NUREG-1423
Volume 6

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

July 1995 – June 1996

U.S. Nuclear Regulatory
Commission

August 1996

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August 1996

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ABSTRACT

This compilation contains 8 reports issued by the Advisory Committee on Nuclear Waste (ACNW) during the eighth year 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, the U. S. Library of Congress, and the internet at <http://www.nrc.gov/ACRSACNW>.

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, 1995 and June 30, 1996. NUREG-1423 is published annually. Volumes 1 through 5 contain the Committee's recommendations and comments from July 1, 1988 through June 30, 1995.

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U. S. Nuclear Regulatory Commission

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

August 10, 1995

The Honorable Shirley A. Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

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

The Advisory Committee on Nuclear Waste (ACNW) has received a letter, dated June 5, 1995, from James M. Taylor, Executive Director for Operations, as a response to our report dated April 28, 1995, to Chairman Selin about contaminated steel-smelting facilities and the disposal of contaminated baghouse dust. In reference to comments in the third paragraph of the letter from Mr. Taylor, we agree that a study of the regulatory program involved in this matter is desirable and that recommendations should be made to alleviate the deficiencies that appear to be extant. But, we believe that the one-year duration assigned for such a study reflects a pace that signals a lack of urgency on the part of the NRC. If the incidents that were discussed in some detail at the ACNW meeting were isolated ones, such a pace could perhaps be justified. However, the information provided to the Committee indicated that the incidents of inadvertent contamination are relatively frequent. We believe that this situation requires more concerted action on the part of the NRC and recommend that the working group's study be performed on a much shorter time schedule.

We continue to believe that the proper management of the large number of sources and the accompanying low-level waste is the province of the Agreement States, but in the matter of oversight, the responsibility of the NRC is to ensure that Agreement State programs are effective.

The Committee wishes to be kept informed on the progress of the study and the development of the NRC staff position regarding this type of waste. In the case of the latter staff effort, we recognize the potential difficulties attending the implementation

The Honorable Shirley A. Jackson

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of any practical position developed by the staff and are prepared to provide assistance and review as may be useful.

Sincerely,

A handwritten signature in cursive script, reading "Paul W. Pomeroy". The signature is written in dark ink and is positioned to the right of the typed name and title.

Paul W. Pomeroy
Chairman

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

August 10, 1995

The Honorable Shirley A. Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: LESSON LEARNED FROM THE WARD VALLEY, CALIFORNIA, LOW-LEVEL WASTE DISPOSAL FACILITY SITING PROCESS

During its 75th meeting on July 26-28, 1995, the Advisory Committee on Nuclear Waste (ACNW) reviewed the National Academy of Sciences (NAS)/National Research Council report on the low-level waste disposal site at Ward Valley, California, and heard a presentation on this topic from a member of the NAS Panel. The Committee also has heard several presentations on issues related to the hearings held on the previously proposed low-level waste disposal site at Martinsville, Illinois, and several of the other proposed low-level waste disposal sites, e.g., Texas, Nebraska. This general topic is part of the waste facility reviews described in the Program Plan of the Committee transmitted to the Commission on November 10, 1993.

The Committee believes that the NAS report and the process used to formulate it were appropriate and thorough. The issues raised for and by the NAS Panel appeared largely to be pertinent and relevant to the health and safety of the public. The Ward Valley site has received intense technical and political scrutiny, and it is not our present purpose to comment further on these facets of the proceedings.

The ACNW has brought to the attention of the Commission lessons learned from the low-level waste facility-siting reviews and hearings that could be useful if applied elsewhere. This was part of the thrust of our interactions with the NAS Panel member during the presentation noted above. The NAS Panel identified a key lesson that the Committee strongly believes is broadly applicable; i.e., the process of developing information on a potential site of a low-level waste disposal facility should be accompanied, preferably from its initiation, by an independent, ongoing peer review that is focused on the scientific and technical quality and completeness of the field investigations, the analytical program, and the planning of the work that accompanies them. Such a review should be conducted by a recognized and demonstrably competent panel of experts.

One important benefit derived from the review process would be the identification of uncertainties and unrealistic assumptions in the site qualification analyses that could reasonably be subject to adverse reactions by licensing authorities or intervenors. Any site-evaluation process is expected to be a comprehensive and defensible technical analysis that supports conclusions about the suitability of a site. We believe that a peer review panel functioning as long as possible in parallel to the investigations would measurably enhance the quality of the final outcome and its visibility.

The Committee recognizes that the low-level waste sites to be developed in the near future are likely to be under the purview of Agreement States. Nevertheless, for those states in which a low-level waste facility is contemplated, the Committee believes the NRC staff should provide a plan that describes the process of forming such peer panels and the way in which their output can best be used. We believe this lesson, while stemming from the concerns about low-level waste facility siting, is broadly applicable to activities, especially in the siting area, in which the data-gathering and analytical processes are designed to yield readily defensible conclusions.

Sincerely,

A handwritten signature in cursive script, reading "Paul W. Pomeroy". The signature is fluid and extends to the right, with a long, sweeping tail.

Paul W. Pomeroy
Chairman

Reference:

"Ward Valley: An Examination of Seven Issues in Earth Sciences and Ecology," National Research Council, Washington, D.C., 1995

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

September 28, 1995

The Honorable Shirley A. Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: COMMENTS ON STREAMLINING THE SITE DECOMMISSIONING
MANAGEMENT PLAN PROGRAM

During its 76th meeting the ACNW heard a presentation from and had discussions with members of the NRC staff on the streamlining process anticipated for the Site Decommissioning Management Plan (SDMP) Program. The Committee discussed this topic further during its 77th meeting, September 20-21, 1995. The Commission requested this review in the referenced SRM. We also had the benefit of information from the briefing that the NRC staff gave to the Commission on this topic.

The NRC staff is developing a process for improving and streamlining the SDMP Program and associated activities. The details of the NRC staff's final proposal await the results of further work by the staff and the results of public meetings and workshops to be held by the staff. Although our final report must await the outcome of these activities, the Committee wishes to bring to the attention of the Commission several important issues raised at the 76th meeting.

The Committee believes that there are two signal milestones in the decommissioning of a site: (1) the initial definition of the scope and magnitude of the contamination problem and (2) the determination of the final results of the decontamination effort.

The Committee believes that these analytical efforts are crucial to the success of the decontamination process and its acceptance by the public as an action that protects its health and safety. Of particular importance, the NRC, other agencies, and the public require assurance that the site, when released, will not represent a hazard. The final site survey and its confirmation will be crucial to this goal. We strongly recommend the NRC staff ensure that in the process of cost reduction and streamlining, the assurance of the quality and scope of the final survey not be compromised. We urge that if the NRC staff believes that the necessity for confirmatory analyses can be supplanted, the staff should ensure that the final survey plan and accompanying quality assurance procedures are carefully crafted by the practitioner and

reviewed by the NRC staff. The NRC staff should include effective audits of the survey process in its management activities. The Committee is convinced that this phase of the SDMP process should not yield to economic strictures.

The Committee learned that the current process of assigning priorities to sites for attention is based largely on the experience of the NRC staff. While the Committee recognizes the need to function in a qualitative manner until more information is developed on the risks posed by each of the sites that have not been evaluated in detail, we urge the NRC staff to approach the prioritization process as quantitatively as the information will allow. This will ensure a defensible strategy in the shortest time for the remediation of sites that pose the greatest risk.

The Committee was pleased to hear the concern of the NRC staff with groundwater contamination and commends the high priority the staff places on diagnostic action when such contamination is suspected or possible. We also encourage the NRC staff to develop general strategies for dealing with groundwater contamination that appears likely to approach regulatory limits.

The Committee heard about the plans of the NRC staff to make use of the manuals, being developed in conjunction with EPA and other agencies, that define protocols for gathering and managing field data. Those prescriptive manuals may be beneficial to the process. We also believe that the staff should pursue qualification of the laboratories that perform the radiochemical analyses.

The ACNW plans to continue to review this topic after the public hearings are over and draft documents are complete. In addition, the Committee plans to review the proposed rule for radiological criteria for decommissioning that will incorporate the results of public comments. Our preliminary report highlights issues that the Committee believes should be noted during the formulation of plans and preparation of documents for the SDMP Program.

Sincerely,

Paul W. Pomeroy
Chairman

Reference:

Staff Requirements Memorandum dated May 30, 1995, from John C. Hoyle, Secretary, to James M. Taylor, Executive Director for Operations, Subject: May 19, 1995 Briefing on Site Decommissioning Management Plan Program and Policy Issues

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

November 6, 1995

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: COMMENTS ON THE HIGH-LEVEL RADIOACTIVE WASTE RESEARCH PROGRAM IN
HYDROLOGY

This letter report communicates the results of the Advisory Committee on Nuclear Waste (ACNW) review of the Office of Nuclear Regulatory Research's (RES) high-level radioactive waste (HLW) research program in hydrology. The Commission requested the Committee to examine and report on the relevancy, sufficiency, and timeliness of the HLW research program. The Committee previously reported on its review of volcanism, natural analogs, tectonics, and engineered barrier system research in the HLW program. The purpose of the Committee's review is to determine the role of hydrology research in the development of technical basis for regulatory guidance and evaluation of a license application for the proposed repository at Yucca Mountain, Nevada.

