

AUG 29 1994

0233

Mr. Ronald A. Milner, Acting Director
Office of Program Management and Integration
Office of Civilian Radioactive Waste Management
U.S. Department of Energy, RW 30
1000 Independence Avenue
Washington, D.C. 20585

Dear Mr. Milner:

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW COMMENTS
ON STUDY PLAN 8.3.1.8.5.2 -- "CHARACTERIZATION OF IGNEOUS
INTRUSIVE FEATURES, REVISION 1"

On August 22, 1994, the NRC staff transmitted its review comments on the subject study plan to the U.S. Department of Energy (DOE). The NRC staff review of this study plan resulted in the identification of three open item questions which were to be included as an attachment to the August 22, 1994, letter. However, in transmitting this information, DOE was erroneously provided with a copy of the NRC observation audit report of the Reynolds Electrical and Engineering Company, Inc. as the attachment, also dated August 22, 1994, and not the three open item questions. The purpose of this letter, therefore, is to provide DOE with the three open item questions identified by the NRC staff in its review of this study plan.

If you have any questions concerning this review, please contact Michael P. Lee at 301/415-6677.

Sincerely,
/s/
Joseph J. Holonich, Chief
High-Level Waste and Uranium Recovery
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

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Enclosure: As stated

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**STUDY PLAN 8.3.1.8.5.2
CHARACTERIZATION OF IGNEOUS INTRUSIVE FEATURES, REVISION 1**

Question 1

What plans exist to conduct heat flow measurements in the area of the Lathrop Wells Cone?

Basis

On page 2-3 of the study plan, there is an indication that additional boreholes may be drilled to obtain heat flow data; however, this plan specifically mentions Crater Flat as the location of such activity.

The staff is unable to find, within the study plan, an indication that heat flow measurements would be considered in either existing or planned boreholes near the Lathrop Wells cone.

If the Lathrop Wells cone is as young as has been suggested from some U.S. Department of Energy (DOE) studies (e.g. 2-4,000 years) it may still have a thermal signature. If a thermal signature still exists, significant information could be obtained on the history of volcanic activity in the area of Yucca Mountain.

Recommendation

DOE should consider obtaining heat flow data in the area of Lathrop Wells cone.

**STUDY PLAN 8.3.1.8.5.2
CHARACTERIZATION OF IGNEOUS INTRUSIVE FEATURES, REVISION 1**

Question 2

What plans does DOE have for obtaining estimates of the Curie Temperature Isotherm?

Basis

The staff agrees that it may be prudent to hold activities on evaluating the Curie Temperature Isotherm until completion of the geophysical review.

The staff also agrees that it may not be cost effective to obtain additional aeromagnetic data specifically for determining the Curie Temperature Isotherm.

The staff is concerned, however, that there appear to be no plans for obtaining an estimate of this information.

The staff suggests that it should be feasible to obtain at least an approximation of this property from an analysis of existing data, and consider that such an analytical exercise is justified.

Recommendation

During the evaluation of the geophysical program, some means of obtaining an estimate of the Curie Temperature Isotherm should be considered.

**STUDY PLAN 8.3.1.8.5.2
CHARACTERIZATION OF IGNEOUS INTRUSIVE FEATURES, REVISION 1**

Question 3

How will heat flow conditions in the Paleozoic carbonate aquifer at the site be adequately characterized using only existing and planned boreholes?

Basis

The objective of this study is to analyze the thermal regime at Yucca Mountain and determine whether there is evidence of fault-controlled groundwater flow paths, molten rock, or cooling magma bodies in the upper part of the crust.

Previous studies have interpreted that the near-surface heat flow in the Yucca Mountain region is strongly influenced by hydrologic processes, which may prevent identification of possible igneous effects. The staff notes, however, that the variations in near-surface heat flow are only assumed to be caused by hydrologic processes. This assumption has not been verified, and other causes cannot be ruled out.

Data from the Yucca Mountain area show heat flow values that are lower than those typically found in the western United States (Sass *et al.*, 1981, p. 512). The site occurs on the southern boundary of the so-called "Eureka Low," a zone located between Mercury and Eureka, Nevada, within which measured heat flows are less than 1.5 HFU's (heat flow units) (Sass *et al.*, 1971).

