
NUREG-1423
Volume 5



A Compilation of
Reports of
**The Advisory
Committee on
Nuclear Waste**

July 1993 – June 1995

U.S. Nuclear Regulatory
Commission

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The Advisory
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Nuclear Waste

July 1993 – June 1995

U.S. Nuclear Regulatory
Commission

August 1995

ABSTRACT

This compilation contains 13 reports issued by the Advisory Committee on Nuclear Waste (ACNW) during the sixth and seventh years of its operation. The reports were submitted to the Chairman and Commissioners of the U. S. Nuclear Regulatory Commission. All reports prepared by the Committee have been made available to the public through the NRC Public Document Room and the U. S. Library of Congress.

PREFACE

The enclosed reports are the recommendations and comments of the U. S. Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste during the period between July 1, 1993 and June 30, 1995. Generally, NUREG-1423 is published annually. Volumes 1, 2, 3 and 4 contain the Committee's recommendations and comments from July 1, 1988 through June 30, 1993.

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Advisory Committee on Nuclear Waste
U. S. Nuclear Regulatory Commission

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

April 8, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: RECENTLY DISCOVERED FAULTING AT YUCCA MOUNTAIN AND ITS
IMPLICATION FOR NRC ON-SITE GEOLOGIC REPRESENTATION

The purpose of this letter is twofold: (1) to advise the Commission on new findings of faulting in the repository block, and (2) to recommend that the Commission expand the capability in pertinent geologic sciences at the office of the NRC On-site Representative in Las Vegas to ensure that the NRC staff is fully knowledgeable about recent geologic findings that could have a major impact on the NRC staff activities in the repository program.

SPECIFIC COMMENTS

1. In conjunction with the 59th ACNW meeting, held in Las Vegas, Nevada, a field trip was scheduled on December 15, 1993, to the Yucca Mountain site so that members of the Committee could be briefed by the Department of Energy (DOE) principal investigators (PIs) on recent studies at the Ghost Dance and Solitario Canyon Faults. In response to questions by Committee members during the briefing on the Ghost Dance Fault, the PI indicated that a new fault, called the Sundance Fault, had been identified by detailed mapping. Although the full extent of the fault had not been mapped, it was determined that the fault intersects and offsets the Ghost Dance Fault, indicating a younger age for the former. The age of the fault may have regulatory significance if movement occurred in the past two million years.

Members of the Committee returned to the site on January 31, 1994, to inspect the fault zone and examine the field evidence for this new fault. They were informed by the PI that field studies led investigators to believe that the Sundance Fault is a zone of faulting at least 245 meters wide, consisting of at least six faults. The Sundance Fault is of potential significance for several reasons.

The presence of the Sundance Fault could adversely impact the areal extent of the repository if the fault zone extends to the depth of the planned repository and if the DOE intends to set back the repository from Quaternary age faults as it has for the Ghost Dance. This matter is supplemented by recent surface geological mapping, which clearly shows that the Ghost Dance Fault, instead of being a single fault, is actually a zone of faults 215 meters wide. Also, indications from the available geologic maps suggest that the Sundance Fault zone may be only one of a family of zones which have not yet been fully identified because of insufficient detail on existing maps of the proposed repository site. These factors indicate that extra site characterization effort will likely be needed to determine the age of the last movement on these faults and to specify the extent of faulting of the proposed repository formation.

The Committee concludes that the Yucca Mountain site may be more disrupted than anticipated. These results strongly point to a need for an increased commitment of staff resources to ensure that the NRC has a timely and comprehensive picture of the configuration of the proposed repository site.

2. The Committee anticipates that near-term activities at Yucca Mountain, including maintenance of the present DOE tunnel boring schedule, may overtax the NRC on-site geologist and the NMSS geology staff. The Committee strongly recommends that more geologists trained in structural geology be part of the staff at the NRC Office of the On-site Representative to monitor and report, in a timely manner, on significant geologic findings. We recommend that the on-site geologic staff have adequate expertise to recognize the potential significance of features uncovered in exploratory studies facility construction and site characterization studies.
3. The work leading to the recognition of the Sundance Fault also brought into focus a problem relating to the interaction between the NRC staff and the DOE. During the January briefing, the Committee was joined by two NMSS geologists. It is our understanding that the NRC staff, without participation in our field trip, would not have received a formal briefing on this feature until May. This delay in obtaining information on newly recognized geologic conditions of such potential importance should not be considered acceptable in view of the need by the NRC staff to respond to activities and findings at Yucca Mountain. The Committee strongly recommends that the Commission urge the NRC staff to study and propose for further discussion with DOE means to expedite interactions between NRC and DOE staffs and to enhance the flexibility available to the NRC staff to effect such interactions.

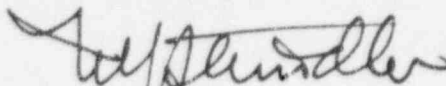
The Honorable Ivan Selin

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April 8, 1994

We trust this information will be useful.

Sincerely,

A handwritten signature in cursive script, appearing to read "M. Steindler".

Martin J. Steindler
Chairman



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

May 27, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: REVIEW OF THE HIGH-LEVEL RADIOACTIVE WASTE PERFORMANCE
ASSESSMENT CAPABILITY OF THE NRC STAFF

In its November 10, 1993 Program Plan, the Advisory Committee on Nuclear Waste (ACNW) recognized the importance of Performance Assessment (PA) to the Commission's responsibilities related to licensing a high-level radioactive waste (HLW) repository. The purpose of this letter is to advise the Commission of the progress made by the NRC staff in developing a capability in high-level waste PA. The Committee is pleased with the progress as demonstrated in Phase 2 of the PA. This evaluation is based on presentations by the NRC staff during the ACNW Working Group meeting held on May 16, 1994, and on discussions during the 64th ACNW meeting held May 17-18, 1994. The following comments are provided:

1. The Committee was impressed with the progress the NRC staff has made in improving its PA capability including computer modeling. The improvements have been in most of the key areas where specific needs were identified in the ACNW letter of December 2, 1991. These needs included the detailing of program goals and means to achieve the goals, the upgrading of the NRC staff's computer hardware, resolution of limitations on key software and data, and assurance of adequate resources to meet future personnel and equipment needs as the PA program evolves.
2. With the completion of Phase 2 of the PA, the NRC staff has taken a major step forward in its capability to review effectively PAs submitted in support of DOE's prelicensing activities such as site characterization and for the licensing application. Despite the advances made by the NRC staff in HLW PA, the computer models and technical data base are not sufficiently developed to allow PA to serve as the exclusive basis for programmatic decisions. However, the PA, even in its present state, is still an indispensable aid in research, technical investigations and site characterization. The Phase 2 effort involved increased sophistication in model and

computer code development, the use of a much more mechanistic and detailed source term model and computer code, more refined modeling of flow and transport in both saturated and unsaturated media, the inclusion of seismic and magmatic disruptive scenarios, and the addition of a dose assessment capability. Specific improvements were observed in such areas as the structuring of scenarios, the treatment of uncertainties and, in Phase 2.5, the eliciting of expert judgment.

3. In order for the NRC staff to continue improving its PA capability, the Committee recommends the following actions:

- Continue to develop simple models that provide an efficient platform to test changes in parameters, subsystem modeling, quality of input data, etc., with respect to the impact on bottom-line results including release rates, dose calculations and health effects. Such models should accommodate the importance ranking of issues for different repository durations and performance indicators. Particular attention should be paid to the propagation of the full range of uncertainties and the transition from the complex to the simple model.
- There needs to be a continued effort to more clearly define the disposition of results obtained from expert judgment panels. The process for eliciting expert judgment was greatly improved during Phase 2.5 of the PA program. An acceptable process for implementing elicitation results by the NRC staff, as well as by the general regulatory community, remains uncertain. This Committee continues to advocate rulemaking on the elicitation and application of expert judgment in order to resolve this issue before submittal of the license application.
- The concept presented by the NRC staff of "confidence building" in the models as a process in model validation, while philosophically appealing, needs clarification with respect to its technical bases.
- The staff is encouraged to anticipate the need to compare performance assessment results between iterations and with other PA results. The comparison of results does not appear to be a major consideration in the performance assessment modeling strategy. The ability to make these comparisons greatly enhances the regulatory review process. In particular, the scoping of the PA needs to be such that the boundary conditions, logic models and parameter values are visible and easily changed. The

important benefit is the ability to efficiently benchmark the results with other assessments.

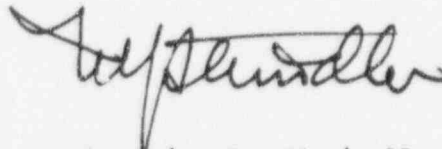
- There needs to be a clearer indication of how the method of successive approximations is applied to the screening process and the identification of "critical issues," i.e., those issues contributing to poor repository performance.

The Committee was pleased to hear of the NRC staff's increased interaction with other agencies, institutions, and especially with the international community.

4. In the NRC staff's PA Strategic Plan, the Committee urges the staff to:
 - clearly delineate tasks that should be completed to ensure a fully developed capability prior to receipt of a license application, and
 - complete the plan for prioritization of PA activities (including the development and weighting of criteria for prioritization) in order to ensure optimum utilization of resources in future PA activities.

The Committee considers a performance assessment capability as key to the carrying out of the regulatory responsibilities of the Commission. Properly performed, PA is essential to giving perspective to technical issues associated with the licensing of the HLW repository. The NRC staff has made impressive progress in improving its PA capability and the Committee recommends continued strong support to obtain results in a timely manner. The Committee intends to keep the Commission advised on the continuing progress to develop this capability.

Sincerely,



Martin J. Steindler
Chairman



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

June 3, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: REVIEW OF THE LOW-LEVEL RADIOACTIVE WASTE PERFORMANCE
ASSESSMENT PROGRAM

The Advisory Committee on Nuclear Waste (ACNW) has developed and operates under a program plan which includes both identification and selection of issues pertinent to nuclear waste management and determination of priorities for the ACNW schedule of activities. Low-Level Radioactive Waste (LLW) Performance Assessment (PA) is specifically identified in the program plan for study by the Committee. This topic is addressed in terms of the activities and capability of the NRC staff and the relation to programs dealing with LLW. These considerations satisfy the Committee criteria for topic selection and prioritization.

