THE ADVISORY COMMITTEE ON NUCLEAR WASTE U.S. NUCLEAR REGULATORY COMMISSION

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ABSTRACT

Because of its increasing role in regulatory matters pertaining to the management and disposal of radioactive wastes, the U.S. Nuclear Regulatory Commission (NRC) in June 1988 established the Advisory Committee on Nuclear Waste (ACNW). During its approximately three years in operation, the ACNW has conducted reviews and provided advice to the NRC on a variety of issues, including expressions of continuing concern that the proposed Environmental Protection Agency (EPA) standards for a high-level waste repository may not be implementable; a lack of adequate emphasis in the Site Characterization Plan, prepared by the U.S. Department of Energy (DOE), on the systematic and early identification and evaluation of potentially adverse conditions at the proposed repository site in Yucca Mountain; plans for the decommissioning of nuclear power plants and other nuclear facilities; problems in the solidification of low-level radioactive wastes being sent for disposal at commercial sites in the United States; and reviews and commentaries on related aspects of waste management activities.

In addition to its regular meetings, the ACNW has held a number of working group meetings which have a format designed to permit a specific topic to be probed in depth and have a strong emphasis on discussions among participants. Issues that have been addressed in this manner include the potential impacts of human intrusion, vulcanism, and releases of carbon-14 on the performance of the proposed high-level radioactive waste repository, and the use of expert judgment in the resolution of repository issues where the timespan of interest encompasses thousands of years. Working group meetings have also been held on the technical and regulatory problems associated with the timely licensing and development of mixed waste disposal facilities.

GENERAL INTRODUCTION

In June 1988, the U.S. Nuclear Regulatory Commission established the Advisory Committee on Nuclear Waste (ACNW). The Committee reports to and advises the Nuclear Regulatory Commission (NRC) on aspects of nuclear waste management that are within the purview of NRC's regulatory responsibilities. The focus of the Committee's work is largely on disposal but includes other aspects such as handling, processing, transportation, storage, and safeguarding of nuclear wastes including spent fuel, nuclear wastes mixed with other hazardous substances, uranium mill tailings, and exposures and risks associated with nuclear waste management. In performing its work, the Committee examines and reports on specific areas of interest referred to it by the Commission. The Committee is also authorized to undertake other studies and activities on its own initiative related to those issues directed by the Commission. Currently, the Committee may have a maximum of four members. Members are appointed by the NRC Commissioners.

In its first two and one-half years, the Committee held 28 general meetings and four working group sessions and issued 42 letter-reports. The Committee also participated in the Symposium on the disposal of high-level waste that was held by the Board on Radioactive Waste Management, National Research Council, in September, 1990. In addition, the Committee met on a regular basis with the NRC Commissioners to discuss items of mutual interest and concern.

The primary purpose of the meetings of the ACNW is to gather information to assist Committee members in formulating comments and recommendations on critical waste management issues. In addition, the meetings of the ACNW and its working groups are designed to make a record of technical issues for the Commission. The Committee interacts not only with the NRC staff but also with waste management personnel from other Federal agencies, for example, the Department of Energy and the Environmental Protection Agency; with representatives from State and local public health and regulatory organizations; with representatives from radiation protection organizations such as the National Council on Radiation Protection and Measurements, the International Commission on Radiological Protection, and the Committee on Interagency Radiation Research and Policy Coordination; and with people from related nuclear utility and industrial organizations. Members of the public in attendance at meetings of the Committee are also invited to offer comments, as appropriate. Through this process, the Committee has promoted exchanges of information, and its meetings have served as one of the primary forums for indepth discussions of key radioactive waste issues.

The ACNW traces its history back to the Advisory Committee on Reactor Safeguards (ACRS) and its subcommittee on nuclear waste. The current Chairman and Vice-

Chairman of the ACNW (Drs. Moeller and Steindler, respectively) had served on the ACRS where they participated extensively in the waste management reviews by that group. They now continue this function with the ACNW. The current members of the ACNW are:

ACNW MEMBERSHIP

CHAIRMAN: Dr. Dade W. Moeller, Professor of Engineering in Environmental Health, School of Public Health, Harvard University, Boston, Massachusetts

VICE-CHAIRMAN: Dr. Martin J. Steindler, Director, Chemical Technology Division, Argonne National Laboratory, Argonne, Illinois

MEMBERS: Dr. William J. Hinze, Professor, Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, Indiana

Dr. Paul W. Pomeroy, President, Rondout Associates, Incorporated, Stone Ridge, New York

Because of its importance to the national interests, the Committee has devoted much of its initial activities to the proposed high-level waste repository at Yucca Mountain, Nevada and the directly related EPA high-level waste standards.

