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January 22, 1991

John W. Bartlett, Director
Office of Civilian Radioactive
Waste Management
U. S. Department of Energy
Washington, D.C. 20545

Dear Dr. Bartlett:

The State of Nevada has reviewed the DOE Study Plan "Characterization of Flood Potential and Debris Hazards of the Yucca Mountain Site" (Study Plan 8.3.1.16.1.1) and the cited references 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's primary concerns regarding the subject Study Plan are summarized as follows:

1. In response to the study and evaluation of hydrological events being an inexact science, the DOE's Study Plan proposes to rely more on expert judgement, than data collection and analysis in determining flood magnitude and frequency.

2. The stated purpose of the study is to describe and outline the strategies to evaluate flood and debris hazard potentials at Yucca Mountain and the proposed repository surface facilities. The objective is to provide data to achieve a safe level of design of these facilities. Yet it is the State's understanding that the exploratory shaft facility (ESF), repository surface facilities, and the geologic repository are presently undergoing design, obviously without the required input data proposed to be gathered by this Study Plan.

3. The scientific investigation interfaces between site characterization and environmental protection required by the DOE Systems Engineering Management Plan have not been documented in this Study Plan. This concern has been identified to the

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Department in State comments on other study plans, but has yet to be addressed in a substantive manner.

We also note a lack of clear interface between this and associated study plans with the need for an approved Flood Plain Permit prior to construction of an exploratory shaft surface facility. Much of the Study Plan's deficiency, including the lack of environmental analysis, summarized above is applicable if the objective of this and associated study plans were simply to establish the basis of a Flood Plain Permit for first, the exploratory shaft surface facility, and then later, a repository surface facility.

Should you have questions, this Office is available to meet with the Department to discuss the State's comments at any time.

Sincerely,

Robert R. Loux
Executive Director

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

ATTACHMENT

State of Nevada detailed comments on DOE Study Plan 8.3.1.16.1.1 "Characterization of Flood Potential and Debris Hazards of the Yucca Mountain Site".

1. CHARACTERIZATION OF FLOOD POTENTIAL AND DEBRIS HAZARD

The Study Plan states that the purpose of the study is to describe and outline strategies to evaluate flood and debris hazard potentials at and near the Yucca Mountain Project (YMP) site. The objectives that are stated in the Study Plan are taken out of the Department of Energy's (DOE) Site Characterization Plan (SCP) for the Yucca Mountain site, Nevada, Research and Development Area, Nevada. The objectives of the Study Plan are to: 1) determine the magnitude and frequencies of major flood events that can potentially occur during the period of repository operation; 2) identify all potential areas of inundation; and 3) determine quantities and characteristics of debris transported by flooding. However, later in the Study Plan the objectives appeared to be redirected to assessing flood and debris hazards at or near areas of potential repository surface facilities and to allow adequate design of the facilities to reduce hazards to an acceptable level. The former objectives, while being rather straightforward, are very broad in scope in terms of what will be achieved; and one could question whether they are practicably achievable. The scope of the latter objectives, however, is phrased in a more limited manner yet serious practical deficiencies exist with the Plan that will probably limit the achieveability of the desired results.

The Plan admits that from previous work (Squires and Young, 1984), projected 500-year floods could exceed the high banks of Drill Hole Wash; and obviously, this is a Potentially Adverse Condition, as defined by 10 CFR 60.122. The Plan does not commit to evaluate this previous work and determine the presence or absence of this adverse condition. The Study Plan only states that it will be necessary to show that this Potentially Adverse Condition will not significantly affect the ability of the repository to isolate waste. Examination of area topography maps clearly indicates the potential hydraulic interaction of Coyote with Drill Hole Washes. Since Coyote Wash hosts the Exploratory Shaft Facility (ESF), it is critical to the overall repository project that the resultant water-surface profiles be accurately ascertained for various storm events throughout the Drill Hole and Coyote Wash regions.

The activities of the Study Plan will consist of four tasks: 1) flood and debris transport characterization; 2) hydrologic modeling; 3) assessment of potential future flooding and debris transport; and 4) analysis of Yucca Mountain flood data. Information from other studies will be used to

determine the design and performance parameters of this study. Throughout the Study Plan, there is reference to the relationship of the Study Plan to other study plans from the SCP, such as 8.3.1.2.1 - Surface-runoff monitoring, 8.3.1.2.1.2.2 - Transport of debris by severe runoff, 8.3.1.5.2.1.1 - Regional paleoflood evaluation, and 8.3.1.5.2.2.1 - Analysis of future surface hydrology due to climate changes. In addition, the Study Plan refers to the use of site characterization data from this study in resolving other performance and design issues based on SCP 8.3.2 to 8.3.5. Unfortunately, sufficient accurate historical hydrologic and hydraulic data for the Yucca Mountain region simply does not exist. As such, within a limited period of time, it is questionable whether the objectives of the planned study activities will be clearly achieved. It is our speculation that much ESF and repository design work will be performed utilizing premature and often inadequate data.