The purpose of this letter is: (1) to provide to the Commission the results of the ACNW review of the NRC staff LLW PA program and (2) to provide comments to the Commission regarding the utility, focus and adequacy of the draft Branch Technical Position (BTP) on PA applied to LLW disposal. These evaluations are based on presentations by the NRC staff during the ACNW Working Group meeting held on March 22, 1994, and on discussions during the 62nd, 63rd, and 64th meetings of the Committee on March 24, 1994, April 21, 1994, and May 17-18, 1994, respectively.

- A. Capability of the NRC Staff PA Program Applied to LLW Facilities
 1. The Committee concluded that the NRC staff has a sound and functional understanding of the bases of comprehensive PAs. Further, it was apparent that the NRC staff members making the presentations were knowledgeable in their fields of specialty. The NRC staff appears to have the necessary resources (personnel, computer hardware and software, etc.) to carry out these assessments. The recent consolidation of the LLW and the High-Level Radioactive Waste (HLW) PA staffs should enhance these capabilities as long as the identity and continuity of experience of these teams are preserved.

2. The Committee recommends that the NRC staff seek ways to demonstrate that the PA results it obtains are in agreement with actual data obtained from sites which are sufficiently similar to those encountered in LLW disposal, to establish functional credibility of the NRC PA process and gain additional experience. Such a demonstration would lend additional credence to the presumption that the staff has the appropriate capability. Although such data are difficult to obtain, the benefits from such a demonstration are worthy of a significant effort.
3. The NRC staff is urged to develop a rational basis for the scope and depth of its required capability in performance assessment. Such a position should be submitted to the Commission for review and discussion. The capability requirements are different, depending on the role the staff may take. Clearly, the thrust should be the ability to review a PA for credibility and completeness.
4. The Committee believes that risk calculations from PA should be made using, to the extent feasible, dose models that are applied elsewhere in the NRC for such purposes. The presentations by the NRC staff indicated no such consistency.
5. The Committee agrees with, and strongly supports, the proposed use of probabilistic techniques in the PA process. These techniques are essential to capture uncertainty, to clearly delineate the current state of knowledge, and to serve as a guide to the acquisition of additional data.

B. Branch Technical Position

1. The revised draft BTP represents a significant improvement over the previous version, and the NRC staff should be commended for this effort.
2. The general approach to PA, as described in the BTP, reflects contemporary methods of analysis including the scenario based approach to risk assessment and the treatment of uncertainties.
3. The individual activities of PA are well articulated with respect to such areas as radionuclide transport, engineered barrier performance, source term definition, and dose assessment.
4. The draft BTP should be reviewed and, where necessary, revised to ensure that it is a generic document applicable to a variety of LLW disposal facility types. The draft version forwarded to the Committee for review requires

significant editing to remove prescriptive sections that are either arbitrarily devised or are based on predetermined, but not evident, concepts of an LLW disposal facility. The Committee believes that the bases for excluding from the BTP above-ground vaults and facilities deeper than 30m should be explicitly stated, and alternative sources of guidance to the reader need to be provided in a timely manner if these facilities are not discussed in this BTP.

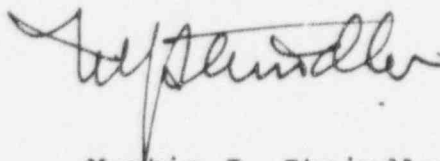
5. We agree with the NRC staff's stated position that PA should adopt a "successive approximation" or "phased" or "iterative" approach. We were disappointed not to see this position more clearly visible in the document. Although the NRC staff alluded to starting PA during the early stages of an LLW disposal facility, this approach was not specifically noted. The Committee favors early application of PA as a means of measuring project progress with each iteration of the assessment and believes this should be reflected in the BTP.
6. The Committee believes that there is significant uncertainty about the required time frame for PA. The presently used arbitrary numerical values (e.g., 10,000y) lack bases in either standards or regulations. The Committee recommends that, as a minimum, the time frame for site-specific PA should be guided by the dose-time profile as depicted in the draft BTP and used in conjunction with an explicit upper time limit. The NRC staff is urged to develop a position on the appropriate time frame and submit it to the Commission for discussion, review, and approval.
7. The Committee believes that the process for elicitation of expert judgment in conjunction with the construction of a PA data base needs to be specified. The NRC staff recognizes the value of expert judgment but does not identify in the BTP specific acceptable processes of expert solicitation. More guidance for the reader of the BTP is needed on the process of transforming expert judgment into a form that is suitable for inclusion in the PA data base.
8. The Committee recommends that in those cases where the BTP describes PA results that have the benefit of uncertainty analyses, the performance indicators be presented accordingly to reflect the full state of knowledge of the results. Specifically, probability distribution functions should be presented rather than simply measurements of the central tendency of the results such as the mean or the median.

June 3, 1994

9. The draft BTP lists specific issues that are not to be included in the PA (e.g., global climate change) but fails to identify the criteria used to exclude these issues. The Committee recommends that such criteria rather than prescriptive specifics be provided to the reader.

We trust these comments and recommendations will be useful.

Sincerely,



Martin J. Steindler
Chairman

Reference:

U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Draft Branch Technical Position on Performance Assessment for Low-Level Waste Disposal Facilities, January 1994



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

July 13, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: DRAFT NOTICE OF PROPOSED RULEMAKING ON DESIGN BASIS
EVENTS FOR THE GEOLOGIC REPOSITORY OPERATIONS AREA

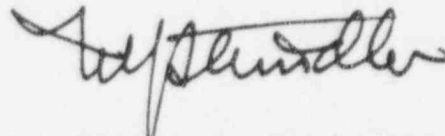
In accord with the staff requirements memorandum (SRM) of February 3, 1994, the ACNW reviewed the subject document and heard presentations by the NRC staff on this topic at its 65th meeting on June 29-30, 1994. The Committee concludes that the draft notice of proposed rulemaking for revisions to 10 CFR Part 60 is satisfactory, and the Committee is in general agreement with the text, the numerical standards, and the definitions. However, the Committee has the following concerns with specific statements and with the compatibility of the definitions with current risk and safety assessment methods. The Committee has discussed these concerns with appropriate staff managers during its 65th meeting:

1. The Committee believes that reference to "maximum potential impacts" in the design basis event definition is not appropriate. The use of "maximum potential impacts" implies upper allowable or existing limits that do not exist and introduces conceptual difficulties akin to those encountered in the past regarding maximum credible accidents in the reactor field. The Committee suggests the staff use a phrase such as "serious impacts" to describe the consequences of events for which design is to be a mitigating factor.
2. The Committee strongly recommends that the Office of Nuclear Regulatory Research carefully review the statements in the rulemaking, and particularly the definitions. We especially believe that a review of the definitions by the PRA staff would provide additional assurance that the rule is compatible with the increasing use of risk-based arguments employed to make more useful the qualifiers such as "unlikely," "moderately," "frequently," and "credible."
3. The Committee notes that while facility design is used to limit the dose to the public from a design basis event, no such provision is invoked for worker protection for a Category 2 design basis event. It appears that the NRC staff intends

July 13, 1994

to use administrative provisions to mitigate the consequences to workers of design basis events. The Committee is concerned that this appears to allow open-ended risk for workers that nevertheless could, in part, be mitigated by additional facility design considerations. The Committee recommends that NRC staff examine regulatory procedures that could increase worker protection.

Sincerely,



Martin J. Steindler
Chairman

Reference:

Memorandum dated February 3, 1994, to James M. Taylor, EDO, from Samuel J. Chilk, SECY, Subject: SECY-92-408 - Proposed Amendments, to 10 CFR Part 60, on Disposal of High-Level Radioactive Wastes in Geologic Repositories - Design Basis Events for the Geologic Repository Operations Area



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

August 24, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: COMMENTS ON HIGH-LEVEL RADIOACTIVE WASTE RESEARCH
PROGRAMS ON VOLCANISM, NATURAL ANALOGS, AND TECTONICS

The purpose of this report is to communicate ACNW observations on three research programs of the Office of Nuclear Regulatory Research in high-level radioactive waste (HLW), namely volcanism, natural analogs, and tectonics. The Committee identified in its November 10, 1993 Program Plan the review of the HLW research program as a priority issue in its support of the Commission's responsibility to license the proposed Yucca Mountain repository. Subsequently, you asked the Committee to examine the relevancy, sufficiency, and timeliness of the HLW research program. This report is a limited review within the broader activity which we are currently conducting at your request. The Committee's review aims to determine the use of the research to the technical basis for regulatory guidance and evaluation of a license application for an underground high-level waste repository. We plan to review other areas in the HLW research program and report these findings to you.

During the past several months the Committee has been briefed by the staffs of the Office of Nuclear Regulatory Research (RES), the Office of Nuclear Material Safety and Safeguards (NMSS), the Center for Nuclear Waste Regulatory Analyses (CNWRA), the U.S. Department of Energy (DOE), and the State of Nevada on their current programs on volcanism, natural analogs, and tectonics. These three programs together receive over thirty percent of the current annual funding for NRC HLW research.

Based on our review and discussions, the Committee views the research programs on volcanism, natural analogs, and tectonics as generally relevant and supportive of the Commission's regulatory mission and sufficient for the intended purposes. Thus, research in these topics deserves continued strong support. Nonetheless, the Committee believes that volcanism and tectonics research should be focused on the application of results to performance assessment (PA) and accelerated toward usable results. The Committee believes the relevance of natural analog studies has not been firmly

established due to the lack, to date, of sufficient integration of natural analog data into PA analyses.

General Comments

As a result of the review to date, we make several comments that appear common to the research programs on volcanism, natural analogs, and tectonics.

1. Program Priorities

The manner in which RES establishes priorities for programmatic areas, as well as for specific projects within these areas, should be improved by use of a risk-based approach. Prioritization of research projects should be rooted in their relevance to the estimated frequencies and consequences and associated uncertainties of specific events or scenarios affecting the proposed repository. Performance assessment will be useful in this effort. The PA by NRC and DOE needs to be a major guiding force for bounding the scope of research issues and establishing relative priorities.