The Committee finds ample justification for the HLW hydrology research program and has important observations and recommendations to improve the relevance, sufficiency, and timeliness of the program. Our major findings are: (1) the risk significance of some of the ongoing work at the Center for Nuclear Waste Regulatory Analyses (CNWRA or Center) has not been demonstrated, (2) the Committee recommends that the staff emphasize the use of Performance Assessment (PA) to justify the basis of research projects, (3) RES needs to ensure that the projects and schedules of the hydrology research program are aligned with current needs of the licensing program and the impending changes in the Environmental Protection Agency's (EPA's) standards for the Yucca Mountain repository as a result of the National Research Council's technical bases findings (Ref. 1). For example, the longer time frame and risk-based standard recommended by the National Research Council panel may place greater emphasis on the dilution potential of the saturated zone, and (4) overall greater emphasis is needed on bringing projects to closure and packaging project results in usable formats for transfer to the licensing staff. These findings and others are discussed in more detail in the body of this report, and are later summarized at the end.

During 1995, the Committee devoted attention to the hydrologic aspects of site characterization at Yucca Mountain and related NRC preparations to evaluate a possible license application for a repository at Yucca Mountain. Of particular interest has been the guidance provided by NRC to the Department of Energy (DOE) on the interpretation and application of the subsystem requirements of 10 CFR Part 60 dealing with minimum groundwater travel time from the disturbed zone of

the repository to the accessible environment. Our comments on that subject were transmitted to you in our report of May 25, 1995. A logical followup to our evaluation of NRC's preparations for guidance on groundwater travel time is a review of the HLW hydrology research program. The DOE program schedule for site characterization, the implication of a new EPA standard for the potential Yucca Mountain repository, and possible changes in 10 CFR Part 60 add to the timeliness of our review. At our 77th meeting on September 20, 1995, the Committee was briefed on this topic by RES, the Office of Nuclear Material Safety and Safeguards (NMSS), the CNWRA, and the principal investigators of the NRC-sponsored HLW hydrology programs at the Apache Leap Research Site of the University of Arizona. This report is derived from the Committee's evaluation of the results of that briefing and subsequent deliberations.

Groundwater is the most likely agent to cause degradation of waste package containment, radioactive release from the engineered barrier system, and transport to the accessible environment. Hydrology research is a high-priority issue at NRC and has a prominent role in the draft HLW Research Program Plan (Ref. 2). Critical issues in hydrology include infiltration, conceptual models for fracture/matrix flow, parameter estimation, and radionuclide transport in both liquid and vapor phases. The hydrology research programs at the CNWRA and the University of Arizona receive approximately 15 percent of NRC's current annual funding for HLW research.

General Comments

In our report of August 24, 1994, to Chairman Selin regarding the HLW research program on volcanism, natural analogs, and tectonics, the Committee identified several general concerns that are also appropriate to the HLW hydrology research program. We note improvement in some other areas; for example, the effective technical communications between the NRC and DOE in matters related to the hydrology of the proposed Yucca Mountain repository site. Further, we are impressed with the advantages accrued to the hydrology research program as a result of the participation of external experts from the University of Arizona. Our general concerns are as follows:

1. Program Priorities

The selection and prioritization of specific research topics in hydrology can be improved by use of a risk-based approach. Prioritization should be rooted in the relevance of the research to estimated consequences and uncertainties. As a result, PA should have a prominent role in selecting research topics, bounding their scope, and establishing relative priorities. We see little evidence of the role of PA in the prioritization of current hydrology research topics or how hydrology research results will be used in Iterative Performance Assessment (IPA).

2. Key Technical Uncertainties (KTUs) and User Needs

In the Committee's report regarding research in volcanism, natural analogs and tectonics, we supported the ongoing activities of NMSS to fine-tune the KTUs and clarify user needs. We reemphasize the importance of this effort and urge a

timely closure on this project. In our previous report, we stated " . . . it was difficult for the Committee to identify how research project objectives and tasks are used to resolve specific KTUs." In our review of hydrology research, a direct connection is not obvious between specific projects and the needs of the licensing staff as specified by the key technical issues (KTIs) and KTUs. The rapidly evolving licensing procedures require the synchronization of hydrology research with changing NRC guidance and licensing concerns.

3. Integration of Research Activities

The hydrology at Yucca Mountain should be closely coupled with other disciplines such as tectonics, volcanism, and geochemistry in evaluating overall repository performance. However, as in the case of previous briefings by the NRC staff and principal investigators of research projects, hydrology research reports fail to identify general mechanisms to bring about needed integration. The focus is on discrete processes, and integration appears to be an ad hoc procedure relegated to the actions of individual investigators. The Committee recommends a more visible integration of discrete research elements.

4. Communications

The Committee is pleased to note the extensive technical communications among the various components of NRC involved in hydrology research and their counterparts at DOE. As a result, there is a sharper focus to the NRC research activities and broadening use of the results of the research by both NRC and DOE. We specifically recognize the quantity and quality of peer-reviewed journal publications by the principal investigators of the NRC-sponsored research at the University of Arizona. However, a concern we raised in our report of August 24, 1994, also is appropriate to the hydrology research. In that report, we recommended, and we continue to do so, that the RES staff convert the results of research at both the CNWRA and the University of Arizona into usable products for NMSS and others. This recommendation is especially applicable to the results from studies by the University of Arizona because of limitations in the principal investigators' views of regulatory concerns.

5. Role of NRC in Hydrology Research

In evaluating hydrology research, the Committee failed to obtain a clear-cut view of the criteria used by RES to identify its research projects. This is an especially critical concern in the current climate of decreasing resources. RES needs to clearly justify the NRC research program in hydrology as well as in other HLW topics.

The Committee believes there are valid reasons for the NRC to conduct research in hydrology related to the proposed Yucca Mountain repository site. Characterization and predictive modeling of fluid flow and transport in unsaturated fractured rock such as that encountered at Yucca Mountain is a relatively new, rapidly evolving science. There is little experience or understanding of governing processes and the behavior of fluids in fractures and faults, and few field demonstrations or standardized methodologies for obtaining parameter values necessary for modeling. The NRC staff is establishing

independent methods, approaches, and data bases, which will enable them to conduct confirmatory checks on DOE's models, modeling procedures, and data. Further, the NRC research is designed to develop and validate methodologies and data bases. Although of primary use to the NRC in the licensing process, this information can be influential in optimizing the hydrology site characterization process. NRC research is providing the NRC staff with valuable experience and insight into the sensitivity of various assumptions, methodologies, and approaches on evaluating site performance. These dividends provide the staff with needed confidence and increased credibility in evaluating DOE methods, models and approaches. Thus, we endorse hydrology research at NRC, but we recommend that these studies be used to better understand critical processes and to develop and validate scoping data and methodologies.

Specific Comments on Hydrology Research

The Committee recognizes the high quality of the research activities in hydrology being carried out for the NRC by the CNWRA and the University of Arizona and of the personnel involved in conducting and directing these studies. Further, we are pleased that to date some of the results of the hydrology research have proven useful in the guidance of regulatory policies and as background for technical assistance and have played a role in improving the site characterization at Yucca Mountain. Nonetheless, the Committee believes that significant improvements are possible and warranted in HLW hydrology research from the regulatory viewpoint. The following comments are intended to increase the overall effectiveness of the NRC HLW hydrology research program.

1. Relevance

CNWRA - The CNWRA is conducting research on regional and subregional hydrology of the Yucca Mountain site, including modeling of the high-hydraulic gradient north of the site and flow channeling in tuff, development of a methodology to evaluate the importance of spatially nonuniform infiltration on the flow of water in the unsaturated zone, and the origin and importance of perched water. The relevance of many of these studies is not apparent because they have not been shown to be significant from a risk perspective. However, an important contribution of the CNWRA research in hydrology is the sharpening of the staff's capability to evaluate and gain insights into conceptual and numerical models and analyses that are anticipated in the licensing process.

The goal of the Center's hydrology research projects is to understand existing site conditions rather than those critical conditions or processes that are potentially a problem from a performance or compliance perspective. For example, the Center is attempting to identify the "correct" model to explain the high-hydraulic gradient upslope from the proposed repository. We suggest that this program element be refocused to design and test bounding models and to perform preliminary analyses of their potential impact on repository performance. Resources would be better utilized by determining if the worst-case scenarios lead to failure to comply with the HLW standards and regulations than by attempting to define the "correct" model that explains the gradient. Although there is a need to better understand governing processes in subsurface hydrology

to develop reliable models and bounding conditions, the Center needs to ensure that these processes are risk significant before they are extensively researched.

University of Arizona - The continuing hydrology research of the University of Arizona at its Apache Leap Research Site is directed to understanding governing processes and modeling flow and transport, with emphasis on field methodologies and model testing at field and laboratory scales. The program addresses many potentially relevant issues such as conceptual models, spatial variability, model uncertainty, model abstraction, model validation and testing, and scaling properties. The Apache Leap Program is also making significant progress at integrating hydrology and geochemistry in designing experiments and interpreting results.

