UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

JAN 10 1994

Albert R. Chernoff, Project Manager
Uranium Mill Tailings Remedial Action
Project Office
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185

Dear Mr. Chernoff:

The U.S. Nuclear Regulatory Commission staff has completed its review of the bedrock permeability study of the Estes Gulch disposal site, which was transmitted to us by letter dated November 9, 1993. This is the disposal site for the U.S. Department of Energy's (DOE) Rifle Uranium Mill Tailings Remedial Action Project in Colorado. Overall, we found the study to be well documented and conducted in a highly professional and detailed manner. The results reported from the field testing and the computer modeling indicate that long-term water accumulation (bath-tub effect) likely would not occur in the disposal cell, given the best estimates of cover and subgrade conditions. However, it is noteworthy that the current best estimates of the subgrade permeability are more than one-half an order of magnitude less than the preliminary estimates made in December 1991.

After careful review and consideration, we concur in DOE's conclusion that a bath-tub effect will likely not result, if the cover is constructed to a permeability not to exceed 1×10^{-7} cm/sec. However, the closeness between the estimated subgrade permeability value and the designed cover permeability value causes some degree of concern, given the inherent uncertainties associated with the subgrade conditions and the normal variability in constructing earthen covers. As part of your implementation strategy, additional field measurements should be conducted during cover construction and the monitoring period for the sand blanket system, planned for the southern end of the cell, should be extended. These measures should compensate for the inherent uncertainties and provide reasonable assurance that active maintenance will be minimized. The details of our evaluation and additional measures are provided in the enclosure. DOE may also propose an alternative to the above recommendation, such as a test pad construction, which would also provide reasonable assurance of design performance. DOE needs to address this issue in the form of a Class I Project Interface Document or a revision to the Remedial Action Inspection Plan.

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U.S. NUCLEAR REGULATORY COMMISSION STAFF EVALUATION OF THE
RIFLE URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT
ESTES GULCH DISPOSAL SITE

The U.S. Department of Energy (DOE) undertook an extensive field testing program of the bedrock permeability characteristics at the Rifle Uranium Mill Tailings Remedial Action Project Estes Gulch disposal site to evaluate the likelihood of accumulating water within the disposal cell over the 1000 year design life. This phenomenon, called the bath-tub effect, occurs when the subgrade permeability is less than the infiltration flux of the cover material. A bath-tub effect can ultimately cause instability and environmental compliance problems if the saturation accumulates to critical levels. The design permeability (infiltration flux) for the radon barrier/infiltration cover is 1×10^{-7} cm/sec.

The results presented in DOE's report, indicate that the highest average permeability of 4×10^{-7} cm/sec occurs within the Group II subgrade designation, which is less than 100 feet in width. Measuring the absolute permeability, either in the laboratory or field, is nearly impossible because of many physical considerations such as measurement scale, anisotropy, or material deformation (shrinking/swelling). Field measurements provide a better estimate of permeability by accommodating a larger scale in the measurement, but some degree of error is inherently introduced because of the physical uncertainties of the material. Likewise, it is well documented that there is also some degree of error involved in constructing an earthen cover to a specified permeability.

When the difference between the cover infiltration flux and the subgrade permeability is large, for example, one order of magnitude or more, the errors introduced from the above-described uncertainties become insignificant. These uncertainty errors gain significance as the estimated cover flux and subgrade permeability values converge.

DOE's field testing program was well planned and designed in an effort to mitigate as many of the uncertainties as possible. However, even with the great care exercised by DOE, the data from several infiltrometers did not reach a steady-state condition. This unfortunate circumstance only permitted an interpretation of the earlier data from many of the infiltrometer tests, which added to the uncertainty of the analysis. DOE also performed several other types of permeability testing, including air-entry permeameters, in an effort to compensate for the shortcomings of the infiltrometer testing. Location-specific circumstances and material anisotropies limited the usefulness of many of the additional permeability methods, even with the high level of care given to performing these tests. Consequently, the derived permeability value of 4×10^{-7} cm/sec represents a measured estimate with some unquantified inherent error.

DOE simulated the long-term saturation build-up potential in the disposal cell by computer modeling with the UNSAT-2 finite element code. The modeling results indicate that "bath tubbing" would not be a concern with the average subgrade permeability estimated from the field tests. The modeling did not incorporate a sensitivity analysis to address the uncertainties associated with the inherent errors of the subgrade permeability or the constructed cover infiltration flux. Consequently, the following measures should be followed

Enclosure

during the construction of the radon cover, and during the post-construction monitoring period to compensate for the site-specific uncertainties which may adversely impact the performance of the disposal cell:

DOE should establish field controls to assure that the minimum shear strength and hydraulic conductivity requirements of the compacted radon cover are met. It is recommended that the procedures identified by Daniel and Benson (Journal of Geotechnical Engineering, Vol. 116, No. 12, December, 1990) be followed. The methods proposed by Daniel and Benson account for variances between field and laboratory compactive effort not otherwise checked in the field. The recommended approach is based on defining water content-density requirements for a broad, but representative range of compactive energy, and relating those requirements to hydraulic conductivity and other relevant factors. An "acceptable zone" on the compaction curve will be developed for quality control during construction, which should also accelerate construction operations. On completion, DOE should confirm that these methods indicate that the cover design hydraulic conductivity has been met. A reasonable alternative to the Daniel and Benson method, if proposed by DOE, will be considered by NRC staff. During construction, DOE should also confirm that grade stake locations, fill pad interfaces, and other areas of potential high hydraulic conductivity or leakage meet minimum standards.

DOE should extend the post-construction monitoring of the constructed sand blanket to include a period of time that will be adequate to demonstrate that long-term water accumulation will not adversely impact the performance of the disposal cell. The system is currently scheduled for monitoring short-term redistribution of water in the cell. The type of water-level monitoring, duration, and identified action levels can be specified in the Long-Term Surveillance Plan.

Performing these measures will provide reasonable assurance that the disposal cell at Estes Gulch will be stabilized in a manner that minimizes the need for future maintenance as required by 40 CFR 192.02(a)(4); and will comply with the post-disposal monitoring required by 40 CFR 192.02(b).

If you have any questions regarding our comments, please contact the NRC Project Manager, Allan Mullins, on (301) 504-2578.

Sincerely,

Joseph J. Holonich, Acting Chief
Uranium Recovery Branch
Division of Low-Level Waste Management
and Decommissioning
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

cc: S. Arp, DOE, AL
C. Smythe, DOE, AL

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SUBJECT ABSTRACT: ~

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