Specifically, it is not evident how PA is being used or contributes to identifying key technical uncertainties (KTUs), user needs, research activities, and those processes, parameters, and assumptions that are most critical to performance. The Committee found little evidence that the studies and associated data are directed at testing assumptions that significantly impact site performance. Making stronger connections between PA and research priorities would improve the relevance and sufficiency of the research program. For example, there are diverse volcanism research activities under way at the CNWRA involving eruption/consequence modeling, studies of volcanic centers, preparation of data bases, and development of probability models for volcanic disruption. These activities need to be prioritized, in part, by a closer linkage to the support or testing of critical assumptions in PA so as to provide timely and usable results.

We recognize quantitative results of PA have only recently become available. Nonetheless, we urge the NRC staff to factor, as quickly as possible, PA results into formulation of the KTUs before new user needs are defined. While we encourage a greater emphasis on use of PA in setting priorities, we caution the NRC staff against basing programmatic decisions solely on PA results, especially until the key PA uncertainties have been explicitly quantified.

The Committee expects to revisit the issue of research priorities and schedules once the DOE Proposed Program Approach (PPA) has been better described.

2. KTUs and User Needs

The Committee believes the NRC staff should expedite the process of fine-tuning the KTUs and clarifying user needs. The need to update user needs is extremely important, as those defined over four years ago are still the bases of current HLW research programs. The NRC staff is now in the process of using Systematic Regulatory Analysis (SRA) to develop its License Application Review Plan (LARP). As a part of the LARP development process, the staff has formulated KTUs for all relevant technical disciplines. While the SRA/LARP process is a welcomed improvement in defining user needs compared to the former, less structured approach, the NRC staff has not completed this process. Many of the KTUs have an excessively broad scope and need to be sharpened. Thus, it was difficult for the Committee to identify how research project objectives and tasks are to resolve specific KTUs.

The NRC staff has indicated that a KTU integration review will be performed in FY 1994. The Committee believes this is very important in prioritizing and refining details of the KTUs and developing new and revised user needs but is concerned that the schedule may be excessively ambitious unless near-term progress becomes evident. The Committee recommends that completion of the integration review and definition of new user needs be given high priority by NMSS. Recognizing that these activities are ongoing, the Committee sees an important opportunity for RES to examine the current relevancy of specific research tasks for both current and future activities, and refocus its research program in response to new user needs.

3. Integration of Research Activities

The interdependence or close coupling of processes under investigation at Yucca Mountain, such as volcanism and tectonics, or tectonics and hydrology, must be evaluated to assess overall repository performance. However, briefings by the NRC and CNWRA staffs did not identify mechanisms in place to bring about such integration.

The existing projects in tectonics and volcanism appear to be focused on understanding discrete processes, as opposed to the interdependency of processes and their relationship to the regional tectonic setting. While the RES staff described a project planned for the future entitled, "Modeling Mantle Dynamics," which is designed to integrate the major tasks in both volcanism and tectonics, the project plan for it will not be developed until FY 1995. We recommend that the required integration should be more rapidly and deliberately implemented.

4. Communication

The Committee has commented before on the need for improvement in communication. We recommend that the RES staff summarize more expeditiously the results of its as well as the CNWRA's research into usable products for NMSS and others. Furthermore, with a few notable exceptions, the research performed by the CNWRA is not widely distributed and generally is not subjected to close scrutiny and peer review by the knowledgeable scientific community. The Committee recommends that NMSS and RES ensure that the results of research completed by the CNWRA receive such peer attention. In addition, the Committee continues to view the communication between the NRC staff and the DOE as unsatisfactory and in need of significant improvement regarding timeliness and level of detail.

5. External Research Activities

The CNWRA and RES are urged to continue to take advantage of opportunities in the use of external personnel to conduct research that is not within the scope of expertise of in-house staff. Several examples of the use of this procedure by bringing research expertise and facilities to bear on specialized problems have shown the merits of the approach. We suggest that benefits of external involvement in HLW research, including cost effectiveness, development of innovative ideas, enhanced program flexibility, and access to research expertise and equipment, merit increased use by RES.

Specific Comments

The Committee is pleased that some research has already proven useful in the guidance of regulatory policies, as background for technical assistance to the NMSS staff, and to stimulate DOE to further its efforts in the volcanism area. The following comments are aimed at increasing the effectiveness of the research activities.

1. Volcanism--This research bears directly upon the regulatory issues of overall system performance (10 CFR 60.112) and a potentially adverse condition identified in 10 CFR 60.122(c)(15). Scenarios of concern involve both direct and indirect effects of magmas that may breach the surface or reach the near surface in the vicinity of the proposed repository at Yucca Mountain. The issues include both the probability of an igneous event in the Yucca Mountain region and the consequences.

NRC's volcanism research is aimed at gaining a better understanding of igneous processes to reduce uncertainty in estimating both the probability and consequences of magmatic

events. The results should lead to development of more reliable models that predict the probability of volcanic disruption and eruptive scenarios and consequences in terms of any eventual transport of radioactive materials to the biosphere. Although preliminary calculations suggest that the probability of volcanism at Yucca Mountain is very low over the next 10,000 years, continued research appears to be justified as the current PA results are based on limited models and data and do not incorporate coupled processes.

- a. Having embarked upon a program to characterize volcanism in the Basin and Range province and to formulate volcanic models for the Yucca Mountain region, RES needs to bring critical aspects of this program to fruition. Specifically, RES needs to formulate expeditiously a set of alternative defensible volcanic and coupled tectonic models that can be used in probabilistic PA and to estimate magmatic effects. RES should continue to concentrate on those parts of the volcanic studies that achieve this goal and, if necessary, limit the overall scope of the program. For example, the Cerro Negro, Nicaragua and the Tolbachik, Russia volcanic analog studies may be of lower priority.

In addition, the Basin and Range province project should not become mired in preparation of Geographic Information System (GIS) data bases, but data bases of an appropriate level of detail should be developed that will enable testing of models for the Yucca Mountain region. The level of detail required and how and when the data will be used should be well established. The NRC staff should have long-term plans for maintenance of and additions to the GIS data bases until they are supported by others.

- b. The Field Volcanism project is wide ranging and appears to be open ended and lacks targets of application. The Committee recommends that the goals of the research, in terms of specific types and uses of data to be obtained, need to be more clearly defined, articulated and limited in the context of realistic expectations considering resources and timeliness.
- c. The indirect effects of magmatism on waste canisters are of sufficient concern that the NRC staff should ensure that these effects are evaluated. The effects of magmatically driven hydrothermal circulation of solutions that may be affected by released volatiles are likely to be important. These effects appear to be readily amenable to modeling and laboratory testing. The Committee recommends that these issues be explicitly

evaluated as to their importance to the goals of the research program.

2. Natural Analogs--This research is directed at systems and processes in a field situation that are considered analogous to the Yucca Mountain geologic setting. This research takes advantage of the large scales, long time periods, and the many and complex interactions that characterize geologic systems. Such processes are difficult or impossible to duplicate in the laboratory.
 - a. Relevancy of natural analog studies is difficult to ascertain because of uncertainties in the initial and boundary conditions of the analogs and complexities in interpretation due to coupled processes. This concern can be dispelled by developing research plans that are closely tied to achievement of regulatory and licensing goals. Furthermore, the data available in the natural setting are virtually infinite, and therefore care must be exercised in the choice of research parameters that are relevant to regulatory concerns. The Committee found that the direct connection between key regulatory uncertainties and data being collected at HLW natural analog sites is not obvious in all NRC projects. The Committee recommends that such nexus be specifically identified for all analog projects.
 - b. Natural analog projects are often conducted and funded in cooperation with other nations. The geological setting of the projects may not be analogous to the Yucca Mountain site. While not negating the potential utility of such projects, the relevance may not be sufficient to warrant the expenditure of resources. The Committee recommends that the expectations and objectives of this type of research be better defined and used in prioritization.
 - c. The use of natural analog data and interpretations in either quantitative PA or model validation needs to be carefully and precisely defined. The Committee is encouraged to learn that RES and CNWRA have recently conducted a workshop on the nexus between PA and geochemical natural analog research. The Committee recommends that this process also be applied to analogs in volcanism, tectonics, and other areas such as the results of ground water movement at the Apache Leap test site in Arizona.
3. Tectonics--This research is important in determining several potentially adverse conditions at the proposed Yucca Mountain repository site that involve seismicity, potentially signifi-

cant faults, movement of gases and surface waters, and ground water levels. In addition, the research provides an overall geologic framework needed to evaluate coupled processes and assess overall site performance.

Tectonics integrates a variety of geoscience disciplines to determine the past as well as present dynamic processes and their effect on the nature of the geologic setting. Understanding these processes requires a knowledge of the regional tectonic framework, far-field stresses and geologic events. The geologic structures resulting from the tectonic processes and the processes themselves impact the nature and integrity of a repository site in a variety of ways. Thus, this research is especially important to NRC's regulatory guidance and licensing concerns. The review of tectonics is exclusive of rock mechanics and seismic hazards.

- a. The tectonics research program of the CNWRA has been in place for a relatively short period and has been largely directed toward literature review, data compilation, definition of research plans, and development and compilation of software for modeling and analysis. These preparatory tasks are completed or scheduled for completion by September 1994, at which point the program will be poised to address critical questions through data analysis and modeling. Tectonics provides the regional picture needed to evaluate other processes, and therefore the Committee recommends that RES accelerate the model development and analysis phase of the program. As a result, it may be necessary to limit the overall scope of tectonics research activities.
- b. The Committee is pleased to see the tectonics research activities take on a regional viewpoint, but extension of the study area beyond the immediate structural province of the proposed Yucca Mountain repository site should only be done with clearly identified goals and strong justification which is currently not available.
- c. The concerns expressed (as discussed in 1.a) regarding the appropriate level of detail, maintenance, and data types of GIS data bases are also applicable to the tectonic data bases.
- d. In view of the continuing concern about the impact of faulting on the integrity of the Yucca Mountain site and about the role of faults in subsurface water movement, tectonics research needs to emphasize the understanding and effects of faults at Yucca Mountain and the nature of faults as a result of the evolution of the regional strain pattern over time. This goal was not apparent to

the Committee in the research plans. We recommend that RES ensure the relevance and sufficiency of the program by inclusion of such plans.