The geology and hydrology of the Apache Leap site are, to a first order, similar to the Yucca Mountain site in that both are in unsaturated, fractured tuff. However, other conditions are dissimilar, such as climate, hydrologic setting, and tectonic conditions. These differences lead to concern about the relevancy of the Apache Leap site as an analog to Yucca Mountain and the validity of the transfer of results from studies at Apache Leap to Yucca Mountain. Experience has shown that considerable care must be exercised in transferring lessons learned from one site to another. This caution is ameliorated by the focus of the research on the general understanding of the nature and relative importance of matrix/fracture flow in tuff rock in an unsaturated environment, field-scale demonstrations, and methodology development, all of which can lend credibility and confidence to NRC's regulatory decisions.

The University of Arizona studies are leading to fundamental understanding of flow and transport processes in unsaturated, dual-continuum volcanic rocks. This understanding will lead to better interpretation and evaluation within the regulatory framework of hydrologic data from Yucca Mountain and to more credible PA. Of particular note are the hydraulic, pneumatic, and tracer tests being used to test alternative models and to evaluate the stochastic continuum approach for defining flow and transport in rocks with both matrix and fracture permeability. However, for the NRC to obtain maximum use of the results of the Apache Leap studies, RES and NMSS should, on a regular basis, interpret and translate the results into meaningful guidance.

2. Sufficiency

NRC's licensing needs are evolving. We anticipate that new research issues will emerge with, for example, the NMSS staff's identification of long-term and short-term research needs for the specific elements of the vertical slice approach. RES must be ready to modify the priorities of its research program, including hydrology research projects. For example, current research projects should place greater emphasis on the role of fault zones on flow and transport in unsaturated tuff rock. This approach recognizes that faults, as identified by the NMSS staff in their presentations to us, are a critical but poorly known hydrologic element of the vertical slice, "Hydrologic Characterization of Structural Features That Affect Water and Vapor Movements."

The Committee was puzzled that none of the projects appear to have been aimed at providing information pertinent to groundwater travel time. Although the importance of this current subsystem provision of Part 60 may change as the result of incorporation of the report by the National Research Council on Yucca Mountain standards, this regulation is pertinent to the behavior of water in the environment of the repository. The difficulties in the establishment of the travel time, made evident in reviews of this matter by the Committee, point to the need to identify research programs that will enable the NRC staff to evaluate this hydrologic characteristic.

The Committee is also concerned about insufficient research at the interface of specific research elements. We have already noted the apparent deficiencies in mechanisms for integrating research activities. Research on the coupling of hydrology of Yucca Mountain with, for example, volcanism and tectonics appears to be deficient in the current program. Briefings on the hydrology research program also failed to show how the two projects at the CNWRA on regional and subregional hydrology are integrated with each other, with related work at the Center, and with the research being performed at the Apache Leap Research Site.

3. Timeliness

No clear evidence has been made available to the Committee that timeliness of the hydrology research is a compelling factor in prioritizing, designing, or conducting the program. We realize that the time line for evaluating the technical site suitability of Yucca Mountain and other prelicensing and licensing issues has been modified recently. However, the NRC staff must be sensitive to those modified deadlines, such as the one requiring the Commission's comments on the high-level findings, and assure the Commission that research results are available on a timely basis.

Summary

The Committee's major findings are summarized as follows:

- RES and NMSS staffs should be commended for the effective communications that exist between NRC and DOE.
- RES needs to place greater emphasis on establishing well-defined, risk-based priorities for its programs and ensuring that the results of hydrology research are fed back into IPA analyses. Greater emphasis needs to be placed on using PA to integrate results from all research disciplines and in turn establishing research priorities and guiding further research.
- RES should pay particular attention to new research needs that may result from the National Research Council's technical bases recommendations, and ensure that it can deliver useful products in the needed time frame. NRC should continue to place high priority on updating its current research program and schedules to meet the evolving needs of the licensing program, which continues to change in response to reduced resources and the changing regulatory environment.

- The CNWRA research program in hydrology provides the NRC staff with valuable experience and insight into the sensitivity of assumptions, methodologies, and approaches in evaluating the performance of the Yucca Mountain site. However, the relevance of this work has not been clearly established from a risk perspective.
- The NRC research at the Apache Leap site should focus on answering regulatory questions and should become more results-oriented with respect to specific application to licensing products and activities. Although the Apache Leap site itself is not an exact analog to Yucca Mountain, the research is leading to a fundamental understanding of flow and transport processes in unsaturated, fractured, volcanic rock, which, in turn leads to greater credibility and confidence in NRC's independent review of a license application.
- Close coupling is missing between this hydrology research and IPA and other closely related disciplines, including thermal studies, geochemical transport, coupled processes, and tectonics. Also lacking is a strong link between the research at the CNWRA and the University of Arizona.
- The Committee believes there are important reasons for the NRC to conduct hydrology research in the HLW program. For example, flow and transport in unsaturated fractured rock, such as encountered at Yucca Mountain, is poorly understood and requires further elaboration to assist in PA. We endorse this research program, but recommend a greater emphasis on understanding significant processes and developing and validating data and methodologies.

Conclusion

The Committee supports the HLW hydrology research program and believes that the research results will enhance the NRC staff's capability to license an HLW repository. However, the NRC staff needs to ensure that the program is relevant to the licensing evaluation of the performance of the repository, that the research priorities reflect resource and changes in regulatory needs, and that research results are available in a timely manner.

Sincerely,

Paul W. Pomeroy
Chairman

References:

1. National Research Council, "Technical Bases for Yucca Mountain Standards," 1995
2. U. S. Nuclear Regulatory Commission, draft NUREG-1406, "NRC High-Level Radioactive Waste Research Program Plan," February 28, 1992

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

December 29, 1995

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: COMMENTS ON SECY-95-201 AND THE NRC ACTIVITIES REGARDING
LOW-LEVEL RADIOACTIVE WASTE

I. Introduction

The NRC staff has proposed significant reductions to NRC's Low-Level Radioactive Waste (LLW) Program in SECY-95-201, "Alternatives to Terminating the NRC's Low-Level Radioactive Waste Disposal Program." As requested by the Commission in the Staff Requirements Memorandum dated September 14, 1995, the Advisory Committee on Nuclear Waste (ACNW) is providing comments on SECY-95-201, including practicable alternatives to the proposed options in the SECY paper and ACNW views on the significant consequences of the alternatives available to the Commission. We had the benefit of the documents referenced.

The ACNW has a number of concerns with the conclusions of SECY-95-201. While recognizing current budgetary constraints, the ACNW concludes that it is in the national interest to have a centralized LLW program within the NRC. This, we believe, is in concert with NRC's fundamental mission to protect the health and safety of the public and the environment. We strongly recommend that the Commissioners prioritize the LLW program in relation to all activities within the agency. On the basis of the assigned priority, the NRC staff should reevaluate the LLW program as part of the current reassessment-rebaselining effort, using its own expertise as well as the suggestions described herein, and structure a program that is responsive to the national need and the mission of the NRC.

The ACNW has reviewed the SECY document, and heard presentations from and held discussions with staffs of the Office of State Programs, the Office of Nuclear Materials Safety and Safeguards, the Department of Energy (DOE), various interested industry groups, and representatives from states and their associations that have responsibility in LLW management. In addition, the ACNW has received several written communications from states and others (referenced) that would be affected by the actions proposed in the

SECY document. Members and staff of the ACNW have attended several related meetings with state representatives. This topic was also a subject of discussion by the ACNW during its 78th, 79th, and 80th meetings.

II. ACNW Analysis of the Options in the SECY Document

SECY-95-201 describes three options regarding the future of the LLW program in the NRC. These options can be briefly described as: (1) continue the program as currently in place, (2) reduce the program by eliminating or reducing various parts, and (3) terminate all parts of the LLW program. The stress of budget reductions is cited in SECY-95-201 as the driving force for eliminating Option 1. The third option requires major changes in the legislation that mandates NRC's responsibilities. The SECY document concludes that, based on statutory requirements and budget restrictions, Option 2 is the only practicable alternative.

The Committee was unable to evaluate in detail the program as outlined in Option 2 because of the lack of specificity in resource allocations for various activities. Further, the use of terms in SECY-95-201 such as "limited" and "essential" to describe the resources and activities under Option 2 is notably ambiguous. In addition, we believe the staff has taken a pessimistic view of NRC's future activities in LLW disposal, and the proposed reductions in activities appear to conform to this evaluation. The staff is silent on the importance of the activities in the program and the rationale governing retention or elimination of the listed functions. The most important shortcoming of the SECY paper is the failure to address the question of what the LLW program ought to be in order to satisfy the mission of the NRC.

III. External Opinions

The overwhelming majority of the opinions expressed by representatives of industry groups, DOE, Agreement States, non-Agreement States, and associations of state officials that have responsibilities related to LLW were strongly opposed to reductions in the NRC LLW program activities. Only occasional recognition of NRC's need to reduce expenditures was evident. On the other hand, the view that NRC has an important role in supporting state activities and the need to maintain or even increase such support was a prominent part of the basis for urging substantial maintenance of the NRC program.