EPA STANDARDS

For more than five years the ACNW and its predecessor organization have been concerned that the current set of proposed EPA standards is overly stringent, is wasteful of resources, and would be difficult to implement. These concerns are based on extensive meetings and discussions with a wide range of organizations, including relevant Federal and State agencies as well as industrial and private groups. The Committee continues to doubt that compliance with the EPA standards can be demonstrated for a specific repository site, even with application of the caveats included in the currently proposed standard, such as the "reasonable assurance" phrase that allows for certain flexibilities in the interpretation of probabilistic analyses. Further, it is not clear to the Committee that the anticipated uncertainties in the data and the models that describe the performance of the repository are compatible with a useful application of probabilistic analysis. Regardless of the schemes proposed to resolve uncertainties in applying probabilistic techniques (e.g., rulemaking), the Committee has seen no convincing evidence that the current set of standards will prove to be workable.

The ACNW has concluded that the EPA standards need to be revised and that now is the time to accomplish this task. In such a revision, the Committee recommended that the standards should be organized in a hierarchical structure with the higher levels expressing the objectives in a qualitative sense and the lower levels stating the objectives quantitatively. The Committee stressed that the several levels should be consistent and that lower levels not be more stringent or conservative than the higher levels so that they become de facto new standards. The Committee believes that the proposed quantitative EPA standards may be internally inconsistent and are based largely on perceived technical feasibility rather than basic environmental standards. In addition, the ACNW believes that secondary requirements, such as those for human intrusion, if expressed in the EPA standards, should be given only as guidance, with qualifying statements clearly specifying that they are not to be applied in a regulatory sense.

Three principal Committee recommendations for revising the EPA standards are:

1. An acceptable risk from a high-level waste repository should be defined and justified, keeping in mind the benefits derived from the activity involved, other societal risks, and additional relevant considerations. Lower-level standards should be expressed in terms of annual risk limits from a disposal facility in an undisturbed and a disturbed state. The critical population group being considered should be clearly defined and the important impacts of uncertainties in, for example, population distribution and methods of food production should be recognized. Such an approach would be in accord with recommendations of organizations such as the International Commission on Radiological Protection and the United Kingdom's National Radiological Protection Board.
2. It should be specified that inclusion in the standards of an appropriate probabilistic approach is acceptable to the definition of risk from a repository, only if it is clearly noted that this probabilistic approach is not the determining factor in judging the acceptability of a specific site. Experience has shown that probabilistic risk analyses alone cannot be used to reliably determine the compliance of a single entity such as a nuclear power plant with a set of standards or as the basis for judging the adequacy of its safety. A single high-level waste repository, which is to function for thousands of years, will be even more difficult to assess quantitatively, in part owing to the uncertainties in the models and the data to support them. The EPA standards should clearly specify that risk assessments are but one of several tools that should be used in the evaluation of a high-level waste repository site and/or facility and that the results of such assessments should be only one of several factors used in evaluating compliance of such a facility with the EPA standards. Deterministic criteria and expert opinion should be acknowledged to be of considerable importance in judging the acceptability of a specific site.
3. Evaluations of the anticipated performance of the proposed Waste Isolation Pilot Plant indicate that, for the

disturbed state, human intrusion has the potential for being the dominant contributor to risk. Preliminary performance analyses for the proposed Yucca Mountain repository also suggest human intrusion to be important. For these reasons, separate considerations for evaluating the impacts of human intrusion should be included in the EPA standards. One approach, suggested by the Committee, is that the standards be rewritten to separate the evaluation of anticipated repository performance into three parts: (a) the undisturbed repository; (b) the disturbed repository, exclusive of human intrusion; and (c) the repository as it might be affected by human intrusion. This would clearly separate out the issues surrounding human intrusion and permit it to be addressed directly.

