



United States Department of the Interior

BUREAU OF MINES  
2401 E STREET, NW.  
WASHINGTON, D.C. 20241

January 9, 1984

Mr. John Greeves  
Chief Engineering Branch  
Nuclear Regulatory Commission  
Willste Building, 6th floor  
Silver Springs, Maryland 20555

WM DOCKET CONTROL  
CENTER  
84 JAN 11 PM 12:30

Dear Mr. Greeves:

In accordance with NRC/BOM Interagency Agreement No. NRC-02-<sup>20</sup>~~08~~-075, "Technical Assistance for Assessment of Repository Siting and Design," we are forwarding a review conducted for NRC by BOM's Denver and Spokane Research Centers. The document reviewed was the first draft of an NRC Technical Position on "Waste Package Reliability."

Sincerely,

Harry R. Nicholls  
Assistant Director--Mining Research

Enclosure

WM Record File 623-SS

WM Project 10, 11  
Docket No.           
PDR           
LPDR         

Distribution: JG

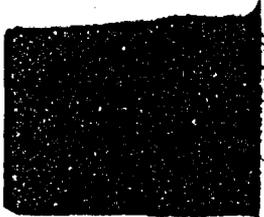
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**ROUTING AND TRANSMITTAL SLIP**

Date

12/21/83



TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. Joseph L. Patrick, Chief, Division of		
2. Health and Safety Technology		
3. Columbia Plaza Room 974		
4. Mail Station 6010		
5.		

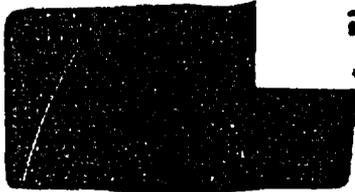
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FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
R. Drouillard DRC	Phone No.



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\* GPO : 1983 O - 391-524 10211

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FPMR (41 CFR) 101-11.206



# United States Department of the Interior

## BUREAU OF MINES

P. O. BOX 25086  
BUILDING 20, DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

December 13, 1983

### Memorandum

To: Chief, Division of Health and Safety Technology, Washington, D.C.

Through: Research Director, Denver Research Center *rlh*

From: Supervisory Geophysicist, Geophysics Division, Denver Research Center

Subject: Technical Review of Draft Technical Position, Subtask 1.2 Post Emplacement Monitoring

We have made a technical review of the subject proposal and we find no major problems with the portions covering radiation monitoring of the waste package. As pointed out in the report, the dominant radiation to be monitored will be from gamma rays coming from the waste packages, but consideration should be given to monitoring the atmosphere of the underground depository for natural radionuclides until closure. This type of monitoring is not covered in the draft.

The report is rather general in its description of techniques for monitoring a variety of parameters related to the depository environment and their practicability is questionable. Nevertheless, we believe that the author has met the goal of giving guidance on the significant problems of monitoring nuclear waste packages after emplacement.

*R. F. Drouillard*  
Robert F. Drouillard



# United States Department of the Interior

## BUREAU OF MINES

SPOKANE RESEARCH CENTER  
EAST 315 MONTGOMERY AVENUE  
SPOKANE, WASHINGTON 99207

December 19, 1983

### Memorandum

To: Chief, Division of Health & Safety Technology, Mail Station 6010

From: Research Director, Spokane Research Center

Subject: NRC Paper Review "Waste Package Reliability"

The subject document has been reviewed, however several general comments are in order. First your December 1 memorandum requests technical review "from your special expertise, as identified in your response to my memorandum of December 10, 1980". Subject memorandum does not cover canister reliability rather addresses mine regulations and mining systems. The reason this is mentioned, is that the subject review document is somewhat beyond Bureau expertise. The statistical methodology is of such a high technical level and uses very specialized engineering equations and concepts that reaches into a rather narrow avenue of science. Given the above, we have reviewed the paper, constrained by our own limitations in nuclear and metallurgical engineering.

We found the paper highly technical, complicated, and sophisticated, but necessarily so. We were able to grasp, to a limited degree, subsections of the paper but do not feel confident about our grasp of the total picture. We had difficulty seeing the forest because of the trees.

We made no attempt to judge the adequacy or inadequacy of the sample mathematical models. Our efforts were centered on evaluating the overall methodology proposed in the paper and on the clarity of presentation. In summary, the methods look good, the clarity could be improved.

The paper's purpose is to provide guidelines and hints to potential applicants for a license to operate a nuclear waste repository. The paper gives suggestions on how to demonstrate that the proposed waste disposal design will satisfy the NRC requirement that the waste package (consisting of the canisters and underground facility) will provide zero release during a containment period of 300-1000 years and thereafter a release no greater than 1 part in 10,000 parts of the remaining waste for the next 10,000 years. Such a task, of course, is a reliability demonstration of the canisters and underground storage facility, or in an equivalent way, a failure analysis of these components.

The demonstration cannot be rigorous and exact because of the many uncertainties involved, particularly the values of environmental variables hundreds of years in the future. The probabilistic nature of the analysis stems from the fact that the future values (1000 to 10,000 years from now) of the model parameters are statistical estimates rather than invariant values. The Monte Carlo simulation method is used to select representative values of the model parameters.

The method consists of identifying the failure modes of the system components, such as the waste container and packing material, calculating the probability of their failure using mathematical models, and propagating this failure value by means of a fault tree scheme to a final probability of failure value for the entire waste disposal design. This overall probability of failure subtracted from one gives the reliability of the system.

The probability of failure for the system components are calculated from mathematical models of the components influencing possible failure. Such components include the temperature, water flow water chemistry, corrosion, mechanical stress, and leaching. These models are combined to form a total performance model for the proposed system. As mentioned, we made no attempt to evaluate the adequacy of these models or their completeness as a group.

These suggested methods for demonstrating the reliability of the proposed waste disposal design are standard operating procedure in the nuclear and aerospace industry. We know of no alternative procedures which would be better (i.e. more accurate) and a quick check with Battelle Northwest confirmed this.

Some specific comments follow:

1. The table on page A.34 is unclear, particularly how it relates to the summary of results on page A.31. Column 1 of the table, the time of canister failure, is understandable, but columns two and three are not. Where are the remaining 456 case results?
2. We would like to see a more clear presentation of the results of their sample problem as well as a good narrative summary interpreting the results and tying together the entire package. The presentation is very disjointed, the parts not being related to one another nor to the whole. Trying to relate the sample section to the theoretical section left us somewhat confused. By leaving their presentation incomplete and hazy, they may have set a less than satisfactory example for potential contractors who are expected to emulate their style.
3. Some of the component models, such as the corrosion one, are more important than others. Weighting factors should be included in the calculation of failure probabilities to reflect this importance.

In conclusion, we find nothing wrong with the proposed method. It seems quite comprehensive and we know of no alternative set of methods for demonstrating the reliability of a proposed design. We did think the paper was more difficult to read than it need be because of the style, English construction, and choice of words. We have no quibble about what was said, but rather about how it is said. We recommend that the paper be sent to a good editor before it is published as a public document.

A handwritten signature in black ink, appearing to read 'D. D. Bolstad', written over a horizontal line.

D. D. Bolstad