Summary

The Committee's major findings are summarized as follows:

- The research programs in areas of volcanism, natural analogs, and tectonics are generally relevant and supportive of the Commission's regulatory mission in HLW. The Committee supports continuation of HLW research in these areas. However, the HLW research program should be improved to make it more relevant and timely.
- RES should ensure that it has established well-defined, risk-based priorities for its programs. In addition, RES should develop a mechanism for establishing that those programs are required to support or test critical assumptions of Performance Assessments (PA) and Key Technical Uncertainties (KTUs). In particular, research efforts should be tied more closely to PA in an iterative manner so that assessing relative risk of a phenomenon becomes an explicit part of the research planning process.
- The current transition period when KTUs and user needs are being developed using Systematic Regulatory Analysis (SRA) is an excellent opportunity for RES to take a prominent leadership role in refocusing the research objectives in response to the new KTUs as well as potential changes in the DOE Yucca Mountain program.
- Integration between research projects that address discrete phenomena but are closely coupled, such as tectonics and volcanism needs to be strengthened to assess the overall performance of the proposed Yucca Mountain repository.
- More effective communication of research results within the NRC and with the larger scientific community is essential for the contemplated use of the program results.
- The benefits of research external to the CNWRA, such as cost effectiveness and availability of specialized research expertise and equipment, merit continued use of such projects by RES.


We are pleased to note that many of the points raised in this report are recognized by the parties involved in the HLW program. However, we believe action is warranted which will lead to improving the effectiveness and timeliness of the program. Future reports to the Commission will detail observations and recommenda-

The Honorable Ivan Selin

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tions on other specific HLW research programs that will serve to support and refine the general observations made herein.

Sincerely,



Martin J. Steindler
Chairman



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

September 30, 1994

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

Dear Chairman Selin:

SUBJECT: GENERAL COMMENTS ON THE IMPACT OF THE DEPARTMENT OF ENERGY'S PROPOSED PROGRAM APPROACH ON THE NRC'S HIGH-LEVEL RADIOACTIVE WASTE LICENSING ACTIVITIES

The Advisory Committee on Nuclear Waste (ACNW) has reviewed information on the Department of Energy's (DOE) Proposed Program Approach (PPA). This subject was discussed during our 66th and 67th meetings and included presentations by staff members of the NRC and DOE. The information obtained from the DOE and the NRC staff was supplemented by draft documents and responses to specific questions posed in writing to DOE by other organizations such as the Nuclear Waste Technical Review Board. This letter provides general comments on the broad outlines of the PPA program as we understand it.

DOE's PPA for the Yucca Mountain area will result in a change of the scope of the repository program to closely match the level of funding and the expected schedules for this program. In general, the Committee is impressed with the objectives of the PPA and in particular with the site characterization process that sharply focuses on the most important issues for site suitability and licensing.

The DOE PPA has not been fully exposed or developed but currently reveals the following attributes.

1. The program seeks to reduce the near-term site characterization studies to a level sufficient to make general findings on the site suitability that can be used to make a recommendation to the President about a repository at Yucca Mountain.
2. In the absence of comprehensive data and model development, DOE plans to use bounding assumptions to bracket the missing data but still allow site suitability findings to be made. It appears that the development and application of models will be based on these assumptions and that estimates necessary for the high-level findings by DOE (i.e., that no significant changes in the "outcome" of the models are expected after

additional data are obtained) will be based on the results of the use of bounding assumptions.

3. The DOE site characterization process will appropriately involve the qualifiers and disqualifiers in 10 CFR Part 960. The NRC regulations concerning siting (10 CFR 60.122) will not play a direct role in forming the conclusions derived by DOE about the site qualification. Present indications are that DOE plans to proceed with site qualification substantially without compelling input from the NRC staff, but DOE has indicated its intent to keep the NRC staff fully informed. Nonetheless, NRC, according to the Nuclear Waste Policy Act, is to provide preliminary comments on the sufficiency of DOE's waste form proposal and at-depth site characterization analysis when DOE recommends a repository site to the President. The protocols for resolving conflicts that arise as a result of this process are not clear.
4. DOE plans to use external peer review panels and is currently negotiating with the National Academy of Sciences (NAS) to organize these panels. The panels are to be assigned to review the technical merits of conclusions formulated from bounding assumptions and codified into topical reports. Whether such reviews may constrain subsequent regulatory actions of the NRC staff is not clear.

We believe that the PPA will substantially affect the activities of the NRC staff and may require changes in focus, schedules, and effort levels. Some of the considerations are as follows.

1. The planned reduction of data acquisition and the accelerated schedule for the submission of an application for a construction authorization following the determination of the suitability of the site as a repository will require greatly increased reliance on the use of expert judgment to support the models used for a description of the performance of the site. In addition, the planned use in the PPA of bounding assumptions when data are not available also places great reliance on the use of expert judgments as the source of estimates for the parameters necessary for the models. Neither the DOE nor the NRC staff has published or implemented validated protocols for the elicitation of such judgments. The site suitability process is developing information that will also be used in the preparation of the license application. We recommend that the NRC staff expeditiously develop generic and detailed protocols for the elicitation of expert judgments. The staff should develop guidelines or even more compelling documents that define acceptable methods of resolving conflicts and uncertainties that arise during the elicitation of expert judgments and are manifested in significant divergences in the resulting estimates.

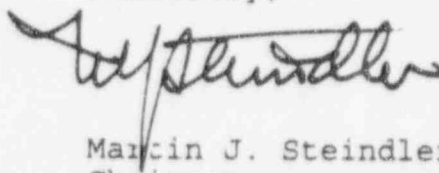
2. Results from the PPA will be utilized in the license application (LA) for construction authorization which is to be submitted to the NRC once the site has been certified by DOE to be suitable for a repository. Although DOE apparently intends to continue to acquire site-related data after the submittal of the LA, the planned use of bounding assumptions will place new and significant burdens on the NRC staff in its review of the LA. The Committee recommends that the role of the high-level radioactive waste (HLW) research program be significantly modified to concentrate on the need to support the NRC staff in the evaluation of the quality, sufficiency, and appropriateness of the assumptions introduced into models in lieu of results derived from data. We recommend that the entire HLW research program be reevaluated and additional resources allocated to ensure that the projects in the program are sharply focused, planned for timely completion, and the scope is sufficiently narrowed to bear directly on information necessary to qualify the model assumptions used by DOE. Similar concerns are appropriate for the technical assistance program.
3. A part of the PPA plan is the use of and reliance on a more robust waste package (i.e., multipurpose canisters with appropriate overpacks) than had been heretofore planned. It is also likely that the LA will be submitted in the absence of a detailed design for the rest of the engineered barrier system (EBS) and much of the repository. Comprehensive information on the performance of the near- and far-field geology in the retardation of radionuclide transport may also be lacking. We believe that the NRC staff should be alert to and prepared to comment on a possible reduction in the reliance on the defense-in-depth approach, which is an important part of the regulatory philosophy for the HLW program. Although we do not believe that the overall safety of the repository needs to be compromised by changes in approach to the defense-in-depth philosophy, the NRC staff should be prepared to defend in regulatory terms its adherence to the original philosophy should it decide to do so.
4. Owing to the close relationship between the repository design (including the design of the EBS) and the performance of the repository system under the full range of likely scenarios, we recommend that NRC strongly urge DOE to prepare, at a significantly accelerated schedule, a reference design of the repository system. This should include, but not be limited to, information on the expected areal heat loading, details of the statistics and physical phenomena on which substantially complete containment is to be based, the use and efficacy of barriers to the migration of waste constituents, the planned geometry and disposition of the waste packages, and the control of processes that could lead to the dispersion of

gaseous waste components. Such a reference design should become available at the earliest possible time but at least before the initial high-level decisions about any of the Part 960 technical guidelines are completed. In the absence of such a design, NRC should convey to DOE its concern about its ability to evaluate the quality of the lower level decisions on any topic pertinent to site qualification.

5. The use of performance assessment (PA) has been fundamental for evaluating the significance of selected phenomena and scenarios and evaluating if the planned repository would meet regulatory requirements. However, the PPA makes it difficult to ensure that PA can be applied in the future in a meaningful manner, particularly since some of the phenomena that are expected to affect the repository will not be sufficiently explored to provide assurance that the basic physical processes are known, pertinent data have not been obtained, or models developed. We recommend that the NRC staff reexamine the role of PA and the development of PA procedures under these circumstances and prepare plans to supplement reviews of the PA results with more sharply focused inquiry into the bases of conclusions reached about the performance of the site.

As more detailed information becomes available (e.g., the DOE five-year plan and the technical implementation plans) for our review, we plan to supplement this letter with additional discussions and more detailed comments. In addition, the Committee will consider the question of issue resolution at a later time.

Sincerely,



Martin J. Steindler
Chairman

References:

1. Preliminary Draft dated 8/3/94, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, "Process for Evaluating the Suitability of the Yucca Mountain Site for Development as a Repository for High-Level Radioactive Waste and Spent Nuclear Fuel"
2. Letter dated June 30, 1994, from Daniel A. Dreyfus, DOE, to Dr. John E. Cantlon, NWTRB. re: Department of Energy's response to the questions contained in the Nuclear Waste Technical Review Board's letter dated May 17, 1994



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

February 6, 1995

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

Dear Chairman Selin:

SUBJECT: PRIVATE OWNERSHIP OF LOW-LEVEL WASTE SITES

The Advisory Committee on Nuclear Waste (ACNW) has concluded that there are no fundamental reasons why private ownership of low-level waste (LLW) disposal sites should be prohibited but finds that several related issues require deliberate and cautious action by the Commission.

During the 67th meeting of the ACNW, we heard from and discussed with representatives of the Office of State Programs the subject of private ownership of LLW disposal sites. We believe that privatization of LLW disposal sites is partly a legal matter but there are several aspects closely related to topics we have dealt with in the past. This report contains a summary of our concerns about private ownership of LLW disposal sites.

