UP	22	17
STAY THE SAME	26	43
GO DOWN	47	34
DON'T KNOW	5	6

Q. How about the amount of agricultural production in your county?

	Deaf Smith/Swisher	Moore/Crosby
GO UP	3	2
STAY THE SAME	21	43
GO DOWN	72	53
DON'T KNOW	4	2

Q. How about the number of places to go for fun or entertainment—like bowling, restaurants, movies, and so on?

	Deaf Smith/Swisher
GO UP	25
STAY THE SAME	50
GO DOWN	21
DON'T KNOW	4

These questions are about health and safety. We know that some people are concerned about problems they think could develop if a nuclear waste repository is built in the Texas Panhandle. Other people are not concerned about the repository. I'm going to ask you for your opinion about it.

Q. The first question is about accidents involving trucks or trains bringing nuclear wastes to the repository. How likely do you think it is that there would be accidents involving trucks or trains bringing nuclear wastes to the repository?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	48	27
SOMEWHAT LIKELY	33	50
SOMEWHAT UNLIKELY	10	14
VERY UNLIKELY	7	6
DON'T KNOW	1	2

Q. How concerned would you be about an accident involving trucks or trains bringing wastes to the repository if it did happen?

	Deaf Smith/Swisher	Moore/Crosby
EXTREMELY CONCERNED	68	55
VERY CONCERNED	21	33
SLIGHTLY CONCERNED	8	6
NOT AT ALL CONCERNED	2	3
NO OPINION/DON'T KNOW	0	2

Q. The next question is about radioactive wastes escaping into the air. How likely do you think it is that radioactive wastes would escape into the air outside the repository?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	38	32
SOMEWHAT LIKELY	31	36
SOMEWHAT UNLIKELY	14	15
VERY UNLIKELY	11	8
DON'T KNOW	6	8

Q. How concerned would you be if radioactive wastes did escape into the air?

	Deaf Smith/Swisher	Moore/Crosby
EXTREMELY CONCERNED	73	57
VERY CONCERNED	18	35
SLIGHTLY CONCERNED	6	6
NOT AT ALL CONCERNED	2	1
NO OPINION	0	1

Q. How about radioactive wastes escaping into the soil? How likely do you think it is that radioactive wastes would escape into the soil outside the repository?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	54	52
SOMEWHAT LIKELY	22	26
SOMEWHAT UNLIKELY	9	8
VERY UNLIKELY	10	6
DON'T KNOW	4	8

Q. How concerned would you be if radioactive wastes did escape into the soil?

	Deaf Smith/Swisher	Moore/Crosby
EXTREMELY CONCERNED	73	59
VERY CONCERNED	21	30
SLIGHTLY CONCERNED	4	8
NOT AT ALL CONCERNED	2	1
NO OPINION	0	2

Q. How likely do you think it is that radioactive wastes would escape into the water outside the repository?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	61	56
SOMEWHAT LIKELY	20	26
SOMEWHAT UNLIKELY	6	7
VERY UNLIKELY	11	5
DON'T KNOW	2	6

Q. How concerned would you be if radioactive wastes did escape into the water?

	Deaf Smith/Swisher	Moore/Crosby
EXTREMELY CONCERNED	81	71
VERY CONCERNED	15	26
SLIGHTLY CONCERNED	2	3
NOT AT ALL CONCERNED	1	0
NO OPINION/DON'T KNOW	0	0

Q. How likely do you think it is that salt dug out of the repository during construction would escape into the soil outside the repository?

	Deaf Smith/Swisher
VERY LIKELY	49
SOMEWHAT LIKELY	24
SOMEWHAT UNLIKELY	10
VERY UNLIKELY	11
DON'T KNOW	7

Q. How concerned would you be if salt dug out of the repository did escape into the soil?

	Deaf Smith/Swisher
EXTREMELY CONCERNED	55
VERY CONCERNED	27
SLIGHTLY CONCERNED	15
NOT AT ALL CONCERNED	3
NO OPINION/DON'T KNOW	1

Q. How likely do you think it is that salt dug out of the repository during construction would escape into the water outside the repository?

