Lawrence Livermore National Laboratory

NUCLEAR SYSTEMS SAFETY PROGRAM

L-196

November 20, 1986

WM Record File WM-RES A0297 LLL

WM Project 10,11,16

Docket No.

X PDR ✓

LPDR B,N,S

Distribution: X Blackford

(Return to WM, 623-SS) 4

Mr. M. E. Blackford, MS-623ss
Project Officer, WMGT
Geotechnical Branch
Division of Waste Management, NMSS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Transmittal of Review Letter Report on "Survey of Geophysical Techniques for Site Characterization in Basalt, Salt and Tuff," by Weston Geophysical, Inc. (Draft Report, dated 28 October 1986)

Dear Mr. Blackford:

In accordance with Task II of our Contract A0297 and your task letter dated 31 October 1986, we have conducted our review and evaluation of the subject draft report.

Enclosed, please find three (3) copies of our Letter Report on the review and evaluation of the subject draft report. We believe that the subject report is a fine geophysical review and description of various geophysical techniques that are currently used in site investigation. There are some obvious weaknesses and we made several suggestions in our report.

If you have any questions, please let us know.

Sincerely yours,

Dae H. (Danny) Chung
Project Leader

DHC/ic
Encls. as stated. (3)

2858

REVIEW OF THE SUBJECT DOCUMENT

by

NRC Nuclear Waste Management Project Team
Lawrence Livermore National Laboratory, Livermore, California

---

SUBJECT: Survey of Geophysical Techniques for Site Characterization Basalt, Salt and Tuff. Final draft report by Weston Geophysical Corporation.

Overall, this report presents an excellent review of geophysical exploratory methods and their potential applications at the 5 nuclear waste disposal sites that have received final EA evaluation by U.S. DOE. Recent advances in certain of these techniques (mainly seismic methods) are described in some detail as are modifications that could be made to some techniques in order to improve their usefulness in specific repository settings.

A few suggestions are offered.

The value of single point resistivity logging for shale interbeds in bedded salt is noted, but then downplayed because this is not a common oil field tool. Interbeds in bedded salt are critical features, particularly because of their lateral continuity (possible flow horizons) and engineering significance. Single-point resistivity logs are common tools among geohydrologic and engineering geophysical service companies, many of whom have the capability of working at PRH depths. Therefore, the use of this potentially valuable tool should not be downplayed.

The report appears to suggest that cross-hole techniques may be of little value in domal salt because of plastic flow conditions. The reasoning is not clear, since Richton Dome is not believed to be deforming rapidly (if at all) at present, and therefore domal salt should be a stable mass from a short term geophysical viewpoint. Since cross-hole arrays have the potential for detecting anisotropy (e.g. anomalous zones) in domal salt, the use of this technique should be reappraised.

Also, the potential for cross-hole techniques (particularly in the tomographic mode) to detect brine pockets in bedded salt should be noted.

Tables I through III do not indicate the potential usefulness of the televiewer in basalt, bedded salt and domal salt respectively, although the report text discusses this instrument and indicates its potential application in these media.

There are a few typographic errors in the draft. An example is Table III, Footnote 5, "salt stack" for "salt stock". The report should be checked once more for these before being made final.

Overall the report appears to present an excellent summary and will provide useful guidance to the USNRC during future evaluations of proposed SCPs and related documents.

General Comment All the common and many of the less routinely used geophysical techniques are addressed. Chapter 1 is a good descriptive summary of the various geophysical techniques they considered. Tables I through IV are good visual summaries of the applicability of the techniques to the potential repository mediums. Occasionally in Chapters 2 through 5 the text drifts away from the assessment with regards to the repository medium and back to the description of the technique as given in Chapter 1 (see p. 60, Sec. 3.10.2). In Tables I through IV under borehole logging "radioactive" should be changed to "nuclear" to be consistent with text. References should be carefully checked, as there are some errors. The ones picked up are listed under the specific comment section.