2. USE OF STUDY PLAN DATA FOR FACILITY DESIGN AND WORKER SAFETY

Historically, all analyses of flood potential in the area of the YMP have not been based on local stream-flow data since there has been very little available. The Study Plan refers to the sections of the SCP which summarize the current data on flood history, future flooding potential, and projected study plans at the YMP. The Study Plan states that further study and evaluation is necessary in order to adequately design surface facilities and to assemble information necessary for the safety of workers and facilities.

One of the greatest potential failures of a repository system at Yucca Mountain is the flooding of the underground facility which would result in probable contaminant migration to the accessible environment. The likeliest methods of water intrusion into the repository are via entrance flooding and infiltration, both of which are hinged upon the location of the ESF and any future ramp/shaft openings with respect to potentially flooded or inundated areas. Interestingly, before any study plans are implemented to accurately quantify and assess the hydrologic and resultant hydraulic events at Yucca Mountain, the ESF and repository design are proceeding, given an expected or prematurely planned shaft(s) location. In the near future (over the next five years for example), little, if any, significant historical data will be collected; and the achievement of a successful flood analysis is highly speculative, leading one to conclude that many of the activities proposed, such as the construction of an ESF, will be based upon inadequate site-specific hydrologic data. Nevada has commented previously on the issue of flooding at the ESF (see Loux to Gertz letter dated September 19, 1988.)

The first stage of flood analysis will be the determination of peak-flow magnitudes and zones of inundation from the PMF resulting from channelized and sheet-flow drainage, using a

relatively simple precipitation-runoff model based upon the unit hydrograph concept of stream flow. This is in keeping with ANSI/ANS, 1981 requirements for incorporating this method of flood-hazard analysis in planning and construction. Currently, this work is proposed to be contracted out to the U.S. Bureau of Reclamation.

The methodology proposed for the hydraulic analyses in the Yucca Mountain area is proposed to utilize standard computations such as the Standard Step Method. The most common form of water-surface profile calculations utilizes the U.S. Corps of Engineers' HEC-2, Water-Surface Profiles, computer program. HEC-2 utilizes the Standard Step Method for calculating water-surface profiles for steady, gradually varied flow in open channels. The Bernouli Energy Equation is utilized as the basis for the solutions derived with energy losses due to friction evaluated using Manning's Equation. Basically, four key elements are needed for the development of an accurate model: 1) the discharge and flow through the channel for which a given profile is desired, 2) the starting or downstream water-surface elevation, 3) the geometric properties of the channel at various cross sections, and 4) the channel's roughness coefficients. It should be noted that the Standard Step Method (HEC-2) is intended for calculating water-surface profiles for steady or gradually varied flow. Flows in arid regions such as Yucca Mountain, in many instances, do not display such flow characteristics. In fact, the resultant flow from an extreme storm event in Coyote Wash, for example, would be expected to be nonuniform and have an extremely high intensity and short duration. The DOE proposes no other alternative methodologies more appropriate for Yucca Mountain conditions.

While a backwater analysis using the Standard Step Method can prove extremely useful, prudent judgement must be employed to account for the short duration and high intensity of a hydrologic event at Yucca Mountain that would result in significant sediment and debris transport, which, in turn, can greatly affect nearfield (short reach) water-surface profiles. This is one of the major concerns with assessing the PMF or performing any flood analysis, as associated with the location of the ESF shaft openings. Furthermore, in question would be the starting water-surface elevation at the intersection of Coyote and Drill Hole Washes used to calculate the upstream water-surface profile in the region of the ESF, because grave errors may exist in the calculation of the water-surface profile through Drill Hole Wash.

The lack of perennially-flowing streams and the paucity of historical stream-flow data means normal stream-flow and flood-flow analysis techniques are inapplicable. Therefore, the activity will also include a search for the existence of applicable knowledge and techniques or possible development or modification of the most acceptable techniques. Various

methodologies will be compared and the best of these are proposed to be selected to predict flood-magnitude potentials at various time intervals. These calculated flood events shall then be compared to the PMF predictions. There is much speculation (or confusion) at this point as to which methodology is going to be utilized to predict the flooding potential. A hybrid of these analyses by various methodologies should not be subjectively synthesized into a single prediction based upon a given storm event.

Several hydrologic methods which will be evaluated that are mentioned in the Study Plan include: 1) Log-Pearson Type III; 2) regional Envelope Curves; 3) National Envelope Curves; 4) Regional Statistical Analysis; and 5) Statistical and Deterministic Watershed Models. However, the unusual nature of runoff in this arid area raises concerns about the validity of applying flood-analysis techniques that were developed and proven valid for use in strikingly different hydrologic terrains. In addition, paleoflood data, which will be collected in other study plans, cannot be used quantitatively in flood-potential estimations because of its semi-quantitative nature.