Deaf Smith/ Swisher

VERY LIKELY52
SOMEWHAT LIKELY23
SOMEWHAT UNLIKELY10
VERY UNLIKELY12
DON'T KNOW4

Q. How concerned would you be if salt dug out of the repository did escape into the water?

Deaf Smith/ Swisher

EXTREMELY CONCERNED62
VERY CONCERNED25
SLIGHTLY CONCERNED11
NOT AT ALL CONCERNED1
NO OPINION/DON'T KNOW0

Q. How likely do you think it is that the repository would lead to contamination of food grown in your county?

Deaf Smith/ Swisher

VERY LIKELY57
SOMEWHAT LIKELY20
SOMEWHAT UNLIKELY10
VERY UNLIKELY10
DON'T KNOW4

Q. How concerned would you be if there was contamination of food grown in your county because of the repository?

Deaf Smith/ Swisher

EXTREMELY CONCERNED78
VERY CONCERNED19
SLIGHTLY CONCERNED3
NOT AT ALL CONCERNED1
NO OPINION/DON'T KNOW0

Q. How likely do you think it is that there would be a nuclear explosion because of the repository? *

Deaf Smith/ Swisher

VERY LIKELY26
SOMEWHAT LIKELY24
SOMEWHAT UNLIKELY17
VERY UNLIKELY24
DON'T KNOW8

Q. How concerned would you be if there was a nuclear explosion because of the repository? *

Deaf Smith/ Swisher

EXTREMELY CONCERNED82
VERY CONCERNED14
SLIGHTLY CONCERNED2
NOT AT ALL CONCERNED2
DON'T KNOW0

Q. How likely do you think it is that there would be sabotage or terrorism because of the repository? *

	Deaf Smith/Swisher
VERY LIKELY	36
SOMEWHAT LIKELY	30
SOMEWHAT UNLIKELY	14
VERY UNLIKELY	15
DON'T KNOW	5

Q. How concerned would you be if there was sabotage or terrorism because of the repository? *

	Deaf Smith/Swisher
EXTREMELY CONCERNED	73
VERY CONCERNED	21
SLIGHTLY CONCERNED	4
NOT AT ALL CONCERNED	2
NO OPINION/DON'T KNOW	0

Q. The next question is about health problems for workers at the repository. How likely do you think it is that there would be health problems for workers at the repository?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	52	49
SOMEWHAT LIKELY	25	27
SOMEWHAT UNLIKELY	8	11
VERY UNLIKELY	11	7
DON'T KNOW	4	6

Q. How concerned would you be if there were health problems for workers at the repository?

	Deaf Smith/Swisher	Moore/Crosby
EXTREMELY CONCERNED	62	45
VERY CONCERNED	29	44
SLIGHTLY CONCERNED	7	8
NOT AT ALL CONCERNED	2	2
NO OPINION/DON'T KNOW	0	1

Q. How about health problems for people living in your county? How likely do you think it is that the repository would lead to health problems for people living in your county?

	Deaf Smith/Swisher	Moore/Crosby
VERY LIKELY	50	40
SOMEWHAT LIKELY	25	29
SOMEWHAT UNLIKELY	11	13
VERY UNLIKELY	12	14
DON'T KNOW	2	4

Q. How concerned would you be if the repository did lead to health problems for people living in your county?

	Deaf Smith/Swisher	Moore/Crosby
EXTREMELY CONCERNED	77	63
VERY CONCERNED	20	34
SLIGHTLY CONCERNED	3	2
NOT AT ALL CONCERNED	1	0
NO OPINION/DON'T KNOW	0	0

* Starred questions were asked of a subsample of about 400 survey participants. They were omitted from other surveys to shorten the overall length of the interview.

Q. More specifically, how about cancer rates? How likely do you think it is that the repository could increase the number of people in your county who get cancer?

