# Lawrence Livermore National Laboratory

NUCLEAR SYSTEMS SAFETY PROGRAM

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Dr. P. S. Justus, Section Leader
Geology & Geophysics Section
Technical Review Branch
Division of High-Level Waste Management
Office of NMSS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Nuclear Waste Repository in Bedded Salt

Reference: Letter Report on "Geologic Stability Issues Relevant to Construction and Operation of a Nuclear Waste Repository in Bedded Salt," by Chung and Carpenter. Three pages.

Dear Dr. Justus:

Enclosed, please find the reference Letter Report on the geologic stability issues relevant to construction and operation of a high-level waste repository in bedded salt. It is our wishes that the report becomes some use to members of your staff and others at NRC.

It is evident that a number of geologic factors can influence the construction and operation of a nuclear waste repository (facility) in an "impure salt" sequence such as that expected at the Deaf Smith site. Impacts may be more valied and severe than with the "pure salt" site that has generally been envisioned to date as a nuclear waste repository.

If you have any questions, please let us know.

Sincerely yours,



Dae H. (Danny) Chung
Project Leader

DHC/ic
Encls. as stated.

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# Geologic Stability Issues Relevant to Construction and Operation of a Nuclear Waste Repository in Bedded Salt

by

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Concerns for the physical stability of the underground openings required in a nuclear waste repository in bedded salt have traditionally been focused on the time dependent properties of salt itself, e.g. plastic deformation, and on the effects of repository depths and thermal loading on these properties. It had generally been assumed that a bedded salt repository would be placed in a massive, essentially homogeneous, salt body and that the properties of salt alone would be relevant to repository construction and operation.

However, the proposal to characterize the Deaf Smith County site as a potential salt repository, necessitates the evaluation of heterogeneous salt sequences since the Palo Duro Basin salts contain numerous thin, but laterally extensive interbeds and are frequently impure.

In 1979 Golder Associates, a multinational mining engineering organization, provided UCRL-15203 to LLNL. In this document they discussed geologic factors which could influence repository design in bedded salt. The report was generic in character, but drew upon Golder Associates experience with salt and potash mines, including mines in the Delaware Basin west of the Deaf Smith area.

Golder Associates emphasized the potential importance of structural, stratigraphic and compositional factors upon repository design and stability.

Based upon review of the Golder Associates study, the following geologic factors would appear to have the greatest potential effect upon the physical stability of a nuclear waste repository in bedded salt at the Deaf Smith site.

1. Interbeds The frequent and laterally extensive thin shale interbeds identified during studies in the Palo Duro basin would influence pillar, roof, floor and canister well stability depending upon their positions with respect to repository openings. Interbeds are a cause of instability in several of the salt and potash mines surveyed by Golder Associates. Fractures in interbeds have been observed to convey water into otherwise "dry" salt and potash mines and therefore such interbeds can constitute permeable pathways through the salt sequence.

2. Impure Salt "Muddy salt" has been recognized with some frequency in Palo Duro Basin cores and a number of hypotheses have been put forward concerning its origin. Golder Associates describe vertically oriented "mud plugs" in Delaware Basin mines which appear to have the general composition of the "muddy salt" seen in cores. These "mud plugs" are reported to be physically weaker than pure salt and Golder Associates recommended isolating them in enlarged pillars. However, if muddy salt proves to be as abundant as the existing cores suggest, an adequately compact repository site may not exist. Also, the thermal, hydrologic and mechanical responses of a repository constructed in impure salt may differ greatly from those envisioned based upon studies of pure salt.

3. Gas and Brine Pockets Hazardous gases and brine under pressure have been encountered in salt and potash mines. While not as yet reported in exploratory holes in the Palo Duro Basin, these hazards have been encountered in the Delaware Basin, and this risk needs to be assessed during characterization of the Deaf Smith site.

4. Discontinuities Faults, joints and bedding planes are discontinuities within the rock mass that have influenced the stability of salt and potash mines. Golder Associates noted that open joints in pure salt are extremely rare, but such joints are possible in interbeds

and could be important at the Deaf Smith site because of the degree of heterogeneity present. Also, with a greater frequency of interbeds, the potential for detachments along bedding plane surfaces is increased. These discontinuities could result from the presence of strong, but brittle anhydrite, dolomite and limestone beds in the section as well as because of the presence of shale interbeds.

5. Solution Breccia Pipes These have been encountered in mines in the Delaware Basin, but have not had major stability effects because of rehealing. One instance of a floor cave-in possibly attributable to a breccia pipe was reported by Golder Associates. The existence of a breccia pipe, even if well healed, within a repository site would be a major issue because of questions that its existence would raise about the long-term ability of the site to contain waste. It is unlikely that breccia pipes would be identified by scattered drilling from the surface and therefore, horizontal exploration for such features would seem to be a significant element in site geologic stability studies. Salt-filled paleosolution channels have also been observed in a few mines, but were not reported to have resulted in stability problems.

Golder Associates reported other geologic features encountered in some salt and potash mines such as small igneous dikes, but did not indicate that these posed major stability problems, although pressured methane pockets were present near a dike encountered in a mine in the Delaware Basin.

It is evident that a number of geologic factors can influence the construction and operation of a nuclear waste facility in an impure salt sequence such as that expected at the Deaf Smith site. Impacts may be more varied and severe than with the pure salt site that has generally been envisioned to date as a nuclear waste repository.