3. INTEGRATION OF FLOOD POTENTIAL AND DEBRIS HAZARD EVALUATION

Debris transport, in relation to the hydraulic action of major storm events, plays a very important function with respect to the conveyance characteristics of open channels and washes. Significant studies have been made in attempt to analyze the behavior of sedimentation and debris transport as they directly relate to such hydrologic events. At the Yucca Mountain site, as is common in other similar climate regions with similar topography, intense storm events characteristically result in significant sedimentation and debris transport and deposition, which routinely affect channel and wash hydraulic characteristics. In some instances, channel behavior is improved; yet, in other instances, depending on location of deposition, the alteration of channel and wash hydraulic characteristics can be detrimental to the conveyance of storm water during a flood event. This is, of course, extremely troublesome when considering the location of the ESF facilities as currently planned. The Study Plan activities do not appear to adequately address the significant impact of sedimentation and debris transport. At this point, it is questionable whether the proposed study activities will adequately address the interaction of transport phenomena with the flooding potential throughout the Yucca Mountain region.

4. UNCERTAINTY IN FLOOD POTENTIAL AND DEBRIS HAZARD EVALUATIONS

It is clearly understood that the study and evaluation of hydrology is by no means an exact science. The evaluation of a site's hydrologic characteristics is a function of

historical data, representative data, the accuracy of the known regional climatological behavior, and of many other factors such as soil characteristics and topography, all of which contribute to the determination of watershed delineation and the assessment of major storm events. In many instances, the determination of hydrological events, especially as applied to engineered systems, is a function of the conservatism employed on the project.

The Study Plan states that the "study will obtain specific data required elsewhere in the project for the design of the systems and components of the repository that are important to safety." The safety referred to is discussed briefly in terms of worker safety and surface-structure safety. By estimating flood magnitudes and recurrence intervals, and quantifying the associated probable maximum flood (PMF) levels, adequate design measures can be implemented to avoid the hazards associated with flood events. However, if a wholly conservative estimate of storm durations, magnitudes, and intervals is not utilized in design, severe catastrophic consequences can arise due to flooding both the surface facilities, and the underground structures.

While the methodologies for calculating the PMF may have become one of the more commonly used methods of determining the worst case flood scenario, there are shortcomings of the PMF which are, first, that it uses present climate conditions, not taking into account climate changes over geologic time, and it has no recurrence interval. Second, the accuracy of the method depends on the determination of the routing of flood flows and estimates of precipitation. Last, much of the methodology used to calculate the PMF does not take into account the sediment component of stream flow. Because of these shortcomings, the long-term collection of data is needed to certify and validate PMF predictions; however, the time required to obtain relevant and accurate historical data exceeds any current time frame proposed for the design of the repository itself. As such, the true validation of the PMF (and other flood events for that matter) will not be achievable during the design and even the construction and operation of a repository.

Since the reliability of flood potential calculations is dependent upon the quantity and ranges of data collected, and on other regional data and knowledge that may be available, the time required for data collection is in excess of the time allotted for repository development. Thus, regional data, paleoflood data, and surface-water models must be included to obtain the best possible results; yet, the Study Plan does not state to what extent and with what weight these additional data will be incorporated into the estimation of flood potential and occurrence. In addition, accurate predictions with current site-specific data are impossible for sedimentation calculations in relation to debris transport and

hazards.

5. SCHEDULE AND RELIABILITY OF STUDY PLAN RESULTS

The collection, validity and reliability of data for this study are not discussed other than by reference to other study plans, as most of the data used in this study will be collected by other plans. The only treatment of this topic in the Study Plan is in the form of tables in the body and appendix of the Study Plan. Since most of the data will be collected from other activities, the validity of this Study Plan will greatly depend on the validity and treatment of the data collection given in the other study plans. Only some supplementary peak-flow data of floods, as they occur, will be collected in this study. Speculation is given to how such accurate flood data will be obtained in a reasonable fashion.

The Study Plan readily admits that because of the nature of the weather characteristics in this area where storm cells of intense precipitation which cause flooding are widely scattered within a storm system, frequent flooding within a region occurs; but infrequent flooding occurs within a given specific drainage area or site. Because of the unpredictable nature of intense storms, and the lack of site-specific data, the likelihood of site-specific flood magnitude and frequency determination is precluded with any significant degree of precision now or in the near future. This, in itself, indicates a lack of credibility for the proposed results from this study.

As in the past, Nevada's comments pertaining to the proposed study activities of hydrologic events at Yucca Mountain yield suspicions regarding whether the proposed activities will provide sufficient reliable data from which to base sound conclusions. It is doubtful that the activities proposed will achieve the desired objectives in a reasonable time frame. The hydrologic evaluation of the Yucca Mountain area and the validation of the analyses performed requires much more time than is currently allotted in the High-Level Waste Program for such activities. Therefore, the Study Plan states, in effect, that the design of surface facilities necessary for the construction of the repository cannot be delayed while flood data is collected. This supports the apparent long-held DOE view that the facilities can and should be designed now, regardless of whether the information upon which the designs are based is reliable or available.

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