We believe that at least two major issues arise when private ownership of waste disposal sites is proposed. The first concerns the assurance of the protection of the health and safety of the public and of the environment (protection function). We recognize that the extent to which assurance of adequacy of the protection function is obtained may be strongly influenced by Agreement State laws and the extent to which the NRC exercises surveillance of the quality of the Agreement State activities. During the recent Commission policy discussions of adequacy and compatibility, the topic of provisions for private ownership of waste disposal sites was not included. We believe that the NRC needs to include explicit statements for pertinent requirements under the heading of adequacy and compatibility if the Commission proceeds with generic approval of private ownership of waste sites. In addition, the NRC should require effective and timely transfer of ownership to another responsible and capable entity, such as the State, when any changes in the private ownership provision for waste sites, including dissolution of the corporate entity, are effected. The measure of adequacy and compatibility of Agreement State operations should include effective and frequent monitoring and evaluation of private entities that are responsible for waste sites.

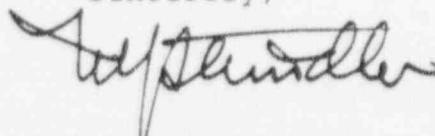
Provisions in Part 61 of Title 10 of the Code of Federal Regulations present 500 years as a target reference for siting and intruder barrier considerations [10CFR61.7(a)(2) and 61.7(a)(5)].

It is likely, however, that waste disposed in LLW facilities will pose a significant hazard for periods that, under some conditions, may well exceed 500 years and indeed Part 61 provides a caution on site characteristics that extends beyond that time. The Commission should expand the criteria for adequacy and compatibility of an Agreement State program in which private ownership is allowed so as to ensure that the State maintains an active interest in the protection function of the disposal site for as long as the waste poses a hazard in the regulatory sense.

The second issue concerns the procedures that lead to privatization. We believe that the procedures used by the NRC that involve open meetings, public and other stakeholder participation, judicial review, and other factors give all interested parties ample opportunity to have their views transmitted and considered. We believe that the importance of transferring accountability for the protection function to a private entity with a likely modest life compared to the hazard life of the waste requires procedures comparable to those used by the NRC. The NRC should ensure that privatization of ownership of LLW disposal sites involves procedures that are at least as open and accessible to stakeholders as those procedures managed according to the policies and regulations of the NRC. We have thus far not obtained information that this was the case when the State of Utah acted.

In summary, we focused our concerns on two aspects of the privatization issue, namely the protection of the health and safety of the public and the environment and the accessibility by stakeholders to the procedures that lead to privatization. Although we believe that private entities are potentially capable of meeting the longer-term protection function requirements, final accountability for the long-term performance of an LLW disposal facility should continue to be through a governmental entity. Further, the privatization decision process should be as open as those now used by the NRC. We believe that the NRC should craft provisions and requirements for private ownership of disposal sites so that government (state or Federal) accountability and open procedures are implemented. In light of NRC's role to ensure adequacy and compatibility we believe that the NRC should be very deliberate and cautious in allowing Agreement States to implement privatization of disposal sites.

Sincerely,



Martin J. Steindler
Chairman

Reference:

U.S. Nuclear Regulatory Commission, "Proposed Rule, Land Ownership Requirements for Low-Level Waste Sites," Federal Register, Vol. 59, No. 148, August 3, 1994, p. 30485



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

April 28, 1995

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

Dear Chairman Selin:

SUBJECT: REGULATIONS PERTAINING TO CONTAMINATED STEEL SMELTING
FACILITIES AND DISPOSAL OF CONTAMINATED BAGHOUSE DUST

At its 72nd meeting, March 15-16, 1995, the Advisory Committee on Nuclear Waste had discussions with representatives of the Steel Manufacturers Association, Florida Steel Corporation, the NRC staff, and others concerning the problems faced by the industry from contamination introduced into their facilities from uncontrolled radioactive sources. This topic was reviewed at the request of the NRC staff. However, the Committee realized that the issues surrounding the problem may be better addressed by consideration of basic causes and, therefore, in this letter we make specific recommendations and also identify more general courses of action.

The sources, usually ^{137}Cs , arrive without detection in the scrap steel used as feed to the smelters. The failure to detect these sources cannot be attributed to a lack of effort exerted by the various groups handling scrap steel from its generation to the smelter plant. The radioactive sources are licensed by the NRC or by Agreement States but were illegally disposed of, lost by, or stolen from the licensees. The inadvertent introduction of such sources into the scrap steel smelting operations contaminates the smelting facilities and, owing to the volatilization of cesium, contaminates the dust from the smelter that is usually collected by bag filters. Since the filters also contain volatilized and condensed cadmium, lead, and zinc in fine dust form, the contamination of these dusts results in the formation of slightly contaminated hazardous material that is designated as mixed waste. Means of disposal of such mixed waste is not readily available. In addition, normal practice of recovery of the zinc in the dust effluent would become an operation with radioactive material and, thus, the economic value usually derived from zinc recovery is lost. Disposal or replacement of contaminated smelting facilities is clearly a significant economic burden to the industries involved and may represent a modest risk to workers.

The Committee is aware of the Draft BTP on the disposition of ¹³⁷Cs contaminated baghouse dust. The proposed recycle/reuse criteria developed for a second enhanced participatory rulemaking (SECY-94-221 dated August 19, 1994), in response to the March 10, 1994 SRM (COMFR-94-001), specifically call for examination of the issues brought to the Committee in our review. We believe that the general regulatory position in the Draft fails to address the specific, underlying causes of the problem with sufficient focus to be effective in the near term.

We believe that this problem requires additional action by the NRC. If, as seems likely, the Agreement State or NRC surveillance of the programs of licensees that own and use such sources does not detect weaknesses that lead to loss of sources and inability to trace lost or stolen sources, the NRC should require a quick and effective remedy of such deficiencies. Further, the Committee believes that the NRC should ensure that specific deficiencies in Agreement State or NRC programs that could lead to a lack of control of radioactive sources by licensees be corrected as quickly as possible. We are aware of the gradual but minor increase in radioactive background from the introduction of sources into the steel smelting and production operations and believe that this trend should be slowed or stopped. Although illegally disposed of, lost, or stolen sources largely represent a significant economic issue, they could also have health and safety implications indicative of an inadequate regulatory program.

Industry and the staff may urge the Commission to enact regulations that would defer or make unnecessary the labeling of contaminated baghouse dust or parts of smelting facilities as LLW or mixed waste. We urge the Commission to proceed in this matter with considerable care. The Commission should take into account: (a) the justification for considering a level of radioactive contamination as below the level of concern regarding health and safety of the public and (b) the need, based on a reasonable risk/benefit consideration, to manage wastes that may contain radioactive contamination at trivial levels.

The resolution of the steel smelter's concerns with regard to the disposal of contaminated material should be addressed with an appropriate eye to the lessons learned from past endeavors in this general area. For example, DOE could dispose of or store the generated mixed waste and material with low levels of contamination, particularly since the DOE intends to provide processes for some of the wastes of a similar type generated by DOE defense operations.

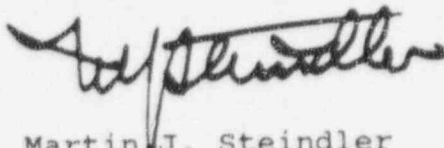
In summary, the baghouse dust issue is symptomatic of a continuing problem of low level contamination of waste or recycled material that has concerned us for some time. The staff should review the

The Honorable Ivan Selin

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current Agreement State and NRC programs with regard to the accountability of radioactive sources to ensure that they adequately address issues which could adversely impact public health and safety.

Sincerely,

A handwritten signature in cursive script, appearing to read "M. J. Steindler". The signature is written in dark ink and is positioned above the typed name.

Martin J. Steindler
Chairman



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20565

April 28, 1995

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

Dear Chairman Selin:

SUBJECT: THE U.S. EPA PREPROPOSAL DRAFT OF 40 CFR PART 193 AND THE
NRC'S PROPOSED RADIOLOGICAL CRITERIA FOR DECOMMISSIONING

At its 71st meeting, February 21-22, 1995, the Advisory Committee on Nuclear Waste had presentations from and held discussions with representatives from the U.S. EPA, the NRC staff, and the Nuclear Energy Institute on EPA's Preproposal Draft (hereinafter referred to as Draft) of 40 CFR Part 193, "Environmental Radiation Protection Standards for the Management, Storage and Disposal of Low-Level Radioactive Waste." We initiated this review at the request of a Commissioner and because of its relevance to the Committee charter and program plan. As an adjunct to the discussions of factors impacting the generation and disposal of LLW, the Committee heard at its 72nd meeting, March 15-16, 1995, a presentation by and discussed with the NRC staff issues on the residual contamination levels associated with the decontamination of facilities and sites used for activities regulated under the Atomic Energy Act. These discussions addressed the bases for and the impact of levels of residual contamination allowed under the proposed decommissioning rule.

The Draft is divided into three subparts. Subparts A and B concern the management, storage and disposal of LLW and Subpart C concerns groundwater protection. Subparts A and B cite an upper limit to the annual committed effective dose (CED) of 0.15 mSv (15 millirem). Subpart C requires that the level of radioactivity from the disposal system in any underground source of drinking water be less than the maximum contaminant level (MCL) which, for radionuclides, is equivalent to an annual CED of 0.04 mSv (4 millirem).

The Committee could not evaluate the technical bases for the Draft or for many of the topics presented in the text accompanying the Draft since the background information documents, the regulatory impact analysis, and the environmental impact analysis in which such information is expected to be detailed are not yet available. Therefore, we focused our discussions and review on the apparent bases for the action recommended by the EPA and also estimated the potential impacts that were evident from the text that accompanied the Draft. The absence of detailed scientific analyses that lead to the standards in the Draft makes our conclusions less firmly

based than desirable. We plan to examine the technical issues as soon as the supporting documents become available.

