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April 15, 1986

DOE RECEIVES NUCLEAR WASTE COMMENTS FROM NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences (NAS) has given general endorsement to the U.S. Department of Energy's (DOE) application of a decision-aiding methodology to help rank possible sites for detailed investigation for the nation's first repository for spent nuclear fuel and high-level radioactive waste. Over the last several months, while DOE has been completing final environmental assessments to accompany the formal nomination and recommendation of sites for characterization, the NAS's National Research Council Board on Radioactive Waste Management has been conducting an independent review of the application of a ranking methodology. DOE requested this review following the suggestion from some states and other interested parties that an independent review be conducted.

"The Board commends DOE for the high quality of the chapters that were reviewed," NAS said in a five-page letter to DOE. "The use of the multi-attribute utility method is appropriate, and the Board is impressed by the care and attention to detail with which it has been implemented..."

Although the Board said it "... is disappointed that DOE did not follow the recommendation ... that independent experts be brought into the assessment process itself...", the letter added, "the Board has seen nothing to indicate bias in the implementation of the method...."

(MORE)

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Ben Rusche, Director of DOE's Office of Civilian Radioactive Waste

Management, said, "We are pleased and gratified that the Board has upheld the soundness of this technical step involved in the ranking process." He added, "The findings of this prestigious body of experts should add confidence and credibility to this important national program."

The Board's letter is attached.

DOE has used the methodology as part of its decision making process. Additional factors and judgments are required to make final decisions about which sites to characterize. They include the diversity of rock types required by the Nuclear Waste Policy Act of 1982 (NWPA) and judgments about the ability to license successfully a site including considerations of waste package performance.

NWPA requires DOE's Office of Civilian Radioactive Waste Management to site, design and construct the first repository and to begin receiving waste for disposal in 1998. As part of the siting process, DOE identified nine potentially acceptable sites in early 1983. In December 1984, DOE issued draft Environmental Assessments on each of the nine sites.

DOE currently plans to issue final environmental assessments in mid-May, at which time three sites will be recommended for site characterization.

- DOE -

R-86-065

NATIONAL RESEARCH COUNCIL

COMMISSION ON PHYSICAL SCIENCES, MATHEMATICS, AND RESOURCES

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BOARD ON
RADIOACTIVE WASTE MANAGEMENT
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April 10, 1986

Mr. Ben C. Rusche, Director OCRWM
U.S. Department of Energy
RW-1/Forrestal
Washington, D.C. 20585

Dear Mr. Rusche:

In response to your August 29, 1985, request that the National Research Council's Board on Radioactive Waste Management (Board) conduct "an independent review of the methodology to be used to evaluate sites for consideration as candidate sites for characterization for the first geologic repository," and your October 30, 1985, specific request that we further undertake an "independent review of [the] application of the methodology," the Board has reviewed portions of the Department of Energy's (DOE or Department) March 17, 1986, draft of the final Candidate Site Recommendation Report (CSRR). The Board has previously provided DOE with comments on the Department's original draft methodology by its letter of April 26, 1985, and comments on a revised methodological approach by its letter of October 10, 1985.

It is neither appropriate nor the intent of the Board to address the ultimate ranking or the recommendation of specific sites, both of which go beyond the implementation of the decision-aiding methodology. Accordingly, the chapters and appendices reviewed by the Board and its consultants were limited to an overview of the decision-aiding methodology, its application to post-closure factors for all five candidate sites, and its application to pre-closure factors at one site. The Board chose not to review, and at its own request did not have access to, DOE's rankings on pre-closure factors, rankings combining post-closure and pre-closure factors using the decision-aiding methodology, or the final recommendation of sites for characterization. Because of the limits on available time and the volume of the documentation involved, the Board did not attempt to review the site-specific data in the draft Environmental Assessments (EAs). To help conduct this review, the Board enlisted the aid of four consultants, three of whom are recognized experts in multi-attribute utility analysis and its applications.

I. THE DECISION-AIDING METHODOLOGY

The Board commends DOE for the high quality of the chapters that were reviewed. The use of the multi-attribute utility method is appropriate, and the Board is impressed by the care and attention to detail with which it has been implemented. It should be noted, however, that the Board's focus was on

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methodology and its implementation and that the Board has not reviewed in detail the data and judgments on which the conclusions from the multi-attribute procedure are based.

While recognizing that there is no single, generally accepted procedure for integrating technical, economic, environmental, socioeconomic, and health and safety issues for ranking sites, the Board believes that the multi-attribute utility method used by DOE is a satisfactory and appropriate decision-aiding tool. The multi-attribute utility method is a useful approach for stating clearly and systematically the assumptions, judgments, preferences, and tradeoffs that must go into a siting decision. The Board strongly supports the DOE position that the methodology is best applied only as a decision-aiding tool and that additional factors and judgments are required to make final decisions about which sites to characterize. These include the diversity of rock types required by the Nuclear Waste Policy Act of 1982, judgments about the ability to license successfully a site including considerations of waste package performance, and judgments about the best set of sites to choose to assure the highest likelihood of a licensable site emerging from the characterization process.

The Board is disappointed that DOE did not follow the recommendation, made in the Board's April 26 and October 10 letters, that independent experts be brought into the assessment process itself as well as into the review of the process. As noted in the October letter, "The Board is concerned that DOE's use of its own technical experts to assess performance by this subjective method may mask the degree of real uncertainty associated with post-closure issues." The Board has seen nothing to indicate bias in the implementation of the method and recognizes that, in this instance, the DOE sensitivity analysis applied to post-closure issues indicates that the rankings on these issues would not change with reasonable or plausible changes in the parameters and judgments. In other applications of the methodology, however, the results may not be so insensitive to the judgments. In that event the addition of independent experts in the generation of those judgments would be important. A final concern with the review draft remains: the need for additional documentation beyond that included in the March 17, 1986, draft of the reasoning and judgement involved in the choices of the scores and probabilities associated with the various scenarios. On the basis of discussions with DOE staff, the Board anticipates a satisfactory response to this concern in the final version of the CSRR.