IV. The ACNW View of the Role of the NRC in LLW

Recognizing that the fundamental mission of the NRC is to protect the health and safety of the public and the environment, the ACNW has concluded that in the radioactive waste field, the management of LLW poses broader, more direct and ubiquitous potential risks to health and safety than any other activity. Factors contributing to

the risk of low-level waste include the long time frames associated with large volumes of uranium-contaminated waste, the performance of near-surface facilities for long-term disposal, and the existence of multiple disposal sites. Hence, the proper management of the storage and disposal of such wastes should command major attention from the NRC. We note that generating, storing, and disposing of LLW at multiple sites often affect the public and other stakeholders more directly than other activities in which NRC participates. We believe the NRC provides the important consistency and technical competence that these stakeholders require to ensure that their interests are protected. Finally, the orderly progress toward safe disposal of LLW requires a stable regulatory base that can only be provided by a centralized agency thoroughly involved in the LLW program.

The Agreement State program has shifted responsibility for many of the regulatory aspects of LLW to the states that participate in this program. It is clear that these states still rely on the NRC for technical and other support. Such reliance is important for several reasons. In addition to assuring consistency in regulation on a nationwide basis, a centralized source of information ensures that advances in the regulatory approach, e.g., use of risk-based regulations, are promulgated and implemented in an appropriate manner and on a timely basis.

The NRC brings two main strengths to interactions and activities in the LLW area: (1) its regulatory experience and (2) its technical expertise. The NRC's experience in developing LLW regulations and guidance, which is the foundation of all state LLW regulations, includes its ability to discuss, interpret, and clarify issues to various stakeholders with regard to 10 CFR Part 61 and supporting guidance. The NRC also maintains a very strong base of technical and scientific expertise among both staff and contractors that is recognized by most stakeholders. No other organization has the combined regulatory perspective and integrated LLW knowledge base and staff capability that NRC has developed and maintained. These strengths are important components of a coherent national regulatory framework for LLW.

The NRC has several groups within the agency that interact with the Agreement States and supports their needs. Not all of the LLW disposal regulatory activities are carried out by Agreement States, and those few states that are neither part of a compact nor an Agreement State clearly depend on the NRC to regulate LLW disposal activities. Finally, the LLW research activities carried out by the NRC tend to be important to a wide range of LLW disposal problems.

V. Consequences of Options 2 and 3 in SECY-95-201

Although it is difficult to predict the ultimate impact of implementing major reductions in the NRC LLW program, we believe that

several potentially undesirable consequences could accrue if this were to be done in accord with Options 2 and 3 of the SECY paper.

- A. The ACNW is concerned about the already fragmented regulatory base for radioactive materials. Under present law, radioactive materials may be regulated by the NRC, DOE, EPA, or the states, depending on Agreement State status, on the presence of other hazardous materials in the waste stream, or on the concentration of radionuclides in the waste. Fragmentation would be exacerbated if Options 2 or 3 were implemented. Inconsistencies, overlap, and gaps in regulatory boundaries will be the likely result and should be avoided.
- B. Some of the Agreement States have requested technical advice from the NRC in licensing LLW facilities. Under Options 2 or 3, this high-quality technical expertise may no longer be available. As a consequence, it may be difficult to respond with technically competent advice.
- C. The absence of a strong, centralized NRC program could be a detriment to the siting and operation of LLW facilities in certain states. This situation could recreate the difficulties that existed before the compact-forming legislation and could hinder the orderly disposal of LLW widely distributed throughout the states.
- D. In the absence of a broad, continuing NRC LLW program, as envisioned in Options 2 and 3, the updating and revision of LLW regulations that take advantage of experience and changes in basic standards is problematic. This could result in health and safety performance measures and other requirements that may be inconsistent and may not be optimized for safety, economics, and long-term impact on the public.
- E. In our view, the absence of a centralized, competent NRC LLW program will diminish the perception that public health and safety are assured. The result will likely be an increased reluctance to allow the use of radioactive materials, to the detriment of society in energy, medicine, and commerce.

VI. Observations and Recommendations

The ACNW believes that none of the three options provided to the Commission in SECY-95-201 is satisfactory. The budgetary focus of the SECY document fails to address the fundamental responsibility of the NRC. Budgetary reductions need to be made in accordance with priorities set with reference to the underlying mission of the NRC. Owing to the importance we believe should be assigned to the LLW program activity, which is directly connected to the public health and safety, we recommend that the LLW program should contain or recapture the following elements:

- A. Staff assigned to the LLW program should include experts in each of the technologies critical to evaluation of the siting, environmental impact, operation, and closure of LLW facilities. Specific expertise among staff and contractors should be maintained in the following areas: infiltration; engineered barriers performance; source term, including near-field flow, geochemistry, and transport; hydrology, including groundwater flow and transport, surface-water flow and transport, and the development of appropriate pumping-well scenarios; and dose, including dosimetry, uptake, and development of reference biosphere models. The staff should also maintain LLW performance and risk assessment capabilities.

The ACNW is concerned that the level of effort committed to LLW has been declining and notes that the continuing reduction of capability as indicated in Option 2 has been a de facto process for several years. We believe this trend should be unacceptable to the Commission. The existence of experts in state agencies distributed throughout the country is not a deterrent to the creation and maintenance of NRC staff experts in a centralized agency.

- B. The NRC LLW program needs to provide technical assistance to those preparing license applications for LLW disposal facilities. Although the various jurisdictions have differing regulations concerning the content and standards for such applications, the broad expertise of the LLW program staff is directly applicable to the commonalities of disposal sites and facilities. We have previously commented on the obvious need for support to the agencies or groups preparing license-related technical or scientific material and have recommended that the NRC staff develop broad guidelines that could be used by such groups to form their own peer review and oversight panels. We reiterate this recommendation and believe it should be part of the NRC LLW program.

In addition, the NRC staff should provide to Agreement States and others such guidance (e.g., staff technical positions) as is needed, first on a generic basis and then on a site-specific basis, unless it is clear that the same information is readily available from other sources. In particular, the Branch Technical Position (BTP) on LLW Performance Assessment is an important and appropriate guidance document because it integrates updated technologies and methodologies for LLW Performance Assessment with regulatory requirements under 10 CFR Part 61. The BTP on LLW Performance Assessment also provides an important transition to a more risk-based approach to LLW regulation from traditional deterministic approaches.

- C. In view of the pending prelicensing activities of the non-Agreement States, the agency needs to maintain its capability

for processing license applications from non-Agreement States for LLW disposal facilities in a timely fashion, and for other licensing activities described in the SECY paper. The ACNW recognizes that flexibility exists to use resources from different waste programs.

- D. The staff proposed in the SECY paper that research in LLW areas be eliminated. We agree that selected long-term studies that have been under way for some time should be brought to closure in a manner that ensures that their value is not lost. The planned "transfer" of support for selected research activities from LLW programs to Site Decommissioning Management Plan (SDMP) programs is appropriate. However, such a transfer requires detailed examination of the importance of such expenditures in light of prioritized needs of the NRC staff responsible for SDMP activities. Finally, limited research activities in the LLW program should be identified and supported by priority judgments. These priorities should be derived from performance assessments for a variety of facility designs and locations. Further, the research should be applicable to a broad range of LLW facilities and operations. The NRC needs to involve the states in identifying, developing, and monitoring these research activities. In addition, the Office of Nuclear Regulatory Research (RES) should be encouraged to ensure that this research and resulting technology is transferred more directly to the states.

- E. Activities targeted for termination or for limited support under Option 2 may be sufficiently related to the mission of the NRC to warrant more expanded attention than indicated in the option. These activities and the ACNW recommendations are as follows:
 - 1. The review of topical reports has, as we understand it, already been discontinued. We believe this is a mistake. In any event, the NRC staff should maintain the technical capability to review topical reports and to evaluate technical information included in license applications.
 - 2. We strongly recommend that the NRC maintain and strengthen the ability to review the quality of Agreement State LLW programs. The Committee urges that the reviews of adequacy and compatibility include increased emphasis on the technical aspects of the programs. This activity falls directly within the mission of the NRC, as we have noted earlier.
 - 3. We believe it is important for the NRC to represent the United States in both national and international activities relating to LLW disposal regulations and standards. Attention should be given to the waste activities of the IAEA/NEA and, for example, the efforts of Europe, Canada,

and Japan. This is particularly important in light of the foreign technology being incorporated into some state disposal systems. We recognize that such participation will require judicious use of resources.

4. Although the ACNW does not encourage the removal of the import/export authorizations and emergency access request evaluations, these activities could be managed by a different agency, as suggested in SECY-95-201, provided that the safety standards promulgated by the NRC are not compromised.
5. Technical expertise should be available to ensure that LLW regulations are revised and updated to be consistent with NRC's transition toward risk-based regulation and with Environmental Protection Agency (EPA) standards.

VII. Proposed Actions

The Committee proposes that:

- A. the Commissioners evaluate the priority of the LLW program relative to other agency programs on the basis of (1) public health and safety and (2) the national need for a centralized source of regulatory and technical expertise to ensure a consistent, adequate, and coherent approach to LLW programs; and
- B. on the basis of the priority assigned to LLW by the Commissioners, the NRC staff reassess the elements of the LLW program as part of the rebaselining process, using the recommendations presented above, and configure these elements into a program that is responsive to the national need.