Deaf Smith/Swisher

VERY LIKELY48
 SOMEWHAT LIKELY20
 SOMEWHAT UNLIKELY10
 VERY UNLIKELY14
 DON'T KNOW9

Q. How concerned would you be if there was an increase in cancer because of the repository?

Deaf Smith/Swisher

EXTREMELY CONCERNED75
 VERY CONCERNED20
 SLIGHTLY CONCERNED4
 NOT AT ALL CONCERNED1
 NO OPINION/DON'T KNOW0

Q. And here's the last one in this section. How likely do you think it is that the repository would increase the number of miscarriages or birth defects in your county? *

VERY LIKELY40
 SOMEWHAT LIKELY27
 SOMEWHAT UNLIKELY10
 VERY UNLIKELY16
 DON'T KNOW8

Q. How concerned would you be if there was an increase in miscarriages or birth defects because of the repository? *

Deaf Smith/Swisher

EXTREMELY CONCERNED73
 VERY CONCERNED20
 SLIGHTLY CONCERNED5
 NOT AT ALL CONCERNED1
 NO OPINION/DON'T KNOW0

Now I'm going to read you some statements about some technical aspects of the nuclear waste repository. Some of the statements are true and some are false.

Q. High-level nuclear wastes are radioactive for thousands of years. From what you've heard, would you say that's true or false, or would you say that you don't know?

Deaf Smith/Swisher

TRUE (CORRECT)70
 FALSE7
 DON'T KNOW22

Q. Drilling for oil and gas will be allowed on land over the repository.

Deaf Smith/Swisher

TRUE6
 FALSE (CORRECT)70
 DON'T KNOW25

Q. More than a thousand people will be needed to build the repository.

Deaf Smith/Swisher

TRUE (CORRECT)50
 FALSE20
 DON'T KNOW30

Q. The repository will be big enough for all the wastes from nuclear power plants for the next century.

Deaf Smith/Swisher

TRUE16
FALSE(CORRECT)57
DONT KNOW27

Q. Once the repository is built, it will permanently employ 1,000 workers.

Deaf Smith/Swisher

TRUE16
FALSE(CORRECT)56
DONT KNOW27

Q. There is no evidence that radiation can cause birth defects.

Deaf Smith/Swisher

TRUE7
FALSE(CORRECT)77
DONT KNOW16

Q. The government has already done some drilling in Deaf Smith and Swisher counties as part of the site selection program for the repository.

Deaf Smith/Swisher

TRUE(CORRECT)82
FALSE5
DONT KNOW14

Q. Your area is being considered as a possible repository site because of its underground salt deposits.

Deaf Smith/Swisher

TRUE(CORRECT)84
FALSE4
DONT KNOW12

Q. If a nuclear waste repository is built in Texas, it will be located above the underground water of the Ogallala aquifer.

Deaf Smith/Swisher

TRUE44
FALSE(CORRECT)24
DONT KNOW32

Q. All of the salt dug out of the repository during construction will be put back into the repository eventually.

Deaf Smith/Swisher

TRUE19
FALSE(CORRECT)38
DONT KNOW44

Q. The nuclear repository will not be finished for at least 10 years.

Deaf Smith/Swisher

TRUE(CORRECT)52
FALSE18
DONT KNOW30

Q. The President of the United States is personally responsible for approving the site for the nuclear waste repository.

Deaf Smith/Swisher
TRUE (CORRECT)37
FALSE38
DONT KNOW25

For the next two statements I'd like you to tell me whether you strongly agree, somewhat agree, feel neutral, somewhat disagree, or strongly disagree.

Q. When I think about the possibility that Deaf Smith or Swisher county might be chosen as a site for a nuclear waste repository, I feel that this is a situation that doesn't really affect me personally. Would you say that you strongly agree, somewhat agree, feel neutral, somewhat disagree, or strongly disagree with that statement?

Deaf Smith/Swisher
STRONGLY AGREE6
SOMEWHAT AGREE8
NEUTRAL4
SOMEWHAT DISAGREE9
STRONGLY DISAGREE74

Q. When I think about the possibility that Deaf Smith or Swisher county might be chosen as a site for a nuclear waste repository, I feel that I need to know more before I can act.

Deaf Smith/Swisher
STRONGLY AGREE46
SOMEWHAT AGREE22
NEUTRAL5
SOMEWHAT DISAGREE7
STRONGLY DISAGREE20

Next I have a list of things that some people may have done because of the repository. You might have done some or all of these things, or you might not have done any of them. For each one, please tell me whether you have or haven't ever done it.

Q. First, have you ever written a letter about the repository to the editor of a newspaper?

Deaf Smith/Swisher
YES3

Q. Have you ever read any reports or pamphlets or other information from a government agency telling about the repository?

