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Mr. O. L. Olson
Project Manager
Basalt Waste Isolation Project
U. S. Department of Energy
P. O. Box 550
Richland, WA 99352

Dear Mr. Olson:

The NRC staff and our contractor, Sandia National Laboratories (SNL), have reviewed the Delphi analysis approach as done by Rockwell International and documented in, Delphi Analysis of Radionuclide Release Scenarios for a Nuclear Waste Repository at the Hanford Site, Washington State (RHO-BW-ST-42P) and Disruption Scenario Analysis of a Nuclear Waste Repository on Hanford Site Basalts, Washington State (RHO-BW-SA-311P). In general, we find the approach taken to be a good first effort. The Delphi approach has merit and is valuable enough to be continued. Should DOE choose to utilize this method, the three principal concerns listed below must be considered in further development of the Delphi approach at BWIP. SNL's comments are enclosed to provide detail.

Based on our review of the above two documents, there are three principal ways in which the Delphi analysis needs improvement. First, the Delphi approach should be applied primarily to probabilities of occurrence, rather than consequences. Whenever possible, consequences should be analyzed using traditional scientific methods. Where analysis must be based more on judgment than on physically measurable parameters, such as for human-induced disruptions, the Delphi approach may be appropriate for consequence analyses. Second, the phrases taken from the EPA draft guidelines ("reasonably foreseeable" and "very unlikely") and from the NRC regulatory guidelines ("anticipated" and "unanticipated events and process") have been misinterpreted and misapplied. These terms have similar, parallel meanings. However, in performing the Delphi analysis the terms have incorrectly been manipulated to form a matrix (pages vi and xiv-xv of RHO-BW-ST-42P). Third, experts chosen should have more experience relating to the Columbia Plateau. Experts need to be knowledgeable both in their particular field and in the environment of the case under study.

There are several additional ways in which the approach taken can be improved. More experts should be included in each field. With more experts, a separate Delphi analysis could be performed for each field, followed by an overall analysis by which to rank the likelihood of events considered by all fields. An attempt to involve the public should be made. Perhaps the public's judgment in the area of human-induced events would be appropriate. Another idea to be considered is that of establishing a panel to make periodic updates by reviewing any new information relevant to making probability estimates. The

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panel would be especially applicable to seismology, as new studies may change our understanding of fault movements.

If you have any questions on this letter, please contact Maxine Dunkelman (FTS-427-4685).

Sincerely,

"ORIGINAL SIGNED BY"

Robert J. Wright, Senior Technical Advisor
Repository Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure:
SNL Comments

cc: R. T. Wilde, RHO
R. G. Baca, RHO
J. D. Davis, RHO
R. L. Hunter, SNL
J. W. Bennett, DOE

*See previous concurrence page.

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JOBunting
JTGreeves
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ENCLOSURE

Sandia National Laboratories Comments on:

"Delphi Analysis of Radionuclide Release Scenarios for a Nuclear Waste Repository at the Hanford Site, Washington State," by J. D. Davis, A. K. Ruchal, N. A. Baumann, and O. L. Ervin, 1983, RHO-BW-ST-42P, Rockwell Hanford Operations, and

"Disruption Scenario Analysis for a Nuclear Waste Repository in Hanford Site Basalts, Washington State," J. D. Davis and A. K. Runchal, 1983, RHO-BW-SA-311P.

REVIEW

"Delphi Analysis of Radionuclide Release Scenarios for a Nuclear Waste Repository at the Hanford Site, Washington State," by J. D. Davis, A. K. Runchal, N. A. Baumann, and O. L. Ervin, 1983, RHO-BW-ST-42 P, Rockwell Hanford Operations, and

"Disruption Scenario Analysis for a Nuclear Waste Repository in Hanford Site Basalts, Washington State," J. D. Davis and A. K. Runchal, 1983, RHO-BW-SA-311 P.

Introduction

Our review of these two papers shows that the second is a summary of the first; for this reason, the following comments are directed only at the first paper, although the conclusions apply to both.

We believe that the authors have done a thorough and complete job of the mechanical aspects of carrying out a Delphi analysis. Almost every aspect of what they have done is well documented. If the Delphi technique is to be used in performance assessment, this report could stand as a model of its application. In addition, the report is well written.

We believe, however, that the analysis as a whole has several serious flaws. First, the development of the occurrence probability categories is technically unsound. Second, there is no concrete evidence presented that the 15 expert panelists are knowledgeable about the BWIP site or even about the Columbia Plateau. Third, the disruptive events considered are in large part not events at all. Finally, although the document is called a scenario analysis, there are no scenarios in the ordinary sense of the term.

Occurrence Probability Categories

The occurrence probability categories were developed by combining categories from the draft EPA and NRC standards. This has resulted in some categories that are meaningless because of conflicting probabilites of occurrence. In the category "very unlikely releases-anticipated," "very unlikely releases" are those with a probability >1 in 10,000 and <1 in 100 of occurring in 10,000 years (p. I-6), roughly equal to 10^{-6} to 10^{-8} per year. "Anticipated" disruptions are those that are "credible" in 10,000 years (p. I-7). Surely an event with probability of less than 10^{-6} per year is not "credible." Ten of the 45 disruptive events listed in Tables E-1 to E-4 are described as "very unlikely-anticipated." At the other end of the spectrum, "reasonably foreseeable releases," with a probability of >1 in 100 in 10,000

years have been combined with "unanticipated disruptions." No disruptive events were placed in this category, although it was one of the ones available.

