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MEMORANDUM FROM: Malcolm R. Knapp, Chief
WMGT

TO: Leo Higginbotham, Chief
WMRP

SUBJECT: REVIEW OF SALT LAKE CITY (SOUTH CLIVE) SEISMIC DISCUSSION PAPER

In response to TAR-85897, we have reviewed the DOE Salt Lake City (South Clive) seismic discussion paper. As concurrence has been given on the Salt Lake City RAP, the primary intent of our review is to clarify and expound on concerns of generic importance. Such concerns include certain points raised by DOE pertaining to NRC's recommendation that the excavation at South Clive be monitored for evidence of faulting.

If you have any questions in regard to our comments, please contact Jose Valdes or Philip Justus.

Malcolm R. Knapp, Chief
WMGT

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ATTACHMENT

The DOE discussion paper addresses five specific concerns raised by NRC in regard to the South Clive disposal site. NRC has the following comments on DOE's responses regarding each of these concerns:

CONCERN #1

This concern relates to NRC's recommendation of March 4, 1985 (letter to J. Themelis from L. Higginbotham) that a geologist be present at the site during critical times of the excavation procedure to inspect the site for evidence fault activity.

Summary of DOE Response

"The processes of excavation, grading, and compaction [at the site] obliterate all sedimentary structures, bedding, joints, soil horizons, etc. This makes it impossible to recognize the presence or absence of tectonic disturbances from visual inspection."

"The only method that would allow for inspection of the site area for evidence of recent faulting would be excavation of a system of backhoe test trenches, with subsequent logging of the exposed surficial materials by a team of geologists and soil scientists. As there are no specific suspected faults on the site, there are no obvious locations for trenching, unless random sites are selected. It is not likely that such a program would uncover evidence of recent faulting."

NRC Comment

DOE's descriptions of the excavation process and the unavailability of adequate exposures as a result of it indicate that a search for evidence of faulting in the excavation would require supplementary tasks. In this regard, NRC agrees that trenching at randomly selected locations, without knowledge of specific suspected on-site faults, would be an impractical way to search for evidence of fault activity. Information on the need for trenching and the selection of suitable trenching locations could be obtained, however, by means of a geophysical (e.g. gravity) survey to delineate, or verify the absence of, concealed structures in the site area. NRC's views on the role of geophysical surveys in the site characterizations process are further discussed in our comments on the DOE responses regarding concern #5.

CONCERN #2

This concern relates to the lack of a definition of "active fault" in the RAP and supporting documents.

Summary of DOE Response

The TAC has been applying and proposes the continued use of the active fault definition provided by Slemmons and McKinney (1976, COE Waterways Experiment Station Miscellaneous Paper S-77-8, pp. 4-5), with emphasis on Holocene-age faults.

NRC Comment

This discussion has been mooted by the adoption of the definition of "capable fault" in the September, 1985 Seismic Hazard Assesments chapter of DOE's UMTRAP Design Manual.

CONCERN #3

This concern relates to: (a) use of fault scarps as evidence of seismic activity, (b) examination of low-sun-angle (LSA) aerial photography, and (c) detection limits of low-sun-angle (LSA) aerial reconnaissance.

Summary of DOE response

In regard to (a):

"In the January 17th memorandum, the NRC staff concluded that our definition of active fault is 'a Holocene-aged [sic] (0-12,000 years before present) fault associated with an existing fault scarp.' We should emphasize that we do not require that a fault be associated with an existing fault scarp in order to be considered active."

"Our position regarding fault scarps is that they are one type of evidence of past fault activity."

In regard to (b):

"...[A]erial LSA reconnaissance and analysis of aerial LSA photography are useful tools in a seismic risk evaluation, but not the only methods used. Failure to detect any fault scarps in Quaternary alluvial materials using those methods is an an indication that active faults are not present. However, other

methods, such as trenching over mapped faults where activity is suspected, analysis of the seismic history, etc., are also generally employed."

"[Besides LSA photography and reconnaissance], [o]ther methods, such as trenching in Quaternary deposits, may give further information in some cases, but in the absence of some other indication of past activity, trenching would have to be done at sites picked at random."

"The point was made by NRC that failure to detect evidence of recent faulting by LSA methods does not conclusively prove the absence of active faults. We agree with this."

"Earthquakes on the order of magnitude 6.5 or greater are. . . the only ones which should be detectable for more than a few thousand years. It is therefore, possible that earthquakes on the order of magnitude 6 could have occurred in the site area as recently as a few hundred years ago [without exhibiting associated surface scarps] . . . or that earthquakes on the order of magnitude 6 to 6.5 could have occurred during the early [sic] to middle [sic] Holocene and their resultant scarps since disappeared." [Emphasis added.]

"Geophysical or other data on subsurface structure, when available, are also used. However, this data generally reveals structures in bedrock but not in surficial materials, and is generally not useful in dating of fault movements."

In regard to (c):

"The NRC staff memorandum states that the detection limit of LSA reconnaissance and photography is 1-2 feet. Reference for this is given as a letter from J. Morley, DOE, to L. Higginbotham, NRC, September 19, 1984. Scarps with very subtle surficial irregularities, on the order of a few inches to a foot, can be detected by careful aerial LSA reconnaissance, and detected on aerial photography under the proper conditions."

