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APR 21 1986

Dr. Donald L. Vieth
Director
Waste Management Project Office
U. S. Department of Energy
Nevada Operations Office
P. O. Box 14100
Las Vegas, NV 89114-4105

Dear Dr. Vieth:

As identified in the meeting summary for the Nevada Nuclear Waste Storage Investigations (NNWSI) Project - Nuclear Regulatory Commission (NRC) Exploratory Shaft Design/Construction Meeting held in Silver Spring, Maryland August 27-28, 1985, the NNWSI Project requested (open item #1) the NRC staff analysis of the flooding potential at the exploratory shaft site. The analysis requested is enclosed.

If you have any questions concerning this analysis, please contact King Stablein of my staff (FTS 427-4611) or Ted Johnson of the Hydrology Section, Geotechnical Branch (FTS 427-4490).

Sincerely,

/S/

John J. Linehan, Acting Chief
Repository Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure:
NRC analysis of flooding potential
at ES site

cc: D. Dawson, SAIC, Las Vegas, NV

WM Record File 102.2
WM Project 11
Docket No.
PDR ✓
LPDR ✓ (N)

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Review of Flooding Analyses
Exploratory Shaft Performance Analysis Study
NNWSI

Background

By letter dated July 15, 1985, from Donald L. Vieth to John J. Linehan, the Department of Energy (DOE) transmitted "Exploratory Shaft Performance Analysis Study" (Reference 1) to the Nuclear Regulatory Commission (NRC) staff. This information was to be reviewed by the NRC staff prior to the August 27-28 meeting regarding the exploratory shaft (ES) technical design. At the above meeting, DOE was informed that the flood analyses presented in the report did not adequately represent an upper bound of the flooding potential at the ES site, and that some of the conclusions reached in the report may not be correct or conservative. These concerns were explained at the meeting; however, DOE indicated that a written explanation and analysis of the flood potential would be helpful. The following analysis has been developed in response to DOE's request.

Discussion and Analysis

The DOE analysis of the flood potential at the ES site indicates that no significant flooding consequences would occur, even if all of the surface runoff from many rare floods entered the ES and flowed into the repository room. It was also concluded by DOE that the flood scenarios assumed establish an upper bound of the flood potential at the ES site over a 10,000-year period (Reference 1).

The NRC staff does not agree with DOE that an upper bound has been established. The NRC staff concludes that there are scenarios which could produce volumes of surface runoff in the ES area in excess of the upper bound limits established by DOE. Following is a discussion of the most important considerations which entered into the DOE and NRC staff analyses:

1. Identification of Controlling Flood Scenario

   DOE has recognized that flooding could be a serious problem under certain conditions. These conditions were identified in Reference 1, where DOE states: ..."Because the ES is located on the side of a wash, there is a potential for runoff to enter the shaft following heavy rainfall. In the short term this occurrence should be prevented by engineered drainage structures which will carry the runoff down the wash past the shaft. Over the longer term these structures could be destroyed by erosion, and landslips and settlement could result in impoundment of water near the shaft. In the extreme case that all of the runoff in the wash should flow into the shaft backfilled with coarse rockfill, much of the northeastern part of the repository downgrade from the ES could be flooded.

The probability of flooding part of the repository by flow through the ES is low but not negligible if the shaft is not sealed in some manner..."

The NRC staff concludes that the above scenario. where erosion and subsidence establish a ponding area near the ES, will likely be the controlling scenario in the assessment of flooding potential at the ES site. In addition, the potential for flooding, erosion and subsidence were identified in Reference 2, where engineering measures such as riprap and diversion channels were proposed for construction in the ES area.

2. Use of Routine Flood Events

In order to show that flooding consequences would be minimal over a 10,000-year period, DOE analyzed the effects of many rare flood events, including 97, 100-year floods; 20, 500-year floods; and 1 potential maximum flood. DOE calculated that these floods would produce a total volume of water in the ES area of about 9.4×10^5 M^3 (Reference 1).

The NRC staff adopted a somewhat different approach in the determination of potential surface runoff. This approach was to calculate the total runoff over a 10,000-year period from routine rainfall events. The approach taken consisted of the following:

1. The drainage area of Coyote Wash in the ES area was determined to be 120 acres (Reference 1)

2. The total average annual rainfall in the site area was determined to be approximately 6 inches per year (Reference 1). Much of this rainfall occurs as thunderstorm precipitation (References 4 and 5). No climatic changes over the 10,000-year period were assumed to occur.

3. The amount of runoff occurring over the drainage area tributary to the ES area was conservatively assumed to equal the rainfall. The terrain in the area is very steep and rocky (Reference 2), and the amount of runoff expected to occur from steep, rocky terrain is normally very great, especially during heavy thunderstorm events (Reference 3). Additionally, the flood runoff estimates presented in Reference 4, when compared with the rainfall estimates presented in Reference 5, indicate that runoff/rainfall relationships during thunderstorm events could be very high. In order to obtain an approximation of the total runoff over a 10,000-year period, calculations were performed as follows:

$$\text{Runoff} = 120 \text{ acres} \times 43{,}560 \text{ ft}^2/\text{acre} \times 6.0 \text{ inches/year} \times 1 \text{ ft} \quad 12 \text{ inches} \times 10{,}000 \text{ years}$$

$$\text{Runoff} = 2.6 \times 10^{10} \text{ ft}^3 = 7.4 \times 10^{8} \text{ M}^3$$

However, if the amount of runoff were assumed to be equal to only 10% of the rainfall, or 0.6 inches, the runoff volume would be 7.4×10^{7} M^3. It can be seen that even the smaller runoff volume is much greater than the runoff volume assumed in the DOE analysis. If one considers that approximately equal volumes of water could enter other shafts and ramp entrances over a 10,000-year period, it can be seen that the total volume of water entering the repository could be several orders of magnitude larger than those volumes assumed in the performance analysis. A detailed analysis of the drainage areas and potential for inflow is needed to accurately assess these other entrances.

Conclusions and Recommendations

The analyses presented above were conducted only to demonstrate that DOE has not established a conservative upper bound of flood potential in the ES area and that the magnitude of surface runoff entering the repository could be considerably larger than that assumed by DOE. The analyses should not be considered to establish design criteria for computing flood volumes at this site or any other site.

References

1. U.S. Department of Energy, Sandia National Laboratories, "Exploratory Shaft Performance Analysis Study," July, 1985.

2. U.S. Department of Energy, Office of Civilian Radioactive Waste Management, "Draft Environmental Assessment, Yucca Mountain Site, Nevada Research and Development Area, Nevada," December, 1984.

3. U.S. Department of the Interior, U.S. Bureau of Reclamation, Design of Small Dams, 1977.

4. Squires, R.R. and Young, R.L., "Flood Potential of Fortymile Wash and Its Principal Southwestern Tributaries, Nevada Test Site," USGS Water Resources Investigation Report 83-4001, 1984.

5. U.S. Department of Commerce, National Weather Service, "Precipitation - Frequency Atlas of the Western United States, Volume VII-Nevada," 1973.