The Committee has communicated these comments directly to cognizant EPA management and staff via both oral and written means and will continue to do so. The Committee and the NRC staff are moving toward, but are not yet, at a consensus over how the EPA standards must be revised.

ACNW REVIEW OF THE NRC ANALYSIS OF THE DOE SITE CHARACTERIZATION PLAN (SCP)

The EPA standards, coupled with their probabilistic base, have led to extensive plans for conducting studies and for collecting the data necessary for the analyses associated with determining whether the proposed Yucca Mountain site can be demonstrated to show compliance. As a result, the ACNW devoted considerable effort in reviewing the DOE SCP and the NRC staff's review of this plan, the Site Characterization Analysis (SCA). The ACNW review of these documents was, of necessity, less than comprehensive. Rather, the Committee focused on specific critical topics. Members and consultants reviewed relevant material in-depth, using an iterative process with the assistance of the NRC and DOE staffs. At the completion of this process, the Committee was in general agreement with the overall content of the SCA. However, the Committee had several residual concerns, some of which are summarized below:

1. One of the primary ACNW concerns was that the SCP does not adequately address the need for the early identification and evaluation of potentially adverse conditions at the Yucca Mountain Site. In a similar manner, the Committee concluded that the SCA should have emphasized the need for DOE's SCP to include plans for explicitly addressing activities leading to an evaluation of the characteristics of the site directly related to potentially adverse conditions [e.g., evaluation of groundwater travel time as stated in the NRC regulations].
2. The ACNW also concluded that insufficient attention is given in the SCP to the limitations and uncertainties in the Yucca Mountain data bases. Here, the key factor is that the standards, as currently written, are probabilistic and therefore the methods for demonstrating compliance must have a probabilistic base. Since the ability to resolve the associated uncertainties experimentally may well be beyond the capability of the site characterization program, increased consideration should be given to the feasibility of developing deterministic criteria for judging the adequacy of the site relative to the EPA goals.
3. The ACNW joined with the NRC staff in raising concern over the delays by DOE in implementing satisfactory quality assurance (QA) programs. The Committee urged that this troublesome issue be resolved promptly, since continued absence of approvable QA systems will increase the burden on the participants in the licensing processes when qualification of data is at issue. As a result of vigorous attention by DOE project participants and the NRC staff to this subject, some of the QA issues have subsequently been resolved.

In addition to the above, the Committee offered a number of comments pertaining to other specific aspects of the site characterization program, such as resolving the dilemma of how to determine the characteristics of the Calico Hills Formation, while still maintaining the integrity of this structure as a barrier between radioactive wastes placed in the repository and the underlying saturated zone. Other Committee comments addressed the need to define the materials to be used in the waste packages and the manner in which these packages will be sealed. The latter information is essential to the evaluation of possible interactions between the waste package and repository materials. The Committee also is concerned with the absence of a clear definition of the manner by which various parts of geoscience data will be integrated and the appropriate sequence for data acquisition and interpretation.

WORKING GROUPS

To further develop its understanding of certain issues in more depth, the Committee has held several working group sessions. These sessions have been dedicated to a single topic, have been less structured than full Committee meetings and have generally been conducted in a much more participatory manner. This format has been found to be extremely conducive to the free exchange of information.

As previously noted, the working group meetings held to date have addressed carbon-14 releases, human intrusion and the use of expert judgment. The following sections briefly encapsulate the conclusions from some of these meetings:

1. Carbon-14 releases for the Yucca Mountain site can present a problem, not due to the evaluated biological or radiological impacts, but because they may exceed the unrealistic limiting release values specified in the EPA standards and the NRC fractional release rate limit. The release of all carbon-14 in the repository would have little additive impact on the risk from the repository, representing only a 2% increase in the earth's current atmospheric C-14 content.
2. As previously mentioned, human intrusion is currently recognized as the dominant contributor to the risk from the disturbed state of the WIPP facility. Depending upon the assumptions used for the evaluation of the Yucca Mountain site, human intrusion could well be an equally significant scenario there. The meetings of the ACNW have shown that, while EPA has stated that the comments on this subject contained in Appendix B to their standards are proposed for guidance only, the public may view any deviations from these guides as a violation of the standards. Furthermore, representatives from the Bureau of Land Management have presented data to the Committee that indicate that the frequency of drilling and the adequacy of borehole seals assumed by EPA in formulating its guidance may be in error.
3. In light of the quasi-probabilistic/deterministic nature (and interpretation) of the existing relevant regulations, and difficulties in predicting geological events within the life of the repository, it would appear that expert judgment must play a major role in the determination of the eventual acceptance/rejection of many of the scenarios proposed as failure mechanisms for a HLW repository. Expert judgment may also be used extensively during site characterization, in the design and implementation of site investigations, in assigning probabilities to earth and atmospheric processes and other activities. The use of expert judgment appears to be particularly necessary when one considers the thousands of years specified as the required time frames of concern for the repository.