We believe the Draft can be divided into two parts that can be considered separately. The first part deals with the protection of the health and safety of the public and is represented by Subparts A and B. The second concerns the application of the drinking water standards and is found in Subpart C. On that basis, we offer the following conclusions:

1. The standards in Subparts A and B dealing with the management, storage and disposal of LLW and its relation to public health and safety may effectively provide the same extent of protection as is obtained from provisions in 10 CFR Part 61 and 10 CFR Part 20 when these regulations are combined with application of the ALARA principle. Although there may be some differences in applicability of each of the NRC regulations, we conclude that the Draft provides protection that appears to be redundant with that provided by the NRC regulations. This conclusion is based on the NRC staff calculation that the 25/75/25 millirem regulation found in Section 61.41 is equivalent to the 0.15 mSv (15 millirem) in the Draft. In addition, in the absence of a clear intent in the Draft, we recommend that the limiting individual (or member of the public) subject to exposure from the LLW be clarified to mean "the average member of the critical group."
2. The selection of the 0.15 mSv (15 millirem) annual CED represents an unnecessarily conservative fraction of the 1 mSv (100 millirem) annual CED limitation recommended by the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) for the population. The need to partition the annual recommended limit among several sources from which a person is likely to be exposed appears justifiable. We have not found explicit guidance from the various national or international bodies, e.g., ICRP, on this subject.

Nevertheless, we believe that one-third (Reference 4) or one-fourth of the 1 mSv limitation is more easily justified, based on the likelihood that no more than three or four separate, regulated sources will affect the exposed person at any instance. The selection of one-seventh of the annual limit, i.e., the assumption that a person will encounter a simultaneous dose from seven different, regulated sources, appears to be unjustified, particularly since the application of the ALARA principle accompanies all such NRC regulatory actions. In addition, the nature of the partitioning of the annual effective dose limit is highlighted by the NCRP comment (Reference 3) that ". . . whenever the potential exists for exposure of an individual member of the public to exceed 25

percent of the annual effective dose limit as a result of irradiation attributable to a single site, the site operator should ensure that the annual exposure of the maximally exposed individual, from all man-made exposures (excepting that individual's medical exposure), does not exceed 1 mSv on a continuous basis. Alternatively, if such an assessment is not conducted, no single source or set of sources under one control should result in an individual being exposed to more than 0.25 mSv annually."

We also have reservations about the applicability of this level to residual contamination following the decontamination of a site or facility. This is especially pertinent when it is noted that the permissible residual activity limit is further reduced by the dose attributable to drinking water. Thus, the net allowed exposure of a person in the most exposed group could actually be as low as 11 mrem annually, a level that, especially when in concert with the ALARA principle, becomes unnecessarily restrictive and without justification. The impact of such regulations on the volume of LLW generated by decommissioning and the risk associated with the generation, transport, and disposal of this LLW require a reevaluation of these regulations.

3. The application of the drinking water standard to the disposal of LLW (Subpart C of the EPA Draft) presents, for at least the several reasons cited below, an entirely different approach to the promulgation of generally applicable environmental standards. The material in the Draft and discussions during our meeting indicated that both the application of the drinking water standard and the level of that application is not now based on evident rationale, in part because the background information documents are not available.
 - a. There is no evident technical basis for the application of the drinking water standard (applied at the tap) to an underground aquifer at the boundary of the LLW disposal facility. In fact, the text accompanying the Draft indicates clearly that this application is a policy issue and not a technically driven standard. We believe that the EPA should provide the cost-benefit support for such a decision and, in the absence of documents supporting the Draft, we have seen no such support.
 - b. The application of the drinking water standard as in the Draft has the effect of moving the point of compliance from the water tap, as it is for the existing drinking water standard, to the fence of the disposal facility. An important factor included in this shift is the definition of drinking water adopted by the EPA which includes waters containing concentrations of solids at

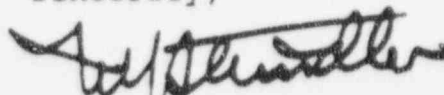
levels significantly above those that can be used for human purposes without treatment. We believe that this change may severely limit, without providing an appropriate benefit, the use of any humid site, otherwise qualified, to serve as a LLW disposal facility.

- c. The introduction of a new standard, particularly the coupling of the exposure standards with the drinking water standard, may introduce confusion and delays in the siting of LLW disposal facilities. In the absence of substantial and necessary improvements in the protection of the health and safety of the public, the application of the Draft standard is likely to be detrimental to progress in siting LLW disposal facilities. A significant refocusing of the application of the Draft standard on the health and safety of the public may therefore be warranted.
 - d. We see little technical justification based on the protection of the health and safety of the public for a 0.04 mSv (4 millirem) annual CED for drinking water. In addition, the identification of nuclides that are to be compared to the standard and the relationship of the contributing nuclides to those that are naturally present point to the need to define requirements that modify the application of the standard to selected aquifers owing to the existing levels of certain nuclides. Hence, a level of radioactive contamination that is equivalent to the 0.04 mSv annual dose is not always acceptable as an expression of an environmental standard, and EPA is seeking alternatives to the application. The potential for shifting the drinking water standard depending on the nature of the background indicates clearly that the standard is not in concert with real situations. If the EPA is to protect resources, then other means, e.g., legislative provisions, must be devised to accomplish this goal.
4. We agree with one aspect of the motivation of the EPA to provide the Draft at this time. The standards and regulations pertaining to the management and disposal of LLW by the DOE and by commercial activities are scattered throughout the Federal regulations and are not consistently defined. A single source of standards, coupled to a set of uniform NRC regulations on the management of LLW, would represent a desirable alternative.
 5. We are aware of the communication from the EPA (Reference 5) offering to waive the application of the Draft standard to the NRC if the EPA drinking water protection standard were to be included in the NRC regulations.

Since the general protection afforded by existing NRC regulations already appears to be equivalent to those proposed in the Draft, and since the applicability of the groundwater standard to the LLW disposal site is apparently not technically justified, we recommend that the proposed waiver be studied further to ensure that there are benefits to the protection of the public that could only be obtained by its acceptance. We do not see such benefits at this time.

The Committee plans to continue the study of the Draft once the background information documents and other documents become available. We believe that at present there appears to be too little information for a complete technical evaluation of the Draft, and we recommend that the Commission defer its final decision. It is likely, however, that the impact of the Draft may be detrimental to the progress in implementing LLW disposal among the State compacts and, therefore, the EPA should be urged to complete the standards development process including issuance of the background information documents as soon as possible. Finally, in light of the similarities in the recommendations of the EPA regarding LLW and the NRC staff regarding residual contamination levels following decommissioning, the Commission is urged to foster a government-wide consistent and practical approach to the regulation of very low levels of contamination.

Sincerely,



Martin J. Steindler
Chairman

References:

1. Preproposal Draft, "Environmental Radiation Protection Standards for the Management, Storage and Disposal of Low-Level Radioactive Waste (40 CFR 193)," November 30, 1994
2. Radiological Criteria for Decommissioning, Federal Register, Vol. 59, No. 161, pp. 43200-43232, August 22, 1994
3. National Council on Radiation Protection and Measurements, NCRP Report 116, "Limitation of Exposure to Ionizing Radiation," p.47, March 1993
4. Clarke, Roger H., "The ICRP Principles of Radiological Protection and their Application in Setting Limits and Constraints for the Public from Radiation Sources" (Presentation to the Nuclear Regulatory Commission, January 12, 1995)
5. Letter dated October 21, 1994, from Margo T. Oge, EPA, to Robert M. Bernero, Office of Nuclear Material Safety and Safeguards, NRC, regarding EPA's preferred option for dealing with groundwater protection at commercial LLW disposal sites



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

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

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.

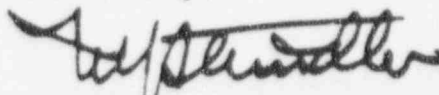
In conclusion, the Committee believes that the EBS research and technical assistance programs have been able to pursue useful and, in accord with past schedules, timely activities. The changes in the DOE program and schedules may require modifications in the NRC staff approach to program planning, scope,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



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

April 28, 1995

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

Dear Chairman Selin:

SUBJECT: ADDITIONAL COMMENTS ON THE DOE PROGRAM APPROACH

As a continuation of our review, requested by the Commission, of the U.S. Department of Energy's (DOE) program approach, the Advisory Committee on Nuclear Waste held discussions with representatives of the DOE at its 72nd meeting (March 15-16, 1995) on aspects of the program approach related to waste containment and isolation at Yucca Mountain and the activities related to the preparation of the license application. The DOE presented a well-organized strategy of waste containment and isolation. We have not reviewed the details of the technical site suitability evaluation process that DOE is developing. Our discussions supplement those reported to you on September 30, 1994. The substance of the concerns expressed in that report remain unresolved. The absence of a repository reference design remains a problem affecting many aspects of the NRC regulatory program.

In this letter, we provide some additional conclusions by the Committee:

1. Continued emphasis by DOE on the two-stage licensing approach will pose serious difficulties for the Commission. A lack of sufficient data, the use of bounding assumptions, the likely absence of a detailed repository design or critical decisions about the design (e.g., thermal management), and the absence of other information needed for determining the quality of conclusions reached by DOE will unduly complicate the Commission's decisionmaking and at best could lead to conditional decisions. The two-stage licensing process, while not necessarily faulty in principle, is in this instance relatively uncertain. In order to clarify the consequences of decisions to proceed with two-stage licensing as currently described, the Commission should ask the NRC staff to analyze the uncertainties that will be reflected in the response to the license application and to define, at an early stage, what limitations DOE can expect in the NRC decisions on the license application.