Sincerely,

Paul W. Pomeroy
Chairman

References:

1. SECY-95-201, Memorandum dated July 31, 1995, from James M. Taylor, NRC Executive Director for Operations, for the Commissioners, Subject: Alternatives to Terminating the Nuclear Regulatory Commission Low-Level Radioactive Waste Disposal Program
2. Staff Requirements Memorandum dated September 14, 1995, from John C. Hoyle, Secretary of the Commission, to James M. Taylor, NRC Executive Director for Operations, Subject: SECY-95-201 - Alternatives to Terminating the NRC's Low-Level Radioactive Waste Disposal Program

3. Letter dated November 9, 1995, from R. E. Gingerich, CT LLRW Program, Connecticut Hazardous Waste Management Service, to Paul W. Pomeroy, ACNW Chairman, regarding comments on NRC's Low-Level Radioactive Waste Program
4. Letter dated November 15, 1995, from J. B. Deshais, Northeast Interstate Low-Level Radioactive Waste Commission, to Paul W. Pomeroy, ACNW Chairman, regarding NRC's Low-Level Radioactive Waste Disposal Program
5. Letter dated November 8, 1995, from J. R. Weingart, New Jersey Low-Level Radioactive Waste Disposal Facility Siting Board, to Paul W. Pomeroy, ACNW Chairman, regarding NRC's Low-Level Radioactive Waste Program
6. Letter dated November 15, 1995, from M. Alissi, Nuclear Energy Institute, to Paul W. Pomeroy, ACNW Chairman, regarding NRC's Low-Level Radioactive Waste Program

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

February 9, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: ISSUES AND NRC ACTIVITIES ASSOCIATED WITH THE NATIONAL RESEARCH COUNCIL'S REPORT, "TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS"

During its 80th meeting on December 19-21, 1995, the Advisory Committee on Nuclear Waste (ACNW) was briefed on activities associated with the subject report. The Committee heard two presentations from the staff. The first reported on the staff's activities in anticipation of receipt of a Yucca Mountain standard from the Environmental Protection Agency (EPA) to be issued later this year. The second presentation was specific to the technical analyses being performed relative to the National Research Council's recommendations. Also, at its 77th meeting on September 21, 1995, the Committee was briefed by Robert W. Fri, Chairman of the National Research Council's committee that prepared the report.

The Committee is prepared to provide at this time only preliminary comments on the implications of the report and on the activities of the NRC staff. Many important issues are associated with the development of the standard and the Nuclear Regulatory Commission (NRC) regulations that must conform with it. Some topics, such as the "critical group" require more study by the Committee before specific recommendations can be made. It is to be noted that the Committee has commented on many of the issues discussed herein in previous letters. These issues include the concept of defense in depth (September 30, 1994), compliance time frames for repository performance (March 3, 1993), human intrusion (February 5, 1993), and critical group (May 1, 1990, January 29, 1991, April 29, 1991, September 30, 1992, and February 5, 1993).

In general, NRC staff activities connected with the standard are satisfactory. The principles being applied by the NRC staff include a strategy of developing Yucca Mountain specific regulations, keeping the regulations as simple as possible, and focusing on key issues such as the implication of a peak risk standard and regulations specifically designed to reflect a risk- and health-based standard. These principles are appropriate and

sound. The staff appears to have effectively identified many other specific issues that will need special study and consideration before the regulations can be modified or developed. Such specific issues include time frames of compliance, definition of the biosphere and the critical group, calculation of peak dose (risk), human intrusion, and subsystem performance. The Committee was pleased to see the staff analyses include different exposure scenarios and conditions as this will enhance the staff's ability to respond effectively to any standard the EPA may propose. On-going technical interaction between NRC and EPA staffs as the EPA develops a proposed standard is an important activity. The Committee urges the staff to maintain what appears to be a sound program.

Preliminary conclusions and recommendations of the Committee are: there needs to be serious consideration of retaining a compliance time frame in the planned standard and regulations, subsystem performance needs to be quantified but not prescribed in advance, human intrusion should not be a part of the standard or the regulations except in a general way, and neither the standard nor the regulation should be tied to the EPA groundwater risk standard. While not a major topic in this letter and as discussed in the National Research Council's Yucca Mountain standard report, the Committee believes that the concept of a "negligible risk" needs revisiting in view of the possibly very long time frames associated with the application of a peak dose calculation and the extreme difficulty of defining acceptable risk.

The following specific points are briefly discussed below:

- regulatory time frame
- definition of the biosphere and the critical group
- foundation of the standard: population or groundwater
- human intrusion
- the defense in depth policy and the matter of subsystem performance criteria
- NRC conformity with EPA in a separate Yucca Mountain regulation
- NRC staff activities

Regulatory Time Frame

Extreme uncertainties in the prediction of magnitude and time of the peak dose are highly likely. Also we concur with the strong desire for regulations to be as simple as can be reasonably achieved. These factors contribute significantly to the Committee conclusion that a specified regulatory time frame for repository performance is necessary. The Committee believes that the balance of factors accompanying modification of the 10,000 year time frame results in no clear advantage for changing the present approach, but will conduct additional reviews on this topic in the near future through working group meetings.

Definition of the Biosphere and the Critical Group

Because the site is known, the opportunity exists to develop a very focused definition of the biosphere. The Committee urges NRC staff to take full advantage of the known site characteristics (land use, climate, habitation potential, potable water sources and usages, etc.) in any proposals to define the Yucca Mountain biosphere. In particular, the Committee believes that the definition of the biosphere should include such elements as risk-relevant pathways, locations and withdrawal rates of wells, and uptake factors of biological systems of the Yucca Mountain site. The Committee sees the biosphere definition as an extremely important opportunity to achieve simplicity in the regulations.

The Committee will require more time to study the topic of the critical group. The Committee recommends that the treatment of the critical group issue be consistent with the concept of a risk- and health-based standard. The Committee believes that the definition of the critical group should be determined by the compliance time frame and on any supporting evidence, including the uncertainties involved.

The Committee believes that if definition of the biosphere and the critical group were to be accompanied by a threshold dose to humans below which the repository would be deemed in compliance, it would represent a major accomplishment in the field of practical, risk-based regulation.

Foundation of the Standard: Population or Groundwater

The Committee has previously expressed concern over using a groundwater contamination requirement for resource protection as a surrogate for protecting the health and safety of the public against the effects of ionizing radiation. Because of the extremely long times involved and the uncertainty in the dose calculations at levels approximating the groundwater standard, invoking the groundwater standard would be inappropriate and not in concert with traditional nuclear regulation.

Human Intrusion

For time frames on the order of thousands of years, it is not reasonable to preclude consideration of human activities that could violate the integrity of the repository. The Committee believes it is better to focus on a well-designed repository that retains its integrity over a long period of time under conditions of the natural geological setting. It is then possible to consider different scenarios of human intrusion to further gain confidence in the general performance of the repository.

The Defense in Depth Policy and the Matter of Subsystem Performance Criteria

In previous letter reports, the Committee has expressed strong support for the concept of defense in depth for achieving safety. We continue to believe that multiple lines of defense are important where there is considerable uncertainty about the risk of a facility. In the case of Yucca Mountain (the site is known, the inventory and characteristics of the waste are known and there will be only one design), we believe it unnecessary to put as much emphasis as we have in the past on such subsystem requirements as container performance, rate of release from engineered barriers, and groundwater travel time. The Committee believes that under the specific conditions of the Yucca Mountain repository, the basis exists for less stringent and more flexible subsystem requirements than have been traditionally imposed. Emphasis should be placed on the contribution of subsystems to overall performance of the repository. The Committee strongly favors quantifying all subsystem performance, engineered and natural, in the performance assessment. Should it be clear from an assessment that a waste container, an engineered barrier, groundwater travel time or another potential subsystem is a particularly critical factor in total system performance, then a logical basis exists for making decisions on how to improve the overall safety of the repository.

NRC Conformity With EPA in a Separate Yucca Mountain Regulation

Pursuant to the Energy Policy Act of 1992, NRC regulations must conform to the final EPA standards within one year. Since the EPA standard will be specific to Yucca Mountain, it follows that NRC regulations should be site specific. Close cooperation between the two agencies is needed to make the standard and the accompanying regulations as seamless as possible. The Committee believes the joint working group is an excellent way to discuss how best to address some of the issues raised by the National Research Council report. The Committee considers the establishment of a technical liaison in frequent contact with EPA a very positive action that should pay excellent dividends. The Committee strongly urges that this process be maintained.

NRC Staff Activities

The Committee agrees with the NRC staff's approach in performing technical analyses related to the National Research Council's recommendations concerning the Yucca Mountain standard. The decision to use existing information and models, including the Iterative Performance Assessment Phase 2 model, to develop near-term insights on such issues as the evaluation of peak doses, to examine critical data needs, and to use conceptual models is sound. The evaluation of scenarios involving different exposure conditions, compliance periods, etc., is an excellent way to anticipate potential problems with implementing a risk-based

standard. The ability to share and discuss the findings with EPA is extremely important to the development of a technically practical standard. Meanwhile, the NRC staff is accumulating experience for efficient in-depth and comprehensive analyses once the standard and regulations are established.

