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April 27, 1992

John W. Bartlett, Director
Office of Civilian Radioactive
Waste Management
U.S. Department of Energy
Washington, DC 20585

Dear Dr. Bartlett:

The State of Nevada has reviewed the DOE Study Plan "Characterization of the Yucca Mountain Unsaturated-Zone Gaseous - Phase Movement" (Study Plan 8.3.1.2.2.6) and is providing its comments in this letter and attachment. The State's comments address the adequacy, completeness, and technical accuracy of the Study Plan to meet the Department's purpose in site characterization.

The State has two general comments regarding the subject Study Plan.

1. The Study Plan describes plans to develop an understanding of the processes that cause gaseous - phase circulation through the unsaturated rock comprising Yucca Mountain based on observations and tests made at one site. The Plan fails to provide a justification that the one site to be studied will produce the representative data necessary to develop an adequate understanding of gaseous - phase circulation processes, and the Plan provides no alternative plans if the one site proves less than satisfactory. In addition, the Plan fails to provide a justification that an understanding of the gaseous phase circulation process at the one site can be extrapolated with reasonable assurance of representativeness to the boundary of the accessible environment surrounding the repository.

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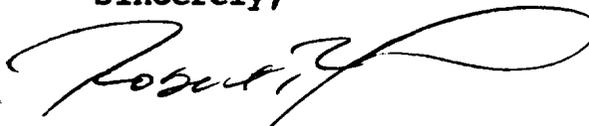
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2. The accomplishment of this Plan will require acquisition of a number of permits, the least of which is an underground injection permit for the use of gaseous tracers. Nowhere in the Plan is there a discussion of the need for permits and the schedule to acquire the permits.

We look forward to your response to the State's comments. Should you have any questions, this Office is available to meet with the Department at any time.

Sincerely,



Robert R. Loux
Executive Director

RRL:cs
Attachment

cc: Carl Gertz, YMPO
Joe Youngblood, NRC
Dade Moeller, NRC-ACNW
Don Deere, NWTRB
Steve Kraft, EEI
Dwayne Weigel, GAO

ATTACHMENT

The State of Nevada comments on Study Plan 8.3.1.2.2.6
"Characterization of the Yucca Mountain Unsaturated - Zone Gaseous
- Phase Movement"

1. In Section 1.2 - Objectives of the Study, the Plan states "This Study was developed in response to the recognition, following a presentation by Doral Kemper (Kemper and others, 1986) in January 1986, that potential exists for substantial topographically affected gas circulation through Yucca Mountain. Presently, the phenomenon is little recognized, and its potential significance to repository performance is unknown." The State could agree with the second sentence if the Study Plan was written in 1986, but according to the approval form which accompanies the Study Plan, the Plan was prepared in 1990 and approved in 1991. The reference list (Section 6.0) identifies literature discussing topographic effects on gas flow at Yucca Mountain as far back as 1987 and continuing to 1990. A review of this literature indicates that the first measurement of rock gas on Yucca Mountain was taken in February 1986 (Thorstensen and others, 1990). This review suggests to the State that the research described in this Study Plan has been on-going for six years, and as such "the phenomenon" has long since been recognized and appears

well documented in the literature. This Plan appears to be an attempt to backfit a "required" study plan to a pre-existing Yucca Mountain study. The Plan at a minimum should recognize the on-going study and present the data collected to date and its significance in meeting the study objective.

2. The study will focus on collecting data from one site on Yucca Mountain containing two existing boreholes, USW UZ-6 and USW UZ-6s. The referenced literature indicates that the first recognition of rock gas circulation was in these two boreholes. The Plan states that these two boreholes will be studied because they provide a "target of opportunity" to study gaseous - phase circulation. The Plan contains no discussion as to why the two boreholes are appropriate to study gas circulation, other than unique availability. Are other existing boreholes more appropriate but not available? The Plan should recognize that as other holes are drilled during site characterization which also exhibit similar behavior, the study could be expanded to instrument those holes and perform similar studies.
3. In the Section 1.3 - Regulatory Rationale and Justification, the Plan states that the gas circulation process understanding and methods developed in this study will be used in the studies of unsaturation zone percolation, both surface-based and in the underground exploratory facility, and in the study

of hydrochemical characterization of the unsaturated zone. Section 5.0 - Schedule and Milestones does not seem to recognize the commitment to coordination and input implied in the statement in Section 1.3

4. Also in Section 1.3 the last paragraph states: "This Study Plan updates and substantially shortens the list of regulatory and design issues to which this investigation applies, based on current thinking." What is the meaning and significance of this statement in meeting regulatory requirements?

5. On page 2.1-1 the following statement is made: "Technical rationale for the study of the unsaturated-zone, gaseous-phase movement is to quantify gaseous flow through and water-vapor flux from the unsaturated geohydrologic units of Yucca Mountain. Significant topographically-affected convective gaseous flow that is driven by seasonal atmospheric-density differences and by geothermal heat may occur through the unsaturated fractured rock comprising Yucca Mountain. The primary concern of this circulation, in terms of radioactive waste disposal, is the possibility of substantially accelerated gaseous radionuclide transport from the repository horizon to the atmosphere. "How will a study of gas circulation in boreholes UZ-6 and UZ-6s accomplish the objective of quantifying gaseous flow through and water-vapor flux from the unsaturated geohydrologic units of Yucca

Mountain? The tests described in this Study Plan will only quantify gas flow and flux at UZ-6 and UZ-6s.

