



UNITED STATES  
**NUCLEAR REGULATORY COMMISSION**  
 ADVISORY COMMITTEE ON NUCLEAR WASTE  
 WASHINGTON, D.C. 20555

ACNWR-0103

PDR

April 28, 1995

The Honorable Ivan Selin  
 Chairman  
 U.S. Nuclear Regulatory Commission  
 Washington, DC 20555-0001

Dear Chairman Selin:

SUBJECT: THE NRC RESEARCH PROGRAM ON THE ENGINEERED BARRIER SYSTEM

As a part of its review of NRC waste management research programs, the Committee, at its 70th meeting (January 18-19, 1995), heard a presentation and held discussions with members of the NRC staff and the Center for Nuclear Waste Regulatory Analyses (Center) on work related to the engineered barrier system (EBS), including the waste package. The Committee was briefed by and held discussions during its 72nd meeting (March 15-16, 1995), with representatives of the DOE on its work on the waste package. This topic is included in the Committee's program plan of November 1993. The review is based on specific requests from several Commissioners.

These discussions focused on the waste package, particularly on the subsystem criterion of substantially complete containment as specified in 10 CFR Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories." The more than fifty key technical uncertainties (KTUs) and user needs that had been identified in 1993 still represent the bulk of the program guidance for this area of research. Under a technical assistance program, the Center staff had investigated scenarios for the proposed Yucca Mountain repository that would lead to predictions of the hydrochemistry and thermal environment of the waste package; such data were deemed critical to the identification of corrosion phenomena likely to be operative in the repository. In addition, the Center staff has been developing a model based on the concept of a repassivation potential that is aimed at the predictability of long-term corrosion behavior of metallic waste package components. The Committee was furnished with a list of relevant publications and presentations by the Center and the NRC staff. In addition, we heard a brief description of the next phase of the integrated waste package experiment (IWPE) that will be initiated in the beginning of Fiscal Year 1996.

The foundations for ranking research priorities were described as a sequence of studies that are first initiated by the staff under a technical assistance program where issues are evaluated to determine if a research program is warranted. Key technical uncertainties are developed from the results of the technical

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assistance programs, and on this basis research by the Center and the NRC's Office of Nuclear Regulatory Research (RES) is initiated. Currently, prioritization of research topics/areas is based on the experience and judgment of the staff. Although the Committee believes that the use of staff expertise and insight is a fully acceptable means of identifying the scope and nature of unresolved issues, and hence identification of the bases for the KTUs, the Committee recommends that systematic performance assessment of the EBS should be employed to (a) ensure that the full scope of important problems has been identified and (b) define the priorities for research related to the importance of unresolved issues. The use of tools such as the performance assessment of the EBS should be made more visible. This visibility would aid in the comparison of facets of the new DOE program approach and would likely reveal information needs of the Office of Nuclear Materials Safety and Safeguards (NMSS) staff in the review of the expected license application.

In addition, broadly based KTUs have been used for defining user needs and these have been employed to educate the staff and Center personnel to issues expected in the management of the license application and development of the compliance demonstration methodology. Here, too, the exclusive reliance on staff may be adequate at present, but it is not clear how such a process will produce the necessary rigorous evaluation of the DOE documents that the evaluation process for the license application will require. The few (seven) broad KTUs result in almost ten times that many specific key uncertainties which may become initiators for research activities. The NMSS staff is planning for a future review of more than fifty KTUs to determine if they are necessary and relevant. Since the KTUs may only be redefined in the future, the basis of the present program is ill defined and may not be in concert with the new DOE program approach. The Committee urges that the bases for the EBS research program be sharply focused and that all KTUs and user needs be revised and consolidated very soon in order to present a coherent planning base for the implementation of the second phase of the IWPE to be started in the beginning of FY 1996.

The Committee heard the NRC staff and Center discuss the problems of extrapolating results from short-duration corrosion studies to the long-term performance required by the regulatory requirements. The Center staff has developed an approach of using a model based on the repassivation potential as a predictive tool. The identification of the problem of extrapolation of short-term data to long-term performance of the waste package containment system seems appropriate and will very likely be a major issue when the NMSS staff reviews the DOE license application. The rate at which the basic aspects of this model are being developed and tested, and the limited scope of the corrosion studies that fail to include radiation effects, microbial-induced corrosion or consideration of natural earth potentials all lead to our conclusion that this important subject should be placed on a more deliberate and planned

strategic path. In addition, we urge that the strategy for understanding the limitations and uncertainties of extrapolation of short-range data in the corrosion field requires that several approaches be pursued simultaneously. Early elicitation of advice from a wide range of experts in this field could be very useful. Finally, a much more integrated approach to defining program activities must be developed which include the interaction of earth scientists, material scientists, modelers, and performance assessment specialists.

As presented to the Committee, comprehensive plans for the new IWPE appeared to be based on sound planning. The bases for program planning were largely the judgments of the NRC and Center staffs. However, an attempt to make the results of the program useful and independent of the changes in direction of the DOE program could make application of a rigorous performance assessment-based prioritization unwieldy. The Committee is also concerned that the results of activities of a program that will not be started until the next fiscal year and is to function for the five-year period during which the DOE plans to complete and submit its first license application will be far less timely than desirable. If resource restrictions do not allow a more aggressive pursuit of the various parts of the program, a much more deliberate prioritization of projects should be undertaken, being mindful of the time requirements of individual experimental activities.

In conclusion, the Committee believes that the EBS research and technical assistance programs have been able to pursue useful and, in accord with past schedules, timely activities. The changes in the DOE program and schedules may require modifications in the NRC staff approach to program planning, scope, and structure of research dealing with the EBS. These changes include the following:

1. An integrated research program on the EBS should be planned on the basis of performance assessment estimates that also allow evaluation of uncertainties and consequent prioritization of information needs. Such planning should take into account the experimental difficulties of obtaining reliable information, include contributions from sciences and technologies other than corrosion science, and should be scheduled to accommodate the needs of NMSS.
2. Deliberate planning, as described above, needs to include the performance of the entire EBS in comparison with both of the 10 CFR Part 60 subsystem criteria that affect the EBS; namely, the substantially complete containment requirement and the low-release-rate requirement. Little information was provided to the Committee on the latter, leading it to conclude that little attention is being devoted to this topic.

3. The problems of extrapolating short-term corrosion data to the long regulatory timespan fully warrants attention. The approach devised by the Center which will be subjected to expansion and testing may succeed, but should be modified to take into account aspects of the repository environment of the waste package that are currently missing, namely, microbial-induced corrosion, radiation, and earth potentials. Further, the reliance on a single model for this extrapolation appears sufficiently risky to warrant a parallel effort.
4. RES and the Center should ensure that improved coordination among the scientific specialties potentially involved in studying the EBS are brought into the planning process. We strongly recommend that realistic models based on earth science considerations be used to describe the chemical and electrochemical environment of the waste package.
5. Finally, there continues to be some uncertainty and lack of clear strategy on distinguishing between research to be accomplished by DOE and that to be done by the NRC staff and the Center. A clearer delineation of the scope of the KTUs as they are expressed by the user needs would aid in the optimization of staff and other resources in the execution of these and other research activities.

The Committee plans to follow the developments of the new IWPE and the impact of the results of this work on the performance assessment studies and their application. We will endeavor to evaluate the sufficiency of the program once the planning process has become more systematic.

Sincerely,



Martin J. Steindler  
Chairman