The Committee strongly recommends that these analyses be sharply focused on conditions specific to Yucca Mountain. Besides emphasizing Yucca Mountain conditions, the Committee recommends realistic calculations wherever possible with respect to such phenomena as radionuclide retardation in fracture flow, dispersion effects in the transport models, and a judicious selection of such events as earthquakes and igneous activity. The assembly and analysis of data will strengthen the staff's understanding of the performance of the site.

We provide here only preliminary observations, conclusions, and recommendations. We believe the evolution of the standards and regulations for the proposed Yucca Mountain repository is a very important activity for NRC and EPA and plan to maintain awareness of the progress made. We urge the NRC staff to pursue these programs in a timely manner.

Sincerely,

A handwritten signature in dark ink, reading "Paul W. Pomeroy". The signature is fluid and cursive, with the first name "Paul" being the most prominent.

Paul W. Pomeroy
Chairman

Reference:

"Technical Bases for Yucca Mountain Standards," National Research Council, 1995

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

February 16, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: COMMENTS ON HIGH-LEVEL WASTE PRELICENSING PROGRAM
STRATEGY AND KEY TECHNICAL ISSUES

This letter communicates our recommendations and suggestions on the "Revised Prelicensing Program Strategy for the U. S. Nuclear Regulatory Commission High-Level Waste Repository Program ('Vertical Slice Approach')" and the NRC staff's plans for resolving key technical issues (KTIs) dealing with the proposed high-level waste (HLW) geologic repository at Yucca Mountain, Nevada. These remarks are based on presentations by the NRC staff to the Committee concerning the vertical slice approach at the 77th ACNW meeting, September 1995; on key technical uncertainty integration and resolution of KTIs at the 79th ACNW meeting, November 1995; and subsequent deliberations of the Committee.

The Committee is aware of the changing emphasis and scope of the NRC's HLW prelicensing strategy as a result of modifications in the Department of Energy's (DOE's) site suitability investigations and prelicensing programs and the reductions in resources to both DOE and NRC. Although there are uncertainties in implementing plans and projecting strategies, we wish to support the general approach of the NRC staff in dealing with both the program strategy and the KTIs.

The ACNW commends the staff for its development of a vertical slice concept designed to focus the HLW program on the most critical licensing issues. In particular, we are pleased to learn of the emphasis on risk to repository performance in identifying elements of the prelicensing strategy and plans for conducting the program. We support the emphasis on issue resolution, but not to the point of compromising legitimate concerns that could impact the health and safety of the public. Other concerns include the need to develop review and acceptance criteria to determine the adequacy of bounding analyses, an apparent lack of emphasis on coupled processes, and the need to maintain sharp focus on risk to the predicted performance of the repository.

Revised Prelicensing Program Strategy

The revisions in the NRC HLW prelicensing program strategy (vertical slice approach) incorporate a comprehensive review of critical issues in the DOE program that have the highest risk of noncompliance with regulations for licensing an HLW geologic repository at Yucca Mountain, Nevada. An important objective of the program is to provide DOE with timely information required for a substantially complete license application. The program is designed to increase the efficiency and effectiveness of NRC's prelicensing activities in view of the changes being made in the DOE prelicensing program and the decreasing resources available to the HLW programs of both agencies. The Committee notes many strengths of the vertical slice approach, including: its focus on the key licensing problems, recognition of the need for flexibility in designing and implementing the program, the integration of disparate key technical uncertainties (KTUs) into KTIs, the integration across and within scientific/technical disciplines, the emphasis on resolving issues with DOE, and the potential for efficiency in utilizing scarce resources.

The NRC staff acknowledges and discusses potential weaknesses of the vertical slice approach in the September 1, 1995 draft of the revised "Prelicensing Program Strategy" document. We support the concern raised in this document that a less than comprehensive approach to prelicensing has some inherent risks. The currently identified list of key issues may not be complete. Our ability to specify these issues is limited by the technical and scientific complexity of the unprecedented effort to license the potential HLW repository at Yucca Mountain. A focused prelicensing program that eliminates substantial issues from review or that is inflexible with regards to selection of KTIs is possibly open to problems. The Committee urges the staff to remain flexible with regard to the selection of KTIs. Performance assessment, expert judgment, experimental programs, and special studies are all valuable procedures for evaluating existing KTIs and identifying new ones.

The Committee has developed the following observations and recommendations on the basis of its evaluation of the NRC's HLW prelicensing program:

1. Issue resolution, which is an important objective of the vertical slice approach, is also important to the progress of licensing the HLW repository. The issue resolution approach should focus on health and safety to the public, reduction of uncertainties in meeting reasonable assurance criterion, and decreasing the risk of noncompliance with the regulations. This requires a cautious approach to issue resolution. In view of the complexity of the problems involved in the repository, it is likely that differences will remain between DOE and NRC on some issues. These differences, and the

evidence supporting them, need to be fully documented with the expectation that these matters will be presented before a licensing board. Resolution should not be required by NRC, and DOE should not be required to conduct data acquisition and analysis it believes to be unwarranted.

The design of the vertical slice approach regarding the actual procedures to resolve issues continues to evolve. The Committee notes that the NRC recently proposed to DOE a process for resolving issues, entailing interactions, documentation, and generic criteria. This process includes the disaggregation of KTIs into subissues. The Committee believes this process needs to assure that the disaggregation mechanism maintains the integral nature of the KTIs and their impact on health and safety. An NRC/DOE task force will be established to review the process. Instruments for specifying and documenting resolution, such as the NRC Issue Resolution Reports, letter reports, Prelicensing Evaluation Reports, and Safety Evaluation Reports, will be developed. But, it is unclear how actual resolution of the KTIs will be achieved between DOE and NRC.

In the interest of achieving the efficiency that is central to the vertical slice approach, criteria should be developed to determine when activities should be terminated within a specific vertical slice. DOE is planning to rely on bounding analyses for decision making. We urge the staff to expeditiously develop methods and acceptance measures to review bounding analyses by using the iterative performance assessment framework. We anticipate that these measures will be significant in establishing termination criteria.

2. The NRC will receive numerous data synthesis and process model reports from DOE in 1996. These reports will synthesize the information available on a topic and will provide a source of reference for the related data. Such reports appear especially important to prelicensing activities because they presumably will contain DOE's approach to bounding analyses. The Committee recommends that the NRC give high priority to reviewing these reports as rapidly and thoroughly as possible so that DOE is informed of any NRC licensing concerns and data needs before it completes its prelicensing activities and makes a decision about repository viability.
3. The vertical slice approach should involve an iterative process within and among vertical slices. We believe the iterative process is important to successfully complete a review and needs more emphasis in the description and implementation of the vertical slice approach. The Committee believes it important to have a process for guiding the

iterations of the KTIs in concert with the iterations of the performance assessment.

4. NRC must ensure that its schedule to conduct priority activities is synchronized with DOE's revised schedule of activities and milestones. Given the uncertainties in DOE's program and budget, NRC should review previously defined time constraints in the prelicensing program. Modifications may be necessary because of current and anticipated funding and staffing limitations and the need to maintain the highest quality products from the NRC.

Key Technical Issues

The Committee supports the important activity of recognizing KTIs through the process of integration of KTUs previously identified through the Systematic Regulatory Analysis Program. We generally agree with the criteria the staff used in this process. We especially support the use of risk to repository performance as the prime criterion wherein both probability of occurrence and consequence are considered. We have the following observations and recommendations pertinent to the identification of KTIs and their investigation in the vertical slice approach:

1. We note that DOE has taken exception to identifying Igneous Activity and Structural Deformation and Seismicity as significant KTIs. We believe that these issues should continue to be subject to review in the vertical slice approach because of the controversy regarding their potential risk to the repository performance. Igneous Activity is important as a KTI because of the uncertainties associated with the probability of occurrence of igneous events and their impact on the repository. Structural Deformation and Seismicity is also significant as a KTI because of the need to determine the level of seismic hazard and to evaluate direct effects on waste containers and engineered barriers. In addition, indirect effects on repository performance resulting from modifications in near- and far-field flow and transport properties of geologic strata and water table elevation changes need further consideration.
2. The Committee is not satisfied that the issue of Thermal-Mechanical-Hydrological-Chemical Coupled Processes is moving toward resolution. Elements of this issue are treated only within individual KTIs. The process by which they are integrated and evaluated as a total system is unclear. Presumably, it will be considered in the Total Systems Performance Assessment (TSPA) and Technical Integration KTI. However, the strong possibility exists that the interaction of phenomena and their resulting modifications of parameters and processes may be neglected in the face of the major emphasis

on TSPA in this KTI. The Committee is concerned with the issue of coupled processes and supports a strong program to resolve this issue with the vertical slice approach.

3. The Committee has long had a major interest in the integration of site characterization activities and their conclusions. We are pleased to see a KTI that considers integration. However, it is unclear at what level(s) integration will be considered in the KTI and how the results of other individual KTIs will be brought into the integration KTI. Further, it is unclear whether components involved in integration will be available in a timely manner. TSPA and Technical Integration is a particularly significant KTI because it will play a key role in establishing the importance of issues and subissues to overall repository performance.
4. The priority rankings assigned to KTIs by staff are open to question. In view of the central role of repository design on DOE's proposed viability assessment, we encourage the staff to place high priority on all KTIs that are closely tied to repository design considerations, since we believe that mixing of scientific/technical issues with management/policy issues has the potential to confuse priorities.
5. The Committee has a longstanding interest in performance assessment and the veracity of the attendant codes and models. DOE will be attaching major importance to its TSPA-1997/1998 results in the conclusions of the viability assessment. In view of the drastic reduction of the site characterization and related studies, it will be particularly important for NRC to conduct confirmatory performance assessments and to evaluate the performance assessment codes and models used by DOE. We note that the latter activity has been removed from the TSPA KTI. This decision should be reconsidered.
6. The NMSS staff has considered preparation of a yearly status report on KTI activities and results. This excellent proposal will prove useful to NRC and DOE. We urge that it be implemented.