Apparently the panelists also had some difficulty in applying the occurrence probability categories. After arranging the two standards in a matrix, "anticipated" and "unanticipated" were used, in practice, as scalars for the EPA terms (p. II-8). We believe that this difficulty arises from the attempt to combine the EPA and NRC standards in a matrix, when in fact the two standards are parallel. Because the categories are supposedly based on probability, and because the experts were not asked to do any consequence modeling, it would have been better to use only the NRC terms. The NRC terms include only probability, whereas the EPA terms include both probability and consequence.

Selection of Panelists

The expert panelists selected for this study are undoubtedly knowledgeable and well known. We have reservations, however, about the selection process. We agree that some panelists should have extensive knowledge of the geology and hydrology of south-central Washington (p. II-5). Other than the unsupported statement near the bottom of p. II-6, however, there is no evidence that any of the panelists have such knowledge. We reviewed the references of the basalt RSD prepared by Sandia for the NRC (Guzowski and others 1982) and the BWIP SCR (Rockwell Hanford Operations 1982). Only two of the panelists were cited; one paper was a review article on porosity and permeability and the other was a textbook. It seems to us that it is possible that by selecting experts with national and international reputations, the authors may have screened out researchers who have the most site-specific knowledge. Someone who has worked in one area for many years is truly knowledgeable, but frequently unknown nationally.

Some of the comments of the experts testify to this lack of site-specific knowledge. One of the hydrologists "guesses" that the Columbia River has changed course during Quaternary time, but is "not familiar with the geomorphic history of this area (p. C-43). Appendix B is obviously inadequate to provide the panelists with necessary site-specific background information.

We also question the logic of going to considerable lengths to identify experts in several fields and then allowing all the experts to vote on every topic. The experts were asked to disqualify themselves whenever thay felt unqualified; however, there is no way for the reader to judge whether someone is qualified outside his specialty, or merely guessing.

Disruptive Events, Conditions, and Processes

The 45 so-called disruptive events, conditions, and processes (ECPs) are a mixture of several qualitatively different kinds of items. Some are actual ECPs; for example, glaciation is a process, and volcanism is an event. Some of the items are site characteristics overlooked during site characterization; for example, an undetected breccia flow or fault. Some of the so-called ECPs are uncertainties arising from lack or sparsity of data, measurement error, or errors of interpretation; for example, estimation uncertainty of greater than one order of magnitude in hydraulic conductivities. It seems to us that ECPs, site characterization problems, and uncertainty should be treated separately. In fact, we do not believe that site characterization problems or uncertainty are appropriately included in scenario analysis. The SNLA risk assessment methodology treats site characterization with RSDs (cf. Guzowski and others 1982) and uncertainty with uncertainty analysis (cf. Iman and Shortencarier 1984). Scenario analysis is so complex that it too is treated separately (cf. Cranwell and others 1982, Hunter 1983).

Some of the ECPs are ambiguous. In response to an ECP on premature shaft faulure, a mining engineer wrote, "If this question means [one thing], the answer is 'very unlikely.' Otherwise, vice versa'" (p. C-11, C.1.6.2). Another ECP elicited the response, "Item 7 is not stated properly" (p. C-12, C.1.7.2.2).

Scenario Analysis

To call an analysis of these ECPs a "scenario analysis," as in the titles of these two papers, is to use the term "scenario" loosely. In general, a scenario is a description of a string of events, conditions, and processes that begins with some initiating event and ends with release to the environment. (For examples of this usage, see Bingham and Barr (1979), Cranwell and others (1982), or Hunter (1983).) Only rarely, as with meteorite impact or drilling that intercepts a waste canister, does the release phenomenon itself give rise to immediate releases to the environment. We have difficulty in stretching this conventional usage of "scenario" to include, for example, estimation errors of fracture permeability (#8, p. xii).

We also believe that it is a serious error to describe and screen scenarios, assign probabilities, and estimate releases all in one step. The most comprehensive scenario analysis of the BWIP site (Hunter 1983) includes much more detailed descriptions of scenarios, and many more scenarios, than this paper. It contains, as a separate but related item, preliminary estimates of probabilities of the scenarios. Even though Hunter's analysis was based on detailed, site-specific information, the number of scenarios that could be screened out was small and no estimate of releases was attempted. Even a rough estimate of releases

usually requires fairly complex calculations. By placing ECPs in the occurrence probability categories, the experts and authors have assumed that any ECP that may occur will result in a release. We do not believe that this is necessarily true, and frankly, we are a little surprised that the authors attempted to include an estimate of releases in an "initial iteration" of their scenario analysis.

We question the advisability of selecting the most adverse disruption for each occurrence probability category for each family (Task 2) and for each occurrence probability category (Task 3) in an initial iteration. Some of the ECPs described require detailed analysis rather than educated guesses.

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Rockwell Hanford Operations 1982. Site Characterization Report for the Basalt Waste Isolation Project, DOE/RL 82-3, Rockwell Hanford Operations, Richland, WA.