Deaf Smith/Swisher
YES60

Q. How about attending a government-sponsored meeting or public hearing about the repository? Have you ever done that?

Deaf Smith/Swisher
YES28

Q. Have you ever testified or spoken up to ask a question at a government meeting or public hearing about the repository?

Deaf Smith/Swisher
YES8

Q. Have you ever contacted a public official by letter, telephone, or in person about the repository?

Deaf Smith/Swisher
YES22

Q. Have you ever gone to a meeting of a community group (such as POWER or STAND or FAD) about the repository?

Deaf Smith/Swisher
 YES26

Q. Have you joined a community group (such as POWER, STAND, or FAD) to deal with the repository?

Deaf Smith/Swisher
 YES7

Q. Have you ever signed a petition about the repository?

Deaf Smith/Swisher
 YES27

Q. Have you ever thought about moving out of the area because of the repository?

Deaf Smith/Swisher
 YES44

Q. Have you changed financial plans for your family or for your farm, ranch, or business because of the repository?

Deaf Smith/Swisher
 YES8

The next questions ask your opinion about several different kinds of energy projects and businesses. I'd like to know how you would feel about having these projects move into your county.

Q. First, a coal-burning power plant. How would you feel about a coal-burning power plant moving into your county? Would you be strongly in favor, somewhat in favor, neutral, somewhat opposed, or strongly opposed to having a coal-burning power plant move into your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	23	28
SOMEWHAT FAVOR	28	32
NEUTRAL	18	22
SOMEWHAT OPPOSED	15	9
STRONGLY OPPOSED	13	8
DON'T KNOW/NO OPINION	2	2

Q. Next is a manure-burning power plant. How would you feel about a manure-burning power plant in your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	25	21
SOMEWHAT FAVOR	27	25
NEUTRAL	19	24
SOMEWHAT OPPOSED	13	13
STRONGLY OPPOSED	14	12
DON'T KNOW/NO OPINION	1	5

Q. How would you feel about a power plant that burned other agricultural byproducts, such as corn cobs, in your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	34	34
SOMEWHAT FAVOR	32	32
NEUTRAL	18	20
SOMEWHAT OPPOSED	8	7
STRONGLY OPPOSED	6	4
DON'T KNOW/NO OPINION	2	2

Q. How would you feel about a nuclear power plant moving into your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	4	6
SOMEWHAT FAVOR	9	16
NEUTRAL	10	9
SOMEWHAT OPPOSED	12	15
STRONGLY OPPOSED	63	51
DON'T KNOW/NO OPINION	2	2

Q. How would you feel about a large number of windmills for electric power generation in your county?

	Deaf Smith/Swisher
STRONGLY FAVOR	56
SOMEWHAT FAVOR	29
NEUTRAL	11
SOMEWHAT OPPOSED	1
STRONGLY OPPOSED	1
DON'T KNOW/NO OPINION	0

Q. How would you feel about a large number of solar cells for electric power generation in your county?

	Deaf Smith/Swisher
STRONGLY FAVOR	43
SOMEWHAT FAVOR	26
NEUTRAL	18
SOMEWHAT OPPOSED	4
STRONGLY OPPOSED	3
DON'T KNOW/NO OPINION	0

Q. How would you feel about a new feedlot moving into your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	43	34
SOMEWHAT FAVOR	25	28
NEUTRAL	16	16
SOMEWHAT OPPOSED	7	12
STRONGLY OPPOSED	8	10
DON'T KNOW/NO OPINION	0	0

Q. How would you feel about a food processing plant moving into your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	68	55
SOMEWHAT FAVOR	22	29
NEUTRAL	6	12
SOMEWHAT OPPOSED	2	2
STRONGLY OPPOSED	2	1
DON'T KNOW/NO OPINION	1	0

Q. How would you feel about a low-level nuclear waste disposal site moving into your county?

	Deaf Smith/Swisher	Moore/Crosby
STRONGLY FAVOR	3	3
SOMEWHAT FAVOR	7	6
NEUTRAL	10	7
SOMEWHAT OPPOSED	11	14
STRONGLY OPPOSED	67	67
DON'T KNOW/NO OPINION	3	2