Summary

The ACNW commends the staff for its revised HLW Prelicensing Program Strategy (vertical slice approach) and the identification of KTIs that will be the subject of prelicensing activities. The Committee recommends that the staff ensure that there is a mechanism to provide rapid and continued input to DOE to influence the site viability decision, data collection, testing, and TSPA. In addition, the staff needs to periodically reevaluate the list of KTIs on the bases of new information, new analyses, and issue

resolution while staying focused on issues impacting repository performance.

The Committee has made several suggestions which, if accepted, should sharpen the vertical slice approach and its implementation. The Committee wishes to be kept informed of the progress of the vertical slice program and to be included in review of the staff's related products, such as Implementation Plans, Issue Resolution Reports, and the Performance Evaluation Reports.

Sincerely,

Paul W. Pomeroy
Chairman

Reference:

U. S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, "Revised Prelicensing Program Strategy for the U. S. Nuclear Regulatory Commission High-Level Waste Repository Program ('Vertical Slice Approach')," September 1, 1995

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

June 7, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: TIME SPAN FOR COMPLIANCE OF THE PROPOSED HIGH-LEVEL WASTE
REPOSITORY AT YUCCA MOUNTAIN, NEVADA

The purpose of this letter is to communicate the Advisory Committee on Nuclear Waste's (ACNW) observations and suggestions on the general principles for establishing the time span for compliance of nuclear waste facilities and our recommendations for specifying the regulatory time frame of compliance for the proposed geologic high-level waste (HLW) repository site at Yucca Mountain, Nevada. This letter follows up a letter from the ACNW dated February 9, 1996, on "Issues and [U.S. Nuclear Regulatory Commission] NRC Activities Associated with the National Research Council's Report, *Technical Bases for Yucca Mountain Standards*."

The time period for compliance of geologic HLW repositories is established at 10,000 years in the Environmental Protection Agency (EPA) standard 40 CFR Part 191 and the NRC regulation 10 CFR Part 60. Elements of the HLW standards and regulations were scrutinized by a National Research Council/National Academy of Sciences (NAS) Committee, which was prescribed by the Energy Policy Act of 1992. The findings of the NAS Committee are published in the *Technical Bases for Yucca Mountain Standards* (National Research Council, 1995). The NAS Committee concluded that there was no scientific justification or basis for specifying a truncation of the analyses at 10,000 years or at any other period of time. Instead, it recommended that the compliance evaluation be conducted to peak risk within the limits of the basic geologic stability of the Yucca Mountain region, which it suggested was on the order of a million years. In contrast to this recommendation, the ACNW has supported the 10,000-year time frame (e.g., letters to the Chairman of the NRC of June 27, 1991, and February 9, 1996). Nonetheless, in our most recent letter on this topic, the ACNW stated that further deliberations on the subject were appropriate. This letter reports on the results of our additional study. The ACNW will report to you in the near future on our recommendations on the time span for compliance of low-level nuclear waste facilities, building upon the

principles identified and discussed in this letter. In addition, the ACNW plans to review the reference biosphere and critical group issues.

Our recommendations are derived from a working group meeting on "Regulatory Time of Compliance for Radioactive Waste Disposal" held during the 82nd meeting of the ACNW on March 27, 1996, and subsequent deliberations by the Committee. Three main topics were discussed at the working group meeting: (1) background and regulatory context for the existing HLW standard that specifies 10,000 years as a time frame for regulatory compliance, (2) insights on time of compliance from performance assessments for both high- and low-level nuclear waste, and (3) scientific/technical issues and concerns. During the working group meeting, presentations were made by personnel from the EPA; the Division of Waste Management, Office of Nuclear Materials Safety and Safeguards, NRC; the U.S. Department of Energy; the National Research Council staff; the Electric Power Research Institute; the Oak Ridge National Laboratory; as well as by individuals from private industry and academia. The latter individuals provided both national and international viewpoints on the problem of compliance time in regulations.

Background of the Problem

A necessary element of a standard or regulation that ensures the health and safety of the public is the compliance period -- the time that the risk of adverse consequences is below a specified level. This compliance period requires the integrity of the facility over the stipulated time interval. In the case of an HLW repository, the assessment of risk involves evaluation of the repository source term, including inventory and waste form; the performance of waste containers and engineered barriers; and the geological, hydrological, and climatological attributes of the site. If the risk of health effects is to be determined, this assessment also involves the specification of the biosphere and the critical population group in proximity to the repository.

In the existing generic standard for geologic HLW repositories, 40 CFR Part 191, EPA established a 10,000-year time of compliance at a distance of no more than 5 km from the boundary of the repository -- a time value that also was used in the NRC regulation. This time period has no scientific or technical justification but was based on an arbitrary compromise between conflicting desirable characteristics. Long time periods have attendant large uncertainties in the behavior of the geosphere and the biosphere, while short time periods have lower uncertainties but do not adequately address the time spans of some of the critical processes that cause release of radionuclides to the biosphere. This compromise was perhaps a justifiable approach for comparative evaluation of the

multiple sites being considered when 40 CFR Part 191 was promulgated. Although not considered a compelling technical basis, this time period was roughly consistent with the period of glacial cycling and the potential profound impact of continental glaciation upon the geosphere and the biosphere. In providing a rationale for the 10,000-year time limit, the EPA stated, "This is not to say that times beyond 10,000 years are not important, but the Agency feels that a disposal system capable of meeting the proposed Containment Requirements for 10,000 years would continue to protect people and the environment well beyond 10,000 years." Although the standards of other nations differ in detail, the international community largely accepts the 10,000-year time frame, but also recognizes the need to evaluate site performance beyond the 10,000-year period, which constitutes a two-part approach.

In its appraisal of the technical bases for site-specific Yucca Mountain standards, the NAS Committee rejected the 10,000-year compliance period although it accepted that a transition to a glacial climate with its cooler, wetter seasons is probable during the next 10,000 years. Rather, the NAS Committee decided that long-lived radioisotopes derived from the repository might not reach the biosphere for more than 10,000 years, and thus it is important to evaluate the repository for a longer time interval. The NAS Committee chose to set this period of time at the predicted time of peak risk to the population as a result of leakage from the repository. It viewed this decision as requiring a period of time possibly extending into hundreds of thousands of years. In so doing, it did not accept the view espoused in the EPA and NRC standards and regulations that the uncertainties in predicting the repository performance at these periods are so large that the results are of questionable utility. The basis of the argument is that the subsurface environment at the repository horizon of Yucca Mountain is sufficiently stable that repository performance can be assessed with an acceptable uncertainty over a period of roughly one million years. The NAS Committee believes that inherent spatial uncertainties in interpolation of site characteristics, which are time independent, are a major contributor to assessment uncertainty.

The dilemma faced in developing the time span of compliance is that the period of time must be sufficiently long to include the evaluation of potential processes leading to the loss of the integrity of the repository and transport of radionuclides to the biosphere. Yet the time span should not be so long that the uncertainties in the process and events, and in the biosphere and critical population group, lead to meaningless results. In the case of a specific site, sufficient information should be available so that reasonable assumptions can be made in order that a defensible solution can be reached regarding the problem of a regulatory period of compliance. This approach is based on general

principles and knowledge of the engineering and scientific aspects of the repository and its site.

Considerations in Defining a Time of Regulatory Compliance

After reviewing the basis for establishing a time of regulatory compliance, the ACNW has concluded that a series of premises and assumptions are a necessary foundation for the decision making process. These include general policy decisions that are generic and a range of scientific and technical considerations that are largely specific to the site and problem:

- The HLW repository system -- waste, containers, engineered barriers, and site geology -- must be capable of preventing leakage of radionuclides to the biosphere for a minimum period of time measured in several thousands of years.
- Risk evaluation is based on characterization of the repository site and investigations of the waste and its container and engineered barriers using performance assessment (PA). However, in the development of the regulations, the marked limitations in using PA as a predictive tool needs to be recognized. PA is primarily an investigative tool that can be used to distinguish between positive and negative attributes of the elements of the repository and, in the best of conditions, the relative range of risk under various assumed scenarios.
- The standard for a nuclear waste repository should be based on limiting risk to a critical group without the constraint of a prescribed time period of compliance. A time period should be defined in the regulations that implement the standard and should be prepared in concert with the characteristics of the waste, engineered barriers, and the nature and vagaries of the geosphere and the biosphere of a specific facility and site.
- The reference biosphere and the critical group that are used in assessing compliance should be defined in the regulations. These definitions are necessarily based on site characteristics and on the impact of climate and predicted climate modifications. They are related to predictions of the nature of society through time. Because of the great uncertainties in the latter, the ACNW recommends that the current societal state be used as the base scenario in predictions of the future states of society.
- Uncertainties in assessing future risks associated with the geologic/geographic setting and the repository design and related engineered features will increase with time. Factors that influence this increasing uncertainty include the

following: geologic conditions and events that may disrupt the repository; climatic changes that could drastically increase the flux of water through the disposal system or change the regional hydrologic flow regime; degradation of the waste containers or repository materials; and synergistic effects of changing site conditions on the degradation of repository features. Design features can be implemented to preclude extreme variations in releases (e.g., waste forms, containers, and near-field barriers may be engineered to minimize transport out of the immediate repository facility and thus minimize uncertainties in transport for several thousand years).