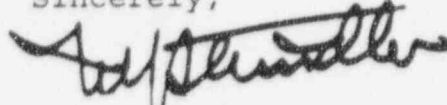
2. The NRC staff has stated that a much closer and more timely surveillance and tracking of DOE activities is necessary. We recommend that the NRC staff and the DOE discuss the need, in light of the program approach and schedules, for more rapid access by the NRC staff to the DOE data and results. There will need to be adequate evaluation and analysis of the results by DOE and its contractors prior to their use by the NRC. The NRC staff needs to be proactive in obtaining early access to the data and results that will be contained in the license applications. However, the staff must also recognize the need for DOE to ensure the quality and validity of the data transmitted, and for the orderly management of their program.
3. The emphasis by DOE on the use of bounding assumptions in modeling with limited field and laboratory data makes evaluation and prioritizing by the NRC staff of parameters and phenomena more dependent on the staff's judgment than on the results of analytical processes. This dependence would be diminished if performance assessment is expedited. The staff will need to ensure that it is able to evaluate and prioritize the technical issues and bases for scenarios that are to be evaluated and for which data or reliable models will be required. We believe this assignment, although difficult, is vital to ensure that the staff resources are employed to meet the schedule requirements contemplated by the DOE program approach. We reemphasize the need of the NMSS and RES staffs to develop protocols for addressing, in the very near future, the potential deficiencies in the planned performance assessment. We are confident that the NRC staff can identify the high-priority issues and scenarios that relate directly to the regulations. The NRC should reorganize its license application review strategy and the PA programs in light of the expected deficiencies in the information supplied by DOE.
4. The NRC staff should formulate, as early as possible, the issues in the current DOE program approach that may be unresolved or difficult to resolve. One path would be to identify the anticipated results that would be available by the deadline for decisions on the site suitability. Owing to the complexity of the system and the descriptions of a suitable site, early awareness of the status of data and modeling related to the site characterization should be developed. The status of the data base and the quality of the models should be analyzed by the NRC staff, and this information should be made available for the Commission decision and comment process at the time that the technical

The Honorable Ivan Selin

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site suitability is transformed into a recommendation to be made to the President.

Sincerely,

A handwritten signature in cursive script, appearing to read "M. Steindler".

Martin J. Steindler
Chairman

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



May 25, 1995

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

Dear Chairman Selin:

SUBJECT: ISSUES RELATED TO GUIDANCE ON 10 CFR 60 GROUNDWATER
TRAVEL TIME REGULATIONS.

In accordance with its program plan, the Advisory Committee on Nuclear Waste has reviewed the basis of the groundwater travel time (GWTT) requirement in 10 CFR Part 60. It also has reviewed the ongoing activities of the NRC staff and the U. S. Department of Energy (DOE) on this topic. The purpose of this letter is to convey our observations on the regulatory aspects of GWTT and our recommendations on the pending guidance by the NRC staff to DOE in this important area. Our conclusions are derived from two working group meetings, one in December 1993 on the status and methodology for study of groundwater flow in the unsaturated zone at the proposed repository at Yucca Mountain, Nevada, and another in October 1994 on the use of groundwater dating techniques in determining GWTT. In addition, we heard presentations from the NRC staff, and representatives from DOE and the State of Nevada at our 71st, 72nd, and 73rd meetings.

In 10 CFR 60.113, the NRC establishes the performance objectives for specific barriers after permanent closure of the repository. These objectives implement the Commission's defense-in-depth philosophy. The subsystem requirement in 10 CFR 60.113(a)(2) specifies a quantitative measure related to the inherent capability of the geologic environment of the emplaced waste to contain radionuclides released to the accessible environment in case of failure of the engineered barrier. This part of the regulations states, "The geologic repository shall be located so that the pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment shall be at least 1000 years or such other travel time as may be approved or specified by the Commission."

The systematic regulatory analysis of the NRC high-level waste regulations identified two key technical uncertainties (KTUs) in the GWTT subsystem requirement. Potential ambiguities have been identified in the terms "fastest path of likely radionuclide travel" and "disturbed zone." As a result, the NRC staff is drafting guidance to clarify these and other potential uncertainties in 10 CFR 60.113(a)(2) and related sections of Part 60. Further, the wording of the GWTT regulation in Part 60 is similar to the GWTT disqualifying condition in 10 CFR Part 960 that DOE will use to determine the technical site suitability (TSS) of Yucca Mountain. Thus, the guidance being prepared by the NRC staff not only will have a major impact on the evaluation of the repository license application but also will be applicable to the Commission's comments on the TSS of Yucca Mountain.

Our review of the basis of the GWTT regulation resulted in the following observations and related recommendations.

1. Role of GWTT

The GWTT requirement is designed to be a numeric measure of the geologic system's ability to contain radionuclides; the geologic system serves as one of the redundant barriers. Thus, GWTT is one element of the triad that makes up the Commission's defense-in-depth approach. However, this subsystem regulation alone is not intended to satisfy the entire performance requirement of the current Environmental Protection Agency high-level waste repository standard. Thus, the NRC staff should clarify in its guidance that the intent of the GWTT requirement is to provide reasonable assurance that the geologic barrier will be effective. The NRC guidance should stress that, because of the overall emphasis on the performance of the repository and the uncertainties in estimating GWTT, adherence to the 1000-year requirement should be interpreted liberally.

2. Need for timely guidance

Because of the rapid progress of the geohydrology studies at Yucca Mountain, early, comprehensive guidance is needed on the KTUs and other technical issues concerning GWTT.

DOE currently plans to complete the acquisition of data and analyses for its technical basis report on geohydrology in its TSS program in early 1997. Although DOE will evaluate the Yucca Mountain site against the requirements in 10 CFR Part 960, the GWTT disqualifying condition of 10 CFR 960 closely parallels the subsystem regulation in 10 CFR Part 60. Further, the Commission is required to comment on the Yucca Mountain site suitability determination that is scheduled to be sent to the President in the year 2000. Thus, it is urgent

that uncertainties in the GWTT regulation be reduced through a carefully developed technical position. Where applicable, the guidance should be specific and quantitative and based on physical or statistical justification.

3. Scope and content of GWTT guidance

Our recommendations for the scope and content of the NRC staff guidance on the GWTT requirement of 10 CFR Part 60 are as follows:

a. Determining GWTT along the fastest path of likely radionuclide travel.

The NRC staff's technical position on defining and determining GWTT along the fastest path of likely radionuclide travel as specified in 10 CFR 60.113(a)(2) is required to eliminate the regulatory uncertainty. The complex, interactive pathways possible in the matrix, fracture, and fault flow conduits in the proposed unsaturated zone repository at Yucca Mountain result in a variety of GWTTs between the disturbed zone of the repository and the accessible environment. Determining the groundwater paths and their travel time is likely achievable with acceptable uncertainties but may require probabilistic calculations to define the distribution of GWTTs. We believe the use of a measure of the central tendency may be acceptable but urge that the technical guidance by the NRC staff indicate the need for justifying any such selected attribute of the GWTT distribution.

We also believe that the NRC staff's position on GWTT should address the possible incorporation of the volumetric flux of water from the disturbed zone to the accessible environment, in that GWTT is not necessarily related to flux. Consideration of the volumetric flux is predicated on the reasonable assumption that higher volumes of water will carry larger quantities of dissolved radionuclides and hence constitute a greater risk. The NRC staff should be urged to point its guidance toward the desirability of modulating the measure of GWTT with water flux.

b. Uncertainties in GWTT

A recognized issue in the determination of GWTT is the ability of geohydrologists to predict the groundwater paths and associated uncertainties in travel time values. We believe that after completion of adequate site characterization of Yucca Mountain and quantification of the sources of uncertainty, these predictions will be possible. DOE must gain an understanding of the saturated and unsaturated zone groundwater flow systems sufficient to bound, for example, the role of fracture flow, the location and behavior of faults as

flow conduits, and the potential role of perched water conditions in the flow system in estimating GWTT. Emphasis on the flow system through rock units underlying the repository horizon is also required. This information, together with definition of geohydrologic units, their relevant properties, and lateral and vertical variability, needs to be available to develop conceptual models of the geohydrologic system at Yucca Mountain.

To address uncertainties in conceptual models, guidance is needed on evaluating the results from multiple conceptual models and the use of information such as groundwater tracers, isotopic dating of *in situ* water, and related geoscience input to constrain and temper the models. All require careful application, integration, and interpretation, but in particular, the NRC staff should, in its guidance, caution against excessive reliance on the results from one method of isotopic dating of water that are not supported by results from other isotopic dating methods or other methodologies.

Further, the NRC staff guidance should encourage DOE to delimit the uncertainties associated with the proximity of the repository to fault zones. Potentially, fault zones provide pathways for rapid groundwater flow.

c. Definition of disturbed zone

The functional definition of the disturbed zone referred to in 10 CFR 60.113(a)(2) remains a KTU. The NRC staff in presentations to the Committee and at technical exchanges between NRC and DOE has proposed a method of defining and demarcating the disturbed zone that is based on a two-step process. The steps are to evaluate the effects of changes in physical and chemical properties of the rock volume of the site resulting from construction and the emplaced waste on pre-waste-emplacement GWTT and determine if the effect on pre-waste-emplacement GWTT is significant. The disturbed zone is the outer limit of the volume in which the GWTT has been "significantly" affected by the repository and its wastes. The staff's definition takes into consideration the rock volume that may affect the capability of the geologic barrier to contain waste, but does not allow credit to be taken if the effect of the repository is to lengthen GWTTs. This approach has been well received by DOE, and we believe it is appropriate. We urge the staff to proceed with it in developing its guidance, but we caution that the term "significant" when referring to the effect of the repository on pre-waste-emplacement GWTT will need further consideration. A suggested course of action is to define the term "significant" quantitatively in such a way that takes into

account the uncertainty and resulting effects of the possible changes of the physical and chemical properties on GWTT in the disturbed zone.

We are concerned that in the absence of a specific thermal loading strategy it will be difficult for DOE to estimate the effects of repository heat and hence difficult to complete the pre-and post-waste-emplacment calculations. Also, DOE has indicated it will not have the results from heater block tests before it performs the post-waste-emplacment GWTT calculations. These deficiencies will result in great reliance on expert judgment in the assessment of post-waste-emplacment effects. The NRC staff should initiate as soon as possible a review of its strategy for evaluating whether DOE has bounded the behavior of groundwater flow in the post-waste-emplacment environment sufficiently to determine compliance with the GWTT regulation and the overall repository performance criteria.

d. Definition of pre-waste conditions

The lack of a clear definition for the term "pre-waste-emplacment" in the GWTT regulation requires that NRC staff provide guidance on what is meant by pre-waste-emplacment conditions. The groundwater conditions are part of a dynamic, constantly changing system as a result of local and regional climatologic variations, modifications in geohydrologic parameters, and disruptive effects due to subsurface site characterization. As a result, some geohydrologic data indicative of groundwater residence time reflect groundwater processes over a broad span of time rather than the present conditions. The effects of these factors are likely to be small over the totality of the repository site, but they need to be evaluated in terms of prescribing pre-waste-emplacment conditions and the need for and the method of extrapolating to a specified pre-waste-emplacment state.

e. Use of transport processes

DOE has proposed the use of transport processes, including diffusion, in the analyses of GWTT. These effects may significantly impact the GWTT results. The NRC staff technical position should provide clear guidance on the appropriateness of the use of transport processes and the rationale for this decision.