There are, however, significant heat flow variations at the Yucca Mountain site, the causes of which have not been confirmed. Near Yucca Mountain, temperature gradients in the unsaturated zone vary from 15°C/km to nearly 60°C/km (Sass, *et al.*, 1988, p. 2). Hydrologic processes have been suggested as the cause of this variability. At well USW G-4, the curvature of the temperature profile suggests an upward component of seepage velocity in the saturated zone of about 100 mm/yr (Sass *et al.*, 1988, p. 35).

Only one well at the site (UE25-p#1) penetrates the deep carbonate aquifer. Sass *et al.* (1988) refer to an apparent thermal high in the vicinity of this borehole. They state (p. 19) that "below ... about 1200 m[eters] ... the temperature profile becomes nearly isothermal, then reverses indicating a complex pattern of lateral throughflow of higher temperature water" They speculated that the anomaly could be explained by a long-lived transient thermal response to annular uphole flow caused by the drilling-induced breach of a hydraulic barrier in the lower part of the volcanic tuffs. They noted that this hypothesis could be confirmed only by completing a well in the carbonate aquifer and grouting in a water-filled access pipe. It is known that an upward hydraulic gradient exists between the Paleozoic carbonate aquifer and the overlying tuffs.

The study plan states (p. 2-2) that no new drill holes are planned that would be solely dedicated to heat-flow studies (although the possibility of one or more holes in Crater Flat is mentioned). Holes drilled for other site-characterization purposes will be used. However, dependence on

existing wells will give a view of thermal (and hydraulic) conditions that is biased for shallow zones, because only one well penetrates the deep carbonate aquifer (UE25-p#1). This deep zone is of special interest, because anomalous heat sources at depth should be more easily detected via deep boreholes.

Recommendation

Describe how heat flow conditions in the Paleozoic carbonate aquifer will be characterized.

References

Sass, J.H., D.D. Blackwell, D.S. Chapman, J.K. Costain, E.R. Decker, L.A. Lawver, and C.A. Swanberg, "Heat Flow from the Crust of the United States (Chapter 13) in "Physical Properties of Rocks and Minerals," 1981, p. 503-548.

Sass, J.H., A.H. Lachenbruch, W.W. Dudley, Jr., S.S. Priest, and R.J. Munroe, "Temperature, Thermal Conductivity, and Heat Flow Near Yucca Mountain, Nevada: Some Tectonic and Hydrologic Implications," U.S. Geological Survey, Open File Report 87-649, 1988, 118 p.

Sass, J.H., A.H. Lachenbruch, R.J. Munroe, G.W. Greene, and T.H. Moses, Jr., "Heat Flow in the Western United States," *Journal of Geophysical Research*, 76(26):6376-6413 [1971].

**STUDY PLAN 8.3.1.8.5.2
CHARACTERIZATION OF IGNEOUS INTRUSIVE FEATURES, REVISION 1**

Comment 52

No specific geophysical program appears to be planned to identify volcanic/igneous features and their extent under or close to the site.

Basis

This comment restates the concern expressed in CDSCP Comment 51.

The SCP includes re-written Activity 8.3.1.8.1.1.3 and also includes a cross reference between Activities 8.3.1.8.1.1.3 and 8.3.1.17.4.3.1; however, the SCP is not specific about a planned program for volcanic/igneous features identification.

Activities 8.3.1.8.1.1.3 and 8.3.1.17.4.3.1 indicate that a number of geophysical parameters exist for the activities; however, there is no indication of a coherent plan in these two sections or elsewhere in the SCP to indicate that the volcanic/igneous investigations will be accomplished in a consistent and coherent manner.

Recommendation

The DOE should include and integrate into its geophysical program a subprogram designed specifically for consideration of volcanic/igneous features.

Evaluation of the DOE March 1994 Response

The study plan addresses how heat flow measurements will be integrated with other investigations. It does not address how heat flow measurements will be integrated with or fit into the entire geophysical program.

This study plan, as well as previous study plans, refers to an ongoing review by an independent consultant to assess the needs for geophysical investigations to resolve volcanic concerns. While this review may help to resolve NRC concerns, until the report is available for the NRC and a determination by DOE is made as to how the geophysical program will be restructured and implemented, the concerns raised in this comment cannot be resolved.

The NRC staff consider this comment still open.