II. POST-CLOSURE ANALYSES

The DOE application of the multi-attribute utility method for the post-closure factors provides useful information concerning the Department's current judgment of the expected performance of the sites for the post-closure

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period and on its judgment of the range of uncertainties. The Board reiterates that, when adequate data and validated models are available, conducting a probabilistic "performance assessment" using quantitative models, as recommended by the National Research Council¹, is a scientifically defensible method of integrating and weighting the post-closure factors at each site. In the absence of performance assessments capable of comparing the expected post-closure performance of the sites directly, judgments of experts are appropriately used to develop subjective estimates of the post-closure factors at each site. DOE has implemented this approach using its technical experts and those of its contractors, and it appears to have incorporated information resulting from models on the release and migration of radio-nuclides to the "accessible environment" (as defined by the Environmental Protection Agency (EPA)). The Department has also conducted an extensive sensitivity analysis.

The DOE analysis assesses post-closure performance based on probabilities of releases to an arbitrarily defined and universally applied accessible environment. This approach is consistent with the DOE siting guidelines and follows the requirements for repository performance established in the EPA Standard (40 CFR 191). Because this approach does not take into account the differences among sites in pathways from the EPA accessible environment to the biosphere, and thus the potential consequences of any given release at the accessible environment, the Board recommends that the DOE decision makers consider such differences in addition to the results of the decision-aiding methodology. Chapter 6, which the Board has been told considers decision factors beyond the scope of the multi-attribute utility method, would seem to be the appropriate place to incorporate such consideration for the present decision. If the multi-attribute utility method is applied to a future site selection process, however, the evaluation of relative environmental consequences should become part of the post-closure analysis. Such an approach would facilitate comparison of post- and pre-closure results.

III. PRE-CLOSURE ANALYSES

The pre-closure results are stated in terms of dollar costs; estimated lives lost in building and operating a repository, and performance measures covering esthetic, archeological, biological and socioeconomic impacts. Although the multi-attribute utility method significantly clarifies the

¹ National Research Council 1983. A Study of the Isolation System for Geologic Disposal of Radioactive Wastes. Board on Radioactive Waste Management, Panel on Waste Isolation Systems. National Academy Press, Washington, D.C.

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relative importance of the many factors considered in ranking sites, the reduction of all attributes to a single quantitative scale depends, in this application, upon the value tradeoffs made by DOE staff. In addition to the sensitivity analysis they conducted, the Department decision makers might have found it beneficial in the selection of objectives and in weighing pre-closure factors to draw on value judgments from a variety of sources outside the DOE.

On the basis of the Board's review of the application to a single site, it appears that the expected total repository and transportation costs will have a major, if not controlling, effect on the rankings under pre-closure factors. This recognition of the heavy dependence on cost reinforces the Board's judgment that the principal usefulness of the multi-attribute utility method is to illuminate the factors involved in a decision, rather than to make the decision itself.

IV. CONCLUSIONS

In addition to the multi-attribute decision analysis, there are other factors that must be taken into account in the final decision to select three sites for characterization. These include the diversity of rock types required by the Nuclear Waste Policy Act of 1982, judgments about the ability to license successfully a site including considerations of waste package performance, and judgments about the best set of sites to choose to assure the highest likelihood of a licensable site emerging from the characterization process.

When the Board commented on the Draft Environmental Assessments a year ago, it expressed strong reservations about the methods used by DOE to select sites for characterization. The Department has made substantial progress since then. As stated in the Board's October 10, 1985, report, "...our concern about the appropriateness of the methodology, as expressed in our April 26, 1985, critique of Chapter 7 of the December, 1984, Draft Environmental Assessments, has now been addressed." DOE has now selected a decision-aiding method that the Board believes is appropriate to the complexity and technical uncertainties of the decision the Department faces in choosing sites to characterize.

Although the Board has not seen the final version of the CSRR, those parts of the draft it has reviewed include substantial documentation of the site-ranking method and the way it has been implemented. On the basis of discussions with DOE staff, we anticipate satisfactory responses to our remaining concerns about documentation in the final CSRR.

In its review of the implementation of the site-ranking methodology, then, the Board finds much to praise. It is important to note that the Board

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reviewed neither the data in the draft EAs nor the application of the procedures in which sites were scored and value tradeoffs were assessed. Moreover, DOE did not take the Board's advice, offered twice in writing, to involve outside groups of experts in the site-ranking process beyond this review of the implementation of the methodology by the Board. The Board has seen nothing to indicate bias in the Department's implementation of the methodology and recognizes the value of the DOE sensitivity analysis, but the lack of external input in technical and value judgments could raise concerns about bias.

Despite the limitations in the scope of the Board's review, we believe the methods used in the CSRR provide a sound analytical basis for aiding the site characterization decision. The Board commends the Department of Energy for taking the time and devoting the resources to identify and apply a comprehensive decision-aiding methodology. We believe that the methodology the Department has selected represents "state of the art" and is adequate and appropriate for this purpose. We compliment DOE on its care and diligence in implementing the site-ranking methodology, and encourage the Department to build on the experience it has gained as it continues the search for a geologic repository.

Sincerely,

Frank L. Parker

Frank L. Parker
Chairman, Board on
Radioactive Waste Management

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