4. Consistency and integration with other guidance

The NRC staff needs to ensure that its technical position on the GWTT regulation is consistent and integrated with other NRC guidance including evaluation of the overall performance of the repository, approach to confidence building of models

and evaluation of uncertainty in modeling, use of expert judgment, and review of DOE's bounding analyses in support of its program approach. The staff may be able to narrow the scope of the GWTT technical position if the document contains information on how GWTT is related to or incorporates other issues and on where related guidance on these can be found.

5. Support for GWTT Guidance

We have observed little direct impact of the Center for Nuclear Waste Regulatory Analyses (CNWRA) in our review of the GWTT regulation. If the staff is not doing so already, we encourage it to take full advantage of the strong technical support available from the CNWRA in formulating the guidance required in the GWTT staff technical position. We look forward to reviewing supporting analyses from the CNWRA when we are briefed on the draft technical position before it is issued for public comment.

6. NRC/DOE interaction on GWTT

We have closely followed interactions between DOE and the NRC staff in their technical exchanges regarding GWTT and related issues at Yucca Mountain. We have been impressed with the professional standards of both groups, the increased frequency of these meetings, and their ability to maintain flexibility in their approaches. We commend both the NRC staff and DOE for their actions and encourage broadening of this type of interaction and demonstrated flexibility to other aspects of the high-level waste program.

Summary

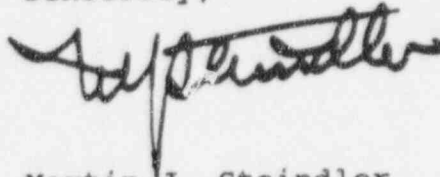
We believe there is a need to develop a technical position paper and guidance on various aspects of the GWTT subsystem regulation. We believe that the timing of activities by DOE and the indicated schedules point to a need to complete such guidance in the very near future. Such a technical position paper should address all of the currently identified relevant KTUs or identify where treatment of their subject matter can be found, and provide quantitative guidance to the extent possible. We urge that clarification of the definition of concepts such as the disturbed zone and pre-waste-emplacement conditions be specifically addressed. Further, the technical bases for evaluating adherence to the numerical regulation for GWTT should be addressed in the guidance in terms that will allow DOE to make early decisions on the need for data and analyses and the strategy for providing the necessary information to the NRC staff. This guidance should also either address data requirements, methodologies, and confidence-building procedures that will minimize the uncer-

The Honorable Ivan Selin

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tainties in the evaluation of this rule or identify where this information may be found.

Sincerely,

A handwritten signature in cursive script, appearing to read "M. J. Steindler". The signature is written in dark ink and is positioned above the typed name.

Martin J. Steindler
Chairman



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

June 28, 1995

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

Dear Chairman Selin:

SUBJECT: REGULATORY ISSUES IN LOW-LEVEL RADIOACTIVE WASTE DISPOSAL
PERFORMANCE ASSESSMENT

As a continuation of the Advisory Committee on Nuclear Waste (ACNW) review of the Low-Level Radioactive Waste (LLW) Performance Assessment (PA) program, and consistent with its program plan, the NRC staff briefed the Committee on March 16, 1995, on recent LLW PA activities. The staff emphasized its response to comments received from the public on the preliminary draft Branch Technical Position (BTP) on LLW PA, including input from the LLW Performance Assessment Workshop on November 16-17, 1994. The Committee will review the draft BTP when it is available.

The NRC staff sought ACNW's advice on its proposed resolution of public comments on four regulatory issues:

- (1) Consideration of Site Conditions, Processes, and Events in Performance Assessment
- (2) Performance of Engineered Barriers
- (3) Time Frame for Performance Assessment
- (4) Treatment of Sensitivity and Uncertainty in Low-Level Waste Performance Assessment

CONSIDERATION OF SITE CONDITIONS, PROCESSES, AND EVENTS IN PERFORMANCE ASSESSMENT

The Committee agrees with the staff's preferred approach of developing a reference natural setting for performance assessment based on anticipated conditions, processes, and events. It is a reasonable approach to define the natural setting on the basis of information about the site, taking into consideration conclusions about future changes in the site. To the extent that the site information suggests it is important to consider such phenomena as earthquakes, climate changes, volcanic activity, etc., then it is also appropriate to include such threats in the definition of the natural setting. We caution the staff not to preclude "direct" or explicit consideration of certain events that may in fact be realistic, based on site information. From the risk perspective, if there is evidence that such threats could become a

reality, then it is also important to address the issue of occurrence frequency as a function of severity based on all the evidence from the site. In terms of what should be considered and what should not, the Committee believes in the principle of completeness, where completeness means if there is evidence of a significant contribution to risk, it should be considered; if not, that contribution to risk need not be analyzed further. The exception would be those events or scenarios that are already accounted for through regulatory siting or design considerations.

PERFORMANCE OF ENGINEERED BARRIERS

The Committee has some concern about the consistency of the staff's approach to the performance assessment of engineered barriers. On the one hand, the staff adopts the view that one should demonstrate the performance of engineered barriers for any time frame, while on the other hand, they indicate that it will be assumed that beyond 500 years the barriers are in a degraded state. Although the staff indicates that an applicant may take credit for a longer period of time than 500 years, there is certainly a lack of incentive for the applicant given the staff position. The applicant should have the latitude to take credit for engineered barriers that can be demonstrated through analysis and competent design. The selection of an arbitrary point in time appears to be without technical basis. The thrust of the staff position that seems to put most of the reliance for safety performance on site characteristics to assure containment is not an adequate basis for limiting the utility of a creative and convincingly designed engineered barrier. Some would argue that there is much more confidence in the state of knowledge of the containment capacity of a quantitatively specified engineered system than of a natural system based on the more difficult task of quantitative site characterization. In the end, the underlying criterion should be the health and safety consequences of the overall disposal facility. A reasonable interpretation of the 500-year requirement is that it be a minimum for engineered barrier integrity, and the BTP should reflect this approach.

TIME FRAME FOR PERFORMANCE ASSESSMENT

The Committee believes there is merit in choosing a generic maximum time frame for analyzing the safety of an LLW facility. We do caution the staff against letting time-frame limits detract from focus on the actual performance of a site-specific LLW facility. One important attribute of the LLW field is the variability in the radionuclide content of LLW. For example, much larger quantities of long-lived radionuclides are being disposed of as low-level waste than was previously anticipated. The result is that at some sites, peak doses will occur at times longer than 10,000 years. We believe the application of peak dose calculations to be an important issue and plan to report to you on this subject after a timely review of this topic. Again, the Committee urges the principle of completeness by assessing first the safety of a specific facility and then being satisfied that it is in compliance with the regulations. Nevertheless, the BTP should identify a time period such as 10,000 years, for which performance assessment of an LLW site should be completed and beyond which such analyses should not be required.

TREATMENT OF SENSITIVITY AND UNCERTAINTY IN
LLW PERFORMANCE ASSESSMENT

The Committee appreciates the difficulties the staff is having in adopting a probabilistic methodology in performance assessment. We agree with the staff's observation made in their March 16, 1995, presentation to the ACNW that the "treatment of uncertainty (is) a necessary component in a credible performance assessment." We believe the BTP should include requirements for the evaluation of uncertainties and sensitivities by probabilistic methods. The Committee reiterates its strong support of probabilistic methods as indicated in its letter of June 3, 1994.

On a more technical note, the staff identifies three types of uncertainties: (1) scenario uncertainty, (2) model uncertainty, and (3) parameter uncertainty. The Committee agrees that these are all important components of uncertainty, but suggests that the first two be considered together as they both are really part of the modeling process. A performance assessment model can be viewed as a structured set of scenarios, thus making the scenarios an integral part of the modeling; that is, the means of coupling specific physical processes. The coupling of the physical processes with the scenarios and their attendant uncertainties needs to be explicitly visible.

Another technical issue that adds some confusion to uncertainty analysis as discussed by the NRC staff in its March briefing on the BTP is the reference by the staff to "conservative point values to bound parameter ranges." It is the "to bound parameter ranges" part of this statement that is confusing. The staff appears to be suggesting that the probability distributions should be conservative. If so, this is a contradiction in logic. For the distributions to have meaning, they have to represent the analyst's full state of knowledge about the parameter or issue in question. The opportunity then exists to choose conservative values within that distribution, an example of which is that the 95th percentile of the distribution is below 100 mrem per year. Also, there is nothing to prevent selection of a point value outside the distribution. However, such choices should not be confused with the actual quantification of the uncertainty - a very important reference. The use of conservative bounding points amounts to artificially stretching out the distribution to represent a level of uncertainty that cannot be supported by the evidence.

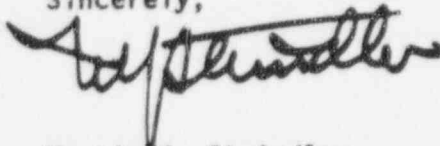
In summary, the Committee generally supports the staff's approach to each of the four issues listed above. Our concerns are mainly in the interpretation of the approaches and in the progress by the NRC staff toward the implementation of a probabilistic methodology for performance assessment and especially in the treatment of uncertainty. We recommend that the staff be more focused on the final result (i.e., the bottom-line safety performance measures), even though we recognize the attempt to encourage the defense-in-depth philosophy by focusing on such intermediate results as time frames for the assumed degradation of engineered barriers. We believe compliance with the regulations should not be

The Honorable Ivan Selin

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at the expense of blurring the analysis of the overall performance of a specific low-level waste site.

Sincerely,

A handwritten signature in black ink, appearing to read "M. Steindler", written in a cursive style.

Martin J. Steindler
Chairman

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