Other topics scheduled by the Committee for future high-level waste repository related working group meetings, include methodologies for dating of volcanic and tectonic features, integration of geophysics into site characterization, and evaluation of long-term climatic changes.

LOW-LEVEL WASTE

In addition to its activities related to high-level waste, the ACNW has been heavily involved in reviews of certain key issues related to the management and disposal of low-level wastes. One recent effort has been the review of the NRC staff's Revised Technical Position (TP) on Low-Level Waste Form. The most recent issuance, Revision 1, represents a significant expansion over the previous document on the same subject. As a result of its review, the Committee suggested that more attention be paid to the leaching resistance of the waste form and the associated ground water chemistry. It noted that the primary focus of the TP appeared to be on mechanical integrity which, while certainly important, does not represent the only major consideration. Biodegradation tests were also recommended as was the testing of aged waste forms for resistance to leaching by ground water.

The principal addition to this TP, however, was the addendum devoted to defining the acceptable compressive strength criteria for cementitious waste. The proposed increase (from 60 to 500 psi) is significant. While a strong technical justification for the 500 psi criterion was lacking, the Committee noted that this value was selected to preclude unstable waste forms and it endorsed this change. The Committee had several reservations about the contents of the TP but nevertheless concluded that the revised TP included enough useful information and guidance to justify its issuance at this time.

Another subject receiving Committee attention has been the need for standards for decommissioning, be it a fuel cycle facility or a nuclear power plant. Relevant to these considerations have been the Committee's review and comments on the NRC's policy on below regulatory concern [BRC], the need for standards for the cleanup of various NRC licensed uranium and thorium facilities, and specific questions associated with the decommissioning of the Pathfinder Atomic Power Plant and the Fort St. Vrain, Shoreham, and Rancho Seco nuclear power plants.

The principal ACNW recommendations on the BRC policy were to emphasize that wastes, practices and/or sources should be "exempted" only after a thorough review and evaluation [and, in fact, would continue to be re-evaluated at periodic intervals in the future], and that the policy should be structured to assure that population groups likely to be exposed to activities contributing dose rates at the higher ranges of the proposed exemption levels would be limited in size.

The major comment made by the Committee in its review of the decommissioning of the Pathfinder Atomic Power Plant was that adequate attention be given to the potential for groundwater contamination. It is anticipated that the reviews of the decommissioning plans for the Fort St. Vrain, Shoreham and Rancho Seco plant sites will be initiated during the coming year.

Another subject under review by the Committee has been the licensing, construction and operation of facilities for the disposal of mixed wastes. A working group meeting, held on this subject in December 1990 and followed up in January 1991 confirmed that dual regulation of such wastes by the NRC and EPA was proving to be a problem to

potential licensees of mixed waste disposal sites. While there are several possible legislative options through which this problem might be resolved, none appears at present to be promising. At the same time, some of the designs for bunkered, low-level radioactive waste disposal facilities being proposed by various state groups appear to be readily amenable to meeting the regulations of both the EPA and the NRC, should those developing these facilities desire to add extra components [cells] for the disposal of mixed wastes. A proposal that DOE be designated to handle the small amount of commercial mixed wastes together with the much larger quantities of mixed wastes from defense operations has been made. Should such a proposal be adopted, the plans of the State compacts would not be seriously affected and such groups would simply not include components for mixed wastes as a part of their overall disposal facilities.

FUTURE ACTIVITIES

Most of the activities outlined above will be conducted on an iterative basis. As a result, it is anticipated that specific objectives and goals will be modified as the work progresses.

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