Q. How would you feel about an oil refinery moving into your county?

	Moore/Crosby
STRONGLY FAVOR	46
SOMEWHAT FAVOR	29
NEUTRAL	10
SOMEWHAT OPPOSED	9
STRONGLY OPPOSED	5
DON'T KNOW/NO OPINION	0

Q. And how would you feel about a project for secondary recovery of oil and gas moving into your county?

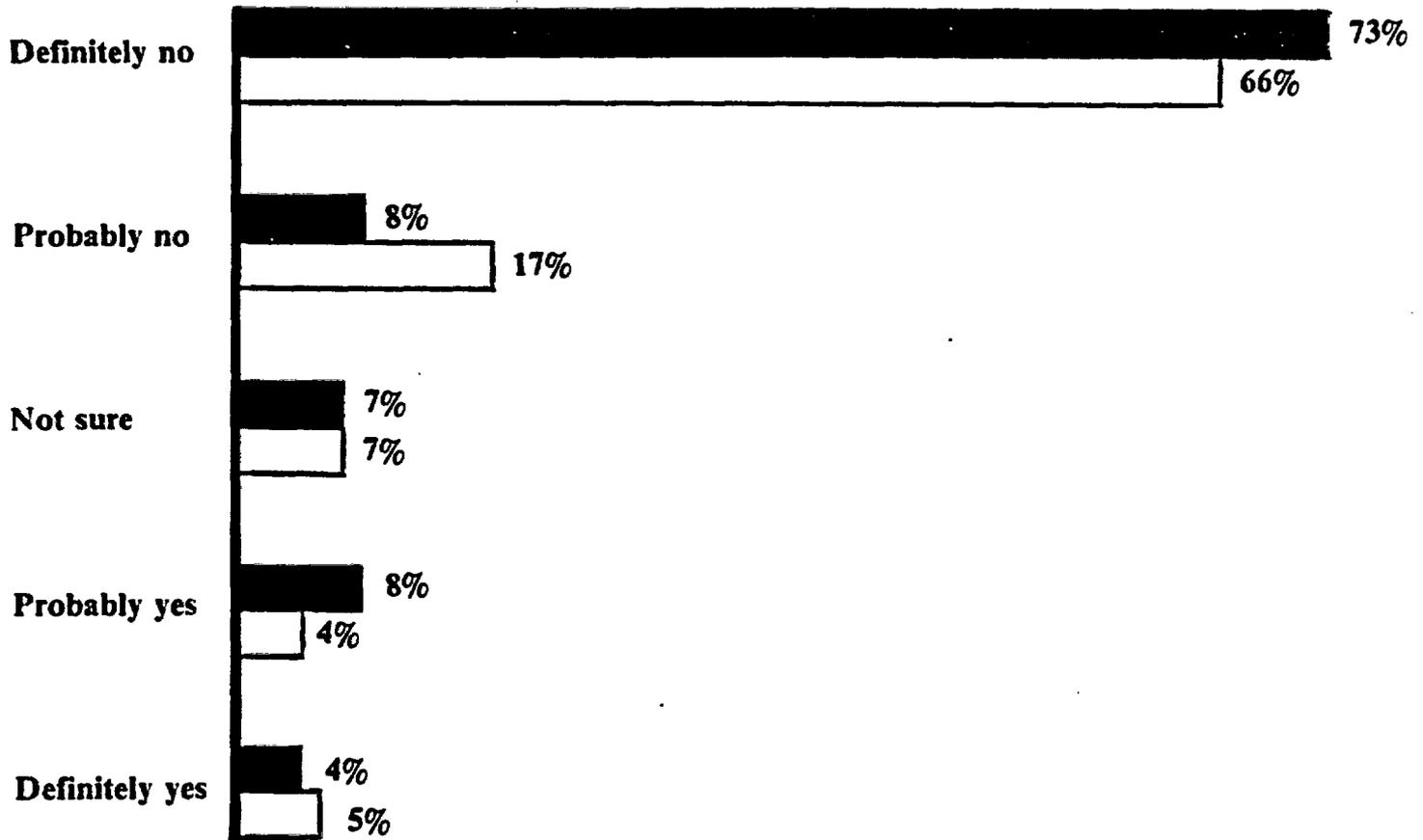
	Moore/Crosby
STRONGLY FAVOR	41
SOMEWHAT FAVOR	28
NEUTRAL	18
SOMEWHAT OPPOSED	6
STRONGLY OPPOSED	4
DON'T KNOW/NO OPINION	3

Q. And how would you feel about a high-level nuclear waste repository moving into your own county?

	Moore/Crosby
STRONGLY FAVOR	2
SOMEWHAT FAVOR	5
NEUTRAL	6
SOMEWHAT OPPOSED	8
STRONGLY OPPOSED	78
DON'T KNOW/NO OPINION	0

TDA NUCLEAR WASTE SURVEY

Would you allow construction of a high-level nuclear waste repository in the Texas High Plains?