NRC Comment

In regard to (a):

The NRC comment regarding the definition of active fault that appears to be implied in the Salt Lake City RAP and supporting documents should have been stated more clearly and explicitly. The comment was based on our finding that, though no explicit definition of the term "active fault" was given in the DOE documents, the description of the reconnaissance methods used to locate "active faults" (which constitutes an operational definition) indicates that only

Holocene faults associated with existing fault scarps would be detectable with such methods. The statements emphasized above, in the summary of DOE's response regarding (b), indicate that our inference was accurate and that only seismogenic faults associated with existing surface scarps (and therefore detectable with the visual or photographic reconnaissance techniques used) were identifiable as "active".

In regard to (b):

NRC agrees that LSA methodology is a useful tool in attempting to define faults in an area for purposes of a seismic risk evaluation. However, it is worth emphasizing that failure to detect any fault scarps in Quaternary alluvial materials using those methods is not an indication that active faults are absent but only that no active faults associated with existing surface scarps appear to be present. DOE's statements indicate that there is no DOE-NRC disagreement on this point.

In regard to trenching as an example of alternative techniques of fault investigation, NRC agrees with DOE's view that, in the absence of some indication of past fault activity, trenching would have to be done at locations selected at random and thus would not be very meaningful. However, we believe that geophysical surveys could provide information on the need for trenching and the selection of suitable trenching locations at sites where trenching may be warranted. NRC's views on the role of geophysical surveys in the site characterization process are further discussed in our comments on the DOE responses regarding concern #5.

In regard to (c):

During our review of the Salt Lake City RAP, the information available to the NRC, was that, as stated by J. Morley to L. Higginbotham in the letter of September 19, 1984: "The conditions during the LSAAR were excellent and scarps of only about one or two feet would have been detected." The discrepancy between this information and that now presented by DOE in the seismic discussion paper does not significantly affect the validity of the NRC RAP review comments.

CONCERN #4

As described by DOE, this concern relates to the lack of a thorough literature review in the Salt Lake City RAP and supporting documents, and the implications of several published studies for the possible existence of concealed faults in the area of the site.

Summary of DOE Response

"The NRC letter and memorandum infer that a gravity survey by Cook, et al. (1964) [Geol. Soc. Am. Bull., vol. 75, p. 715-740], with important implications for the subsurface structure at Clive, were not reviewed. This study was reviewed during our investigation, and is specifically referred to several times. The implications of the study for the possible existence of concealed faults in the site area are also brought out in our report."

"The two faults of unspecified age mapped by Moore and Sorensen (1979) [USGS Miscellaneous Investigations Series, Map I-1132] on the west flank of the Cedar Mountains were not specifically addressed in the FEIS. Several other studies of the same area were cited. . . ."

"NRC's criticism regarding the west flank of the Cedar Mountain is understandable and justified because we failed to discuss the reasons why the area was not determined to be active. In future studies. . . we will be more careful to specifically address faults which were considered during the study and not determined to be active, and explain our findings in detail."

NRC Response:

The NRC's comment in regard to the need for a thorough literature review in future RAP's or supporting documentation was motivated by the fact that the Moore and Sorensen (1979) geologic map of the Tooele Quadrangle is not mentioned in the RAP, yet it appears to be the best available geologic map of the area and was readily identified by the NRC staff through the USGS "List of Geological Survey Geologic and Water-Supply Reports and Maps for Utah."

In regard to the Cook et al. (1964) gravity survey, the NRC acknowledges that DOE cited and described the study in the RAP. However, we must reiterate that the RAP did not address the question of whether the buried faults which the study suggests may exist in the vicinity of the site pose a significant hazard to the site. The same statement applies in regard to the buried faults within 10 km of the site which were mapped Moore and Sorensen (1979).

NRC considers that DOE has addressed a key issue by committing to thoroughly document its fault studies in the future.

CONCERN #5

This concern relates to the need for subsurface geophysical surveys to delineate concealed structures in the site.

Summary of DOE Response

"The NRC position that further field studies, in particular geophysical studies, are needed to generate data on the subsurface structure of the site area, goes beyond the scope of work that could be reasonably justified for a low-level waste pile. For example, the gravity survey study of Cook, et al. (1964) was carried out over four years. . . and involved measurements of 1,040 stations. The existence of concealed bedrock faults as delineated by the gravity survey was already generally accepted by most geologists working in the region. What the gravity survey failed to do was to indicate whether or not the detected faults were active, or what was the date of the last movement on them."

". . . [G]eophysical studies such as those recommended by NRC are unlikely to generate significant new data. In order to carry them out, we would have to greatly expand our budget and the amount of time spent on site characterization."

NRC Response

NRC considers that the need for geophysical surveys in the UMTRAP program cannot generally be excluded a priori. Such surveys may be necessary and reasonable at sites where visual and photographic reconnaissance techniques may not be sufficient to define the existence of capable faults pertinent to design considerations.

In terms of the example cited (Cooke et al., 1964) regarding the level of effort that such surveys would necessitate, we do not agree that it is appropriate to equate the level of effort required for a regional study, such as that of Cook and others (which covered all of the northern Great Salt Lake Desert and adjacent areas) with that which an UMTRAP-site-specific study would involve. In regard to gravity surveys specifically, Gimlett (1967, in Slemmons, D.B, CUE Waterways Experiment Station Miscellaneous Paper S-77-8, p. 78), has noted that its advantages are its low cost and speed and ease of application.

The gravity survey of Cook and others (1964) extends within 15 miles of the South Clive site area and therefore only suggests that buried faults may exist locally. Subsurface geophysical information for the site area would allow a determination of whether buried faults are present. Though, as DOE states, such information would not directly indicate the date of the last movement on the fault, it could be used in conjunction with trenching to assess a fault's potential significance.