Review of U.S. Department of Energy Technical Basis Report for Surface Characteristics, Preclosure Hydrology, and Erosion

Committee for Yucca Mountain Peer Review
National Research Council
National Academy of Sciences
National Academy of Engineering

Presentation to the NWTRB Meeting, Las Vegas, January 11, 1996

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Objectives (from Statement of Task)

To analyze the manner in which the scientific and technical information used in the TBR was collected, analyzed, and interpreted and, at a minimum, to address the following questions:

- Have the data been collected and analyzed in a technically acceptable manner?
- Do the data, given the associated error and analytical uncertainties, support the technical interpretations and conclusions?

Objectives (from Statement of Task)

- Are there credible alternative interpretations that would significantly alter the conclusions?
- What testing, if any would discriminate among alternative technical interpretations?
- If such testing is recommended, how effective would it be at reducing significant uncertainties?

The committee's goal was to help the DOE improve the scientific quality of its TBR.

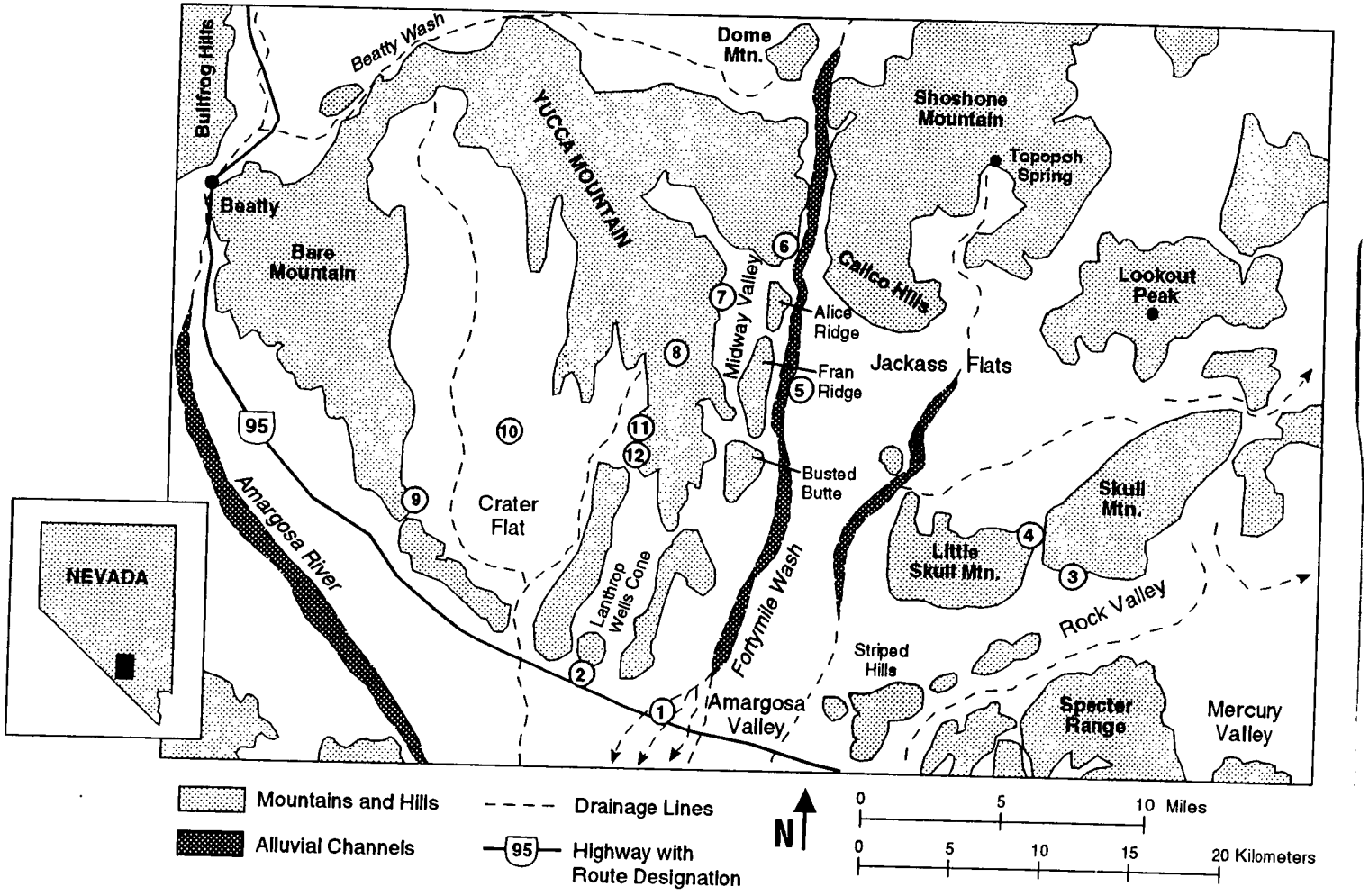
Review Basis

- The committee's evaluation of the TBR is based entirely on scientific judgment.
- In accordance with the charge to the committee, it made no attempt to evaluate the science in terms of management decisions related to the suitability of Yucca Mountain as a high-level nuclear waste repository.
- Again, according to its charge, the committee did not evaluate whether the identified weaknesses in the science would have a significant impact on the management decision to site a repository.

Sources of Information Used in Peer Review

- The Technical Basis Report and supporting materials cited in its Appendix A.
- Oral and written information from the DOE and its contractors, other federal and state agencies, and members of the public obtained at two information-gathering open sessions.
- Discussions with scientists during a three-day field excursion to the Yucca Mountain site.