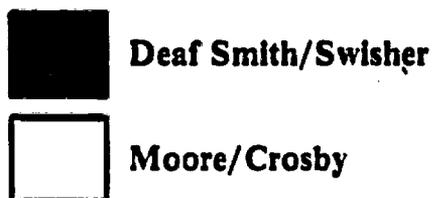
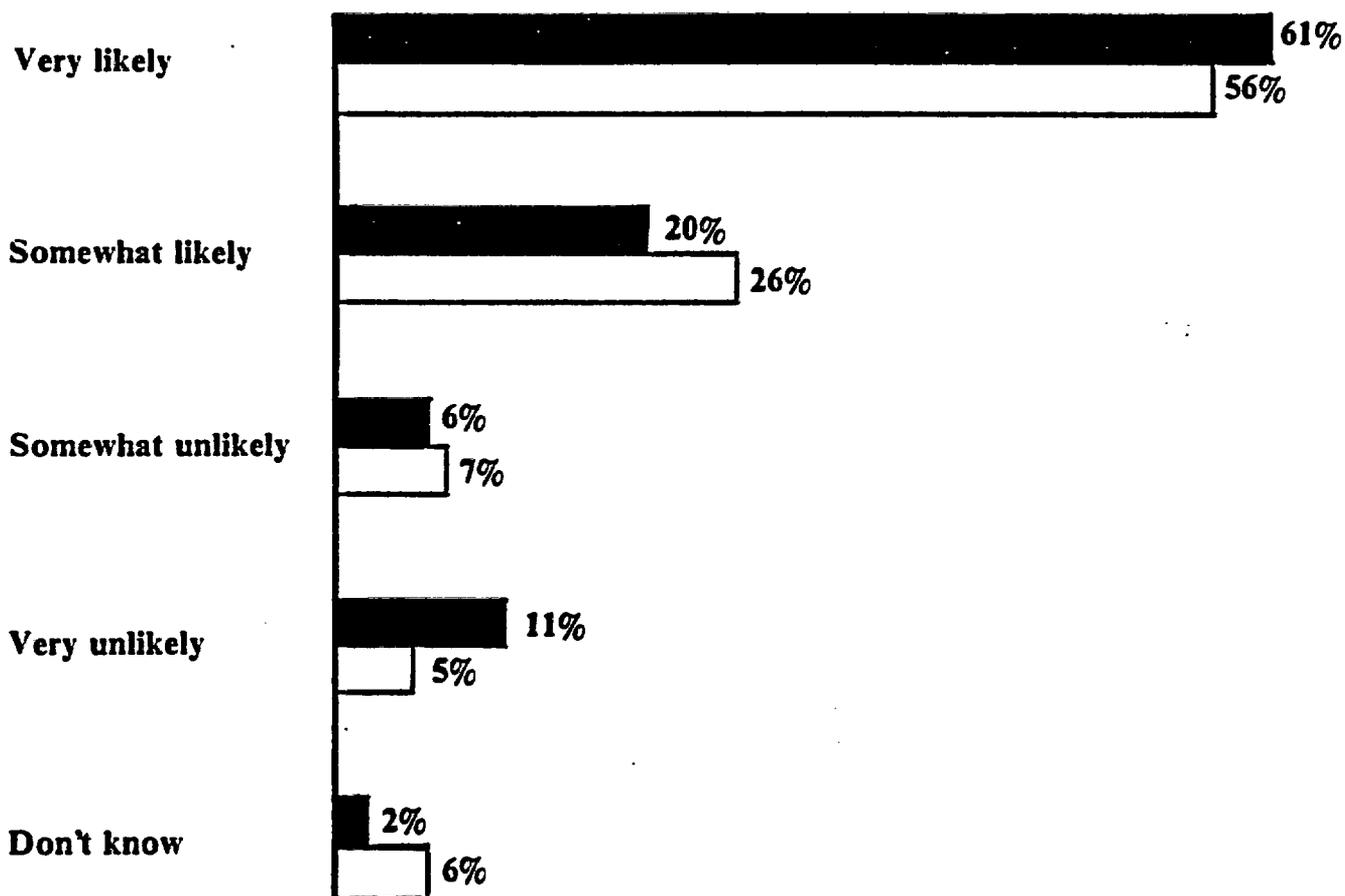
Deaf Smith/Swisher