Regulatory Principles for Establishing the Time Span for Compliance

On the basis of the preceding considerations, the ACNW recommends that a two-part approach to definition of the compliance period be established for nuclear waste facilities. The first part involves the following three elements:

- (1) The time period for compliance should be based on the estimated time for release and transport of the radionuclide contaminants to reach the critical group. This time estimate should be based on geologic, geochemical, and hydrologic characterization of the site and its environs, as well as regional study of geologic processes and their potential effects on the site, and total systems performance assessment. This estimate must confirm the ability of the repository system to retain radionuclides for a minimum of several thousand years. The selection of the time of compliance must be evaluated along with the specification of the reference biosphere and critical group.
- (2) The reference biosphere and the lifestyles of the critical group should be defined on the premise that no major changes will occur in society that will significantly affect their lifestyles as they relate to risk from the repository and that the climate can be reasonably bounded. The minimum distance from the boundary of the repository to the critical group will be a major decision.
- (3) The compliance time should be sufficiently short such that extrapolations of significant processes and their rates can be made robustly with reasonably modest uncertainties.

The second part of the compliance period regulations should be based on assessments extending from the specific compliance period to the calculated time of the peak risk to the critical group. There is no definitive measure of compliance in the sense of a numeric match between a standard and the calculated peak risk, and

this second part should not be allowed to become a de facto regulation. A comparison between the standard used in the first part and the calculated peak risk should lead to identification of important performance factors that define risk to the critical group. Depending upon the extent to which the peak risk exceeds the standard, ameliorating actions to reduce this difference should be initiated, such as increasing the integrity of the engineered barriers, improving site characterization to more closely bound uncertainties, or, in the extreme, abandoning the candidate site.

Scientific and Technical Insights Into the Time Span for Compliance of the Proposed Yucca Mountain Repository

Critical steps in the regulatory principles for establishing time of compliance as specified above in element (1) are the characterization of the proposed repository site and the relevant processes acting upon it and assessing the total system. Although site characterization is still in progress at Yucca Mountain, extensive data have been acquired and information has been derived from these data. The following scientific and technical insights that have been gained at the site over the past decade bear upon the definition of the compliance time in the forthcoming regulations designed specifically for Yucca Mountain.

- The current climate in the Yucca Mountain region is arid, with annual precipitation of roughly 15 cm. In the future, the climate will change, depending upon the relative importance of advancing cooler (glaciation) conditions and possible greenhouse effects that may counteract the cooling effect. Although the timing and precise amplitude of the climate change cannot be predicted, the range of conditions can be bounded in terms of timing and effect. Paleoclimatological studies in the region of Yucca Mountain suggest that during the last glacial period (14 to 20 thousand years ago) the precipitation may have been four times the present and the average annual temperature 10 °C cooler (Forester and Smith, 1995). Climatic conditions are anticipated to change, but the region is likely to be at least semiarid and will lie south of the glaciated area. Thus, it is unlikely that climate change will have a marked effect on the reference biosphere or the lifestyle of the critical group. Infiltration is likely to significantly increase as a result of the increased precipitation and cooler temperatures, but the total flux through the repository will still be limited. The maximum climatic change is not predictable with our present science, but all evidence from extrapolations indicates that the principal effect will occur prior to ca. 20,000 years.
- Results of recent site characterization activities at Yucca Mountain indicate that matrix, fracture, and fault infiltra-

tion are present in the unsaturated zone. Matrix flow results in long travel times, but fracture and fault flow that may lead to relatively rapid travel times also occurs. Ground water travel times within the saturated zone between Yucca Mountain and the location of the critical group, which is likely to reside in the Amargosa Valley several tens of kilometers south of the proposed repository, are poorly documented at this time. However, the low hydraulic gradient indicates that travel times are likely to be long. Further, the sorptive capacities of formations through which the water will traverse are not presently known and the degree of dilution of contaminants within the saturated zone has not been ascertained. In view of the likely long travel time of water in the saturated zone from the proposed Yucca Mountain repository to the critical group, the movement of contaminants may well take in excess of 10,000 years to reach the accessible environment, despite the potential for relatively short travel time through the fractures and faults of the unsaturated zone.

- The relative uncertainties in predicting the time dependent and spatial variations in the Yucca Mountain geosphere and related geologic processes have come to the forefront as a result of the NAS Committee's report and their statements on the confidence that can be placed on performance assessment at distant future times. The NAS Committee concluded that although "... the level of confidence for some predictions might decrease with time ... [m]any of the uncertainties in parameters describing the geologic system are due not to temporal extrapolation, but rather to difficulties in spatial interpolation of site characteristics." The ACNW acknowledges that the spatial variations in the Yucca Mountain geosphere contribute to uncertainty. Nonetheless, we believe that with the completion of an adequate characterization of the site and with consideration of the integration over the heterogeneities for the operational scale of the pertinent processes, the time-dependent uncertainties in events and processes, such as climate change, will be more prominent than those derived from spatial variations. Yucca Mountain lies within a region of potentially high gradient tectonic and climatic processes. As a result, the ACNW anticipates that uncertainties will increase with time, although we agree with the National Research Council/NAS report that it should be possible to bound these uncertainties over a time span on the order of one million years.

Recommendations for a Yucca Mountain Repository Compliance Period

On the basis of the previous discussion of both generic principles and Yucca Mountain specific insights, the ACNW recommends the

following two-part approach to establishing the time period for compliance for the proposed HLW repository site at Yucca Mountain, Nevada:

The first part involves the following:

- (A) The time period of compliance should not be specified in the risk-based standard for Yucca Mountain being prepared by the EPA. Rather, it should be defined in the regulations being developed by the NRC to implement the EPA standard and should use existing knowledge of the engineering and scientific aspects of this proposed repository and its environment.
- (B) The time period should be defined in concert with specifying the reference biosphere and the critical group. The definition of the biosphere and the critical group should take advantage of known site characteristics and any other long-term effects that can be technically supported.
- (C) The time span for the compliance period should be no shorter than an estimate of the anticipated time it takes for potential radionuclide contaminants to reach the nearest critical group and no longer than a time period over which scientific extrapolations can be convincingly made. Because of the need to come to closure on this subject, the ACNW suggests that the NMSS staff review the scientific and technical components needed to make these decisions, identify critical missing elements, and provide the necessary information in a timely manner. On the basis of currently available information, the ACNW anticipates that the appropriate compliance period will be somewhat greater than the present standard of 10,000 years. The increased distance from the proposed site to the nearest probable location of the critical group, the nature of the site and the likely characteristics of the waste, the containers, the engineered barriers, and the design of the repository, together with consideration of the stability of the site, suggest a time frame on the order of a few tens of thousands of years, but specifying a precise value must await more comprehensive assessments.

The second part of the compliance regulation should require assessment extending from the specified compliance period to the time of the calculated peak risk to the critical group. The regulation for compliance during this intervening period should be significantly less stringent than is used in the previous period, considering the increasing scientific, technical, and critical group uncertainties. Depending upon the extent to which the peak risk exceeds the standard for the first part, steps should be considered to ameliorate the potential risk. This second part of

the compliance regulations should not be allowed to become the de facto regulation.

Summary

The regulatory time period for compliance is an important element in regulations for nuclear waste facilities and remains a problem in developing site-specific requirements for protecting the health and safety of the Nation, as well as its environment. The ACNW suggests a solution to this problem from a generic standpoint, which employs two parts. Using scientific and technical insights into the environment of the repository proposed for Yucca Mountain, we recommend an approach that establishes the time of compliance of the facility at this site, which differs from the current regulation and the proposal on this topic made by the National Research Council/NAS Committee in its report, *Technical Bases for Yucca Mountain Standards*. We believe that our recommendations will lead to a simple, robust, and defensible regulation that can be readily implemented.

Sincerely,

Paul W. Pomeroy
Chairman

References:

1. Report dated February 9, 1996, from Paul W. Pomeroy, Chairman, ACNW, to Shirley Ann Jackson, Chairman, NRC, Subject: Issues and NRC Activities Associated with the National Research Council's Report, "Technical Bases for Yucca Mountain Standards"
2. Report dated June 27, 1991, from Dade W. Moeller, Chairman, ACNW, to Kenneth M. Carr, Chairman, NRC, Subject: "Response to questions Accompanying Working Draft #3 of the EPA Standards"
3. R. M. Forester and A. J. Smith, "Late Glacial Climate Estimates for Southern Nevada: The Ostracode Fossil Record," in *High-Level Radioactive Waste Management*, Vol. 4, pp. 2553-2561, 1994

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