The second sentence conveys a suggestion that topographically-affected convective gas flow is occurring at Yucca Mountain. A definite substantiated claim of topographically-affected convective gas flow can be made from the references cited in Section 6.0 of the Study Plan. Kemper and others (1986), Kipp (1987a), Kipp (1987b), Thorstenson and others (1990), Weeks (1987), and Yang and others (1985) are examples of the references from the Study Plan which present evidence to support topographically-affected convective gas flow.

The third sentence is a succinct statement of the issue related to gas and vapor flow at Yucca Mountain. Why is this primary concern not addressed as an issue under the regulatory section (Section 1.3)?

6. Also on page 2.1-1 the following statement is made:

"However, under conditions that would prevail if the repository were constructed, gaseous-phase circulation should be greatly enhanced by the high rock temperatures produced by heat from the waste." Given that statement, how will repository thermal loads be considered in assessing the adverse effects of gas circulation on site performance? More specifically, is it the intent to add the results obtained for

net vapor transport due to topographic effects and barometric pumping to the thermal loading of the proposed repository to yield an total drying effect?

7. On page 2.1-4 the Plan acknowledges that numerous data has already been collected relative to the gas circulation question, and indicates that large quantities of gas circulate through open boreholes at Yucca Mountain. The Plan further indicates that the monitoring of these open boreholes will lead to an understanding of gaseous-phase circulation and its effects on subsurface moisture and chemistry. The Plan does not address how the data obtained from the open boreholes are related to the natural convection to estimate drying after repository sealing?

8. On page 2.2.1 the statement is made: "The study is not intended to be representative of the repository scale, but to develop an understanding of potential gas-flow effects on repository conditions." Given that the study is not intended to be representative of the repository scale and will focus on a site which maximizes the topographically-affected gas circulation, are there to be additional studies which will be undertaken to obtain data which are representative of repository-wide gas circulation and is readily scaled up to the repository scale required for performance assessment?

9. Section 3.1.1 lists the objectives of the gaseous-phase circulation study. Item 6 will be the development and calibration of a model for gas circulation beneath the western part of Yucca Mountain. How does the DOE propose to verify and validate the model developed under objective 6? What are the plans to develop and calibrate a model for the eastern part of Yucca Mountain?
10. Section 3.1.2 discusses the rationale for the selection of this activity. The rationale can be summarized as a regulatory requirement to understand transport of gaseous radionuclides at Yucca Mountain. The Section fails to discuss the rationale for the selection of only one site (UZ-6 and UZ-6s) for study. The text states that additional boreholes at other locations will only be studied if gas-phase studies indicate that moisture and/or gaseous-radionuclide transport in the unsaturated zone is potentially significant. The assumption is that the UZ-6 site will be definitive as to whether gaseous radionuclide transport is a problem. The study contains no plan if the results of UZ-6 site studies are inconclusive, and thus the significance of gaseous transport cannot be determined. What is the decision process which will be used to determine if additional studies are warranted? Are there any plans to obtain information on gas circulation at Yucca Mountain from the exploratory study underground ramps and drifts?

11. The gaseous-phase circulation study will collect data on gas flow to or from boreholes USW UZ-6 and USW UZ-6s. As part of the study, a variety of tracer-tagged divergent and convergent tests will be performed. Because the time required to reequilibrate back to baseline conditions (before presence of open boreholes) is not known as are the baseline conditions, a concern is that the divergent, convergent-divergent, and convergent tests, that require open boreholes for extended periods of time, will interfere with other tests in the unsaturated zone such as the hydrochemical characterization tests. The hydrochemical characterization tests involve sampling the aqueous and gaseous phases at various locations around Yucca Mountain in the vadose zone of the repository block, and if the gaseous-movement tests using tracers perturb the unsaturated zone as is suggested by the discussion, then will the results of the hydrochemical tests be valid? What studies have been performed to ensure that the tracers contemplated to be used in the tests will not adversely affect the hydrochemistry of Yucca Mountain? What provisions are being considered to ensure that the hydrochemical tests results will be valid?

12. The Plan does not identify the tracers to be used in conducting gas flow tests at the UZ-6 and UZ-6s site. The Plan mentions that atmospheric fluorocarbons (F-11 and F-12) have been used previously in other regions to determine

diffusion parameters in unsaturated rocks. One can only assume from the discussion that fluorocarbons will be the tracers of choice. Given that the President of the United States has recently by Executive Order banned the use of fluorocarbons in the United States, the Plan should be revised to substitute "environmentally-friendly" gaseous tracers for use in the gas flow tests. The Plan should also acknowledge that an underground injection control permit from the State of Nevada will be required prior to the conduct of tracer-tagged tests.

13. A major problem of this study is to determine the magnitude of natural flow through the fractured rock in response to thermal-topographic and barometric effects. As stated in the text (page 3.1-13), this is a problem because the effects are small and are complicated by the extreme spatial variability of the fracture network. It would appear these are two valid reasons why the results of gas circulation tests at one site on Yucca Mountain cannot be extrapolation with reasonable confidence across the geologic repository operations area. The Study Plan remains overly optimistic as to results achievable based on data from one site only.

14. Section 5.0 - Schedule and Milestones states that the field-work scheduled is governed by the schedule for stemming UZ-6 and UZ-6s. The Section should acknowledge that the field-work

schedule is also governed by receipt of a UIC permit from the State for use of tracers in gas flow injection tests.