Moore/Crosby

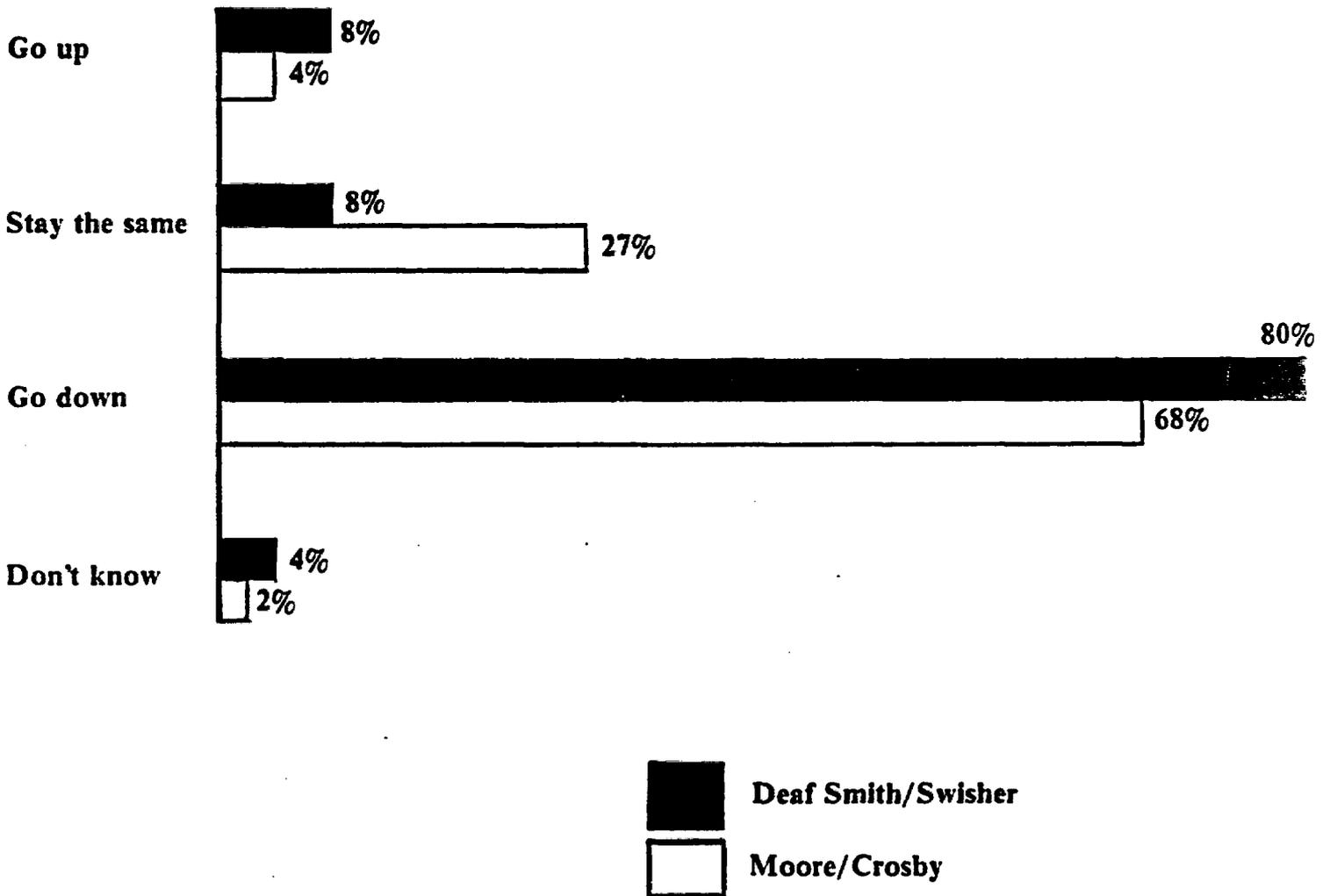
TDA NUCLEAR WASTE SURVEY

How likely is it that radioactive wastes would escape into the water supply?