Field Trip Excursion



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Conclusions

- Distributions and Relative Ages of Surficial Deposits
- Stream and Debris Flow Erosion Potential
- Ages of Hillslope Deposits
- Long-Term Rates of Erosion
- Potential for Surface Flooding
- Potential for Subsurface Flooding
- Water Supply
- Overall Effectiveness

Conclusions: Distributions and Relative Ages of Surficial Deposits

- Identification of surficial deposits is based on traditional and accepted techniques of analysis.
- Better age control is needed on surficial deposits to estimate erosion rates.
- Surficial data from west side of Yucca Mountain (Crater Flat) should be integrated into the TBR.
- Surficial mapping efforts need to be better integrated with efforts to evaluate hillslope erosion processes.

Conclusions: Stream and Debris Flow Erosion Potential

- The assumption that streams are presently in dynamic equilibrium is not supported in the TBR.
- The possible effects of climate change on fluvial erosion should be addressed.
- The effectiveness of debris flows and landslides as erosive agents of the landscape under present and possible future climatic conditions should be addressed.

Conclusions: Ages of Hillslope Deposits

- Analyses of hillslope ages are inadequate because they are based on a single geochronological method (CRD) and are applied to only one type of hillslope deposit (heavily varnished hillslope deposits).
- Different dating techniques (e.g., ^{3}He, ^{10}Be) should be applied to check the CRD results.
- Different geomorphic surfaces should be dated to obtain estimates of the spatial variability of hillslope ages.

Conclusions: Long-Term Rates of Erosion

- Analysis of erosion rates is too narrowly focused on estimating a spatial and temporal average rate for comparison with a regulatory standard.
- The analysis should be expanded to assess the spatial variability of erosion, and especially to identify those portions of the landscape that may be eroding much faster than average.
- The analysis should consider the range of erosion processes operating at the site and the possible effects of climate change.

Conclusions: Potential for Surface Flooding

- The application of probable maximum flood procedures to estimate maximum flood events is consistent with accepted engineering practice.
- The values and assumptions, although not well documented in the TBR, appear to provide for conservative estimates (i.e., overestimates) of maximum flooding depths.
- Nonetheless, more work should be done to assess the sensitivity of the PMF estimates to these values and assumptions.

Conclusions: Potential for Subsurface Flooding

- Subsurface flooding potential from deep seepage of surface infiltration and rising water tables should be addressed in the TBR.
- The distribution, volume, and age of perched water are not adequately addressed in the TBR.
- It does not appear to the committee that perched water will pose problems during the construction and operation of a repository, but the TBR does not make effective use of data to make this point.

Conclusions: Water Supply

- The TBR lacks a clear statement of the technical questions that must be addressed to establish sufficiency of water supply for construction and operation of a repository.
- It is likely that water supply availability can be established by means of bounding calculations, but such calculations are not provided in the TBR.

Conclusion: Overall Effectiveness

The TBR is the product of great national importance: to assess the suitability of Yucca Mountain for the safe, permanent disposal of high-level nuclear waste. Given the importance of this undertaking to the health and safety of present and future generations, the scientific and technical analyses should meet the highest standards of scientific quality. Judged in this context, the TBR is not an effective synthesis of data, analyses, and interpretations.

Recommendations for Improving Effectiveness of the TBR (1)

1 The audiences for the TBR should be identified, and the report should be written to be comprehensible by these groups. The DOE should consider the advantages of writing for a broad audience to help build scientific credibility and public acceptance.

2 The TBR should contain a clear statement of the technical questions to be addressed and hypotheses to be tested for each technical topic.

Recommendations for Improving Effectiveness of the TBR (2)

3 All available scientific and technical information related to the issues addressed in the TBR should be cited and discussed. Essential information (e.g., data and equations) used in the analyses should be provided in the TBR, and primary sources should be referenced.

4 The TBR should provide a complete discussion of the analyses supporting the technical interpretations; alternative hypotheses and methods used to test them, and uncertainties and additional data needed to address them.

Recommendations for Improving Effectiveness of the TBR (3)

5 The TBR should be prepared with the direct involvement of the scientists involved in site characterization studies, and these scientists should be identified in the report. The report should also provide a discussion of how data and analyses were selected and integrated.

6 Multiple methods of analysis (e.g., bounding calculations) should be employed to improve understanding, reduce uncertainties, and thereby build confidence in the interpretations and conclusions.

Recommendations for Improving Effectiveness of the TBR (4)

7 The TBR should include informative graphics to orient the reader and illustrate spatial relationships among elements of the site.

8 Preparation of the TBR should include a process for "internal" peer review by the scientists whose work is used in the report. This process should include provisions to ensure that the results of internal and external peer review effectively feed back into the TBR and, when appropriate, the associated scientific and technical programs.

Reflections on the Process (1)

- The NAS-NRC process worked well and resulted in what the committee hopes will be constructive input for the DOE. The committee believes that the DOE should be commended for seeking external review of its work.
- The review was very demanding on the time of committee members, largely owing to the short schedule and lack of technical documentation in the TBR. Reports that are "self contained" are more likely to obtain more timely and more positive reviews.

Reflections on the Process (2)

- The committee (and NAS-NRC staff) received complaints from several DOE "stakeholders" about the lack of time for input into its review. Allowing additional time (e.g., 1-2 months) for future reviews would provide more opportunity for stakeholder input, especially for the committee nominations process.