Specific Comments

Table I - under borehole logging magnetic logs for stratigraphic correlation may be somewhat useful and the televiewer should be indicated as useful for fracturing/permeability.

Table II - borehole gravimetry could be somewhat useful in determining shallow non-faulted structures such as dissolution structures.

Table III - same comment as for Table II. In conjunction with γ-γ density borehole gravimetry could be somewhat useful in determining the presence and nature of anomalous features in salt domes.

Table IV - same comment as for Table II, except shallow structure definition would result from offsets of tuffs with varying densities. Effectiveness would depend upon density contrast and supporting geologic and geophysical data.

p. 1 Goal Number 2

Identifying faults which may be critical to repository safety and stability in event of earthquake is a part of this goal.

p. 4 Sec. 1.2.3.1 Sources

The marine air gun has been used successfully on the Nevada Test Site, especially in Yucca Flat.

p. 28 Sec. 1.8.4 4th sentence.

This sentence is incorrect. Change Yucca Flats, NV to Yucca Mountain and basaltic rocks to volcanic rocks. The basaltic rocks are relatively insignificant compared to the silicic rocks at Yucca Mountain. The sentence is correct in that there are anomalous remanent magnetization directions and intensities in the volcanic rocks at Yucca Mountain.

p. 29, Par. 2, line 4

Change "is" to "if"

p. 29, Par. 3, sentence 5

Sentence is unclear data cannot "blow up".

p. 32, Sec. 1.9.2.5, Par. 2, line 5

"Thich" should be "thick"

p. 35, Sec. 1.9.4.1, Par. 1, line 7

"Limmited" should be "limited"

p. 35, Sec. 1.9.4.1, Par. 3

Reference - Hagstrum et al. 1980 is same as Hagstrum, Daniels and Schott, 1980a.

p. 39, Sec. 1.10.2

ULSEL tool mentioned on p. 64 is not described or listed in Fig. 1.11.

Basalt No specific comments

Bedded Salt

Gets away from assessment in logging section.

p. 58 Par. 4

.1 mile = .16 km, not 1 km

p. 60, Sec. 3.10.8

No assessment of role of neutron log in bedded salts.

Domal Salt

p. 63, Sec. 4.7.1

Borehole gravimetry could be used to model vertical nature of salt dome.

p. 63, Sec. 4.8.1

The Gibson Salt Dome is not a typical salt dome in that it is a true structural dome, not a piercement structure like Richton, so the Gibson Dome is not an exact analogy.

Tuff

p. 65, Sec. 5.1, Par. 2

The incorrect and misleading statement "No major faulting at the site has apparently occurred during the past 11 m.y." generally implied only vertical movement along the fault. Horizontal movement was not considered. In addition, there is increasing

evidence that Holocene and/or late Quaternary movement has occurred on faults very near the RRL. Such movement is unrelated to the cinder cones in Crater Flat. A better statement would be that the extent and nature of faulting is still under investigation.

p. 65, Sec. 5.2

This section seems to take an unusually pessimistic view of seismic reflection profiling given the success in Yucca Flat and Mid Valley on the NTS and COCORP work in Death Valley and Central Nevada.

P. 68, Sec. 5.7.1, Par. 2

Ponce, 1981, not in references.

p. 72, Sec. 5.10.9

With static water level at approximately 1500 m (Fig. 5.1) most holes will be dry, or have large upper sections of them dry. In hole G-2 (Stock et al. 1989, USGS OFR 84-172) televiewer was run only below 526 m. This was probably the upper limit of fluid in the hole. Five hundred and twenty six meters is below the proposed repository horizon in the Topopah Springs Formation (~510-225 m). Obtaining sonic data in such holes could be a real problem. A dry hole acoustic log (DHAL) is run in weapons program holes in Yucca Flat and Pahute Mesa. See Hearst and Nelson (1985), "Well Logging for Physical Properties", McGraw-Hill, for a brief description of the DHAL.