TDA NUCLEAR WASTE SURVEY

What will happen to the value of farmland in your county if a high-level nuclear waste repository is built in the High Plains?





Facts about the High-Level Nuclear



Waste Repository

(AUSTIN)—The federal government is considering Deaf Smith and Swisher counties as possible sites for building a high-level nuclear waste repository. If Deaf Smith or Swisher county is chosen for the repository, highly radioactive wastes from nuclear power plants and possibly from nuclear weapons production would be buried deep underground for thousands of years.

How much do you know about the proposed nuclear waste repository?

Some of the statements below are true and some are false. You can quiz yourself by covering the correct answer below each statement.

High-level nuclear wastes are radioactive for thousands of years.

TRUE. High-level nuclear wastes take many years to lose their radioactivity. The U.S. Department of Energy (DOE) says these wastes must be isolated from people and the environment for 10,000 years.

Drilling for oil and gas will be allowed on land over the repository.

FALSE. Drilling will have to be restricted over the repository to assure that radioactive wastes do not escape accidentally through a drill hole.

More than a thousand people will be needed to build the repository.

TRUE. The U.S. Department of Energy estimates that the workforce for building the repository in Texas will be more than 1,000 workers during the peak construction period. Construction of the repository is expected to take five to eight years.

The repository will be big enough for all the wastes from nuclear power plants for the next century.

FALSE. The U.S. Department of Energy projects that the repository would receive waste shipments for approximately 30 years. After that the repository would be closed and decommissioned. Planning for a second nuclear waste repository is already

underway. Decisions being made now about building and operation of nuclear power plants will affect the amount of storage space needed for nuclear wastes for many years to come.

Once the repository is built, it will permanently employ 1,000 workers.

FALSE. A Texas repository would employ approximately 870 workers for 30 years of operation, according to early estimates by the U.S. Department of Energy. Employment forecasts for construction and operation of the repository may change as the Department of Energy develops detailed plans for repository design. After the repository is closed, it might be monitored by a small work crew or it might be monitored by technology that doesn't require any personnel at the repository site.

There is no evidence that radiation can cause birth defects.

FALSE. Extensive scientific evidence shows that exposure to radiation can cause birth defects. Scientists disagree about whether there is any "safe" level of radiation exposure.

The government has already done some drilling in Deaf Smith and Swisher counties as part of the site selection program for the repository.

TRUE. The federal government has drilled test boreholes in both counties to gather geologic and hydrologic information that is important in determining whether a safe repository could be built in this area.

The Deaf Smith and Swisher county area is being considered as a possible repository site because of its underground salt deposits.

TRUE. If Texas is chosen for the repository, nuclear wastes would be stored in underground bedded salt. Basalt, tuff, and granite are other geologic rock types that are being considered for a repository.

All of the salt dug out of the repository during construction will be put back into the repository eventually.

FALSE. About 200-million cubic feet of salt would be excavated from the repository and not all of it will fit back into the underground repository. The U.S. Department of Energy doesn't know yet how or where excess salt would be disposed.

The nuclear waste repository will not be finished for at least 10 years.

TRUE. The repository is scheduled to open in 1998. So far, planning for the repository has fallen behind DOE's target dates.

The President of the United States is personally responsible for approving the site for the nuclear waste repository.

TRUE. According to the Nuclear Waste Policy Act of 1982, the President is responsible for recommending a repository site to Congress.

If a nuclear waste repository is built in Texas, it will be located above the underground water of the Ogallala aquifer.

FALSE. A Texas site for the repository would mean drilling shafts through the Ogallala, the nation's largest freshwater aquifer. Nuclear wastes would be placed below the Ogallala and below the deeper Santa Rosa aquifer. The Santa Rosa is another important aquifer that provides water for drinking and for irrigation.



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