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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

April 17, 1991

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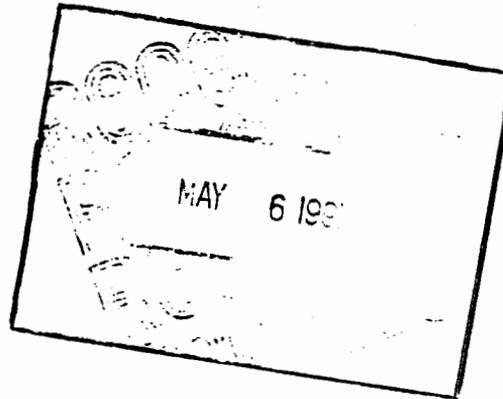
NRC COMMISSION MEETING WITH THE ADVISORY COMMITTEE ON NUCLEAR
WASTE ON MARCH 22, 1991 (SP-91-55)

Enclosed for your information is the briefing package prepared by the
Advisory Committee on Nuclear Waste (ACNW) for their discussion at
the Commission meeting held on March 22, 1991.

The ACNW discussed with the Commissioners mixed waste, dose limits -
risks to individuals from high level waste, stringency of the Environmental
Protection Agency high level waste standards, and 10 CFR Part 60 subsystem
performance requirements.

Carlton Kammerer
Carlton Kammerer, Director
State Programs
Office of Governmental and Public Affairs

Enclosure:
As stated



910403



BACKGROUND ACNW LETTERS/REPORTS FOR THE ITEMS
TO BE DISCUSSED AT THE PERIODIC MEETING
WITH THE COMMISSIONERS
MARCH 22, 1991 - 2:00 p.m.

The following is the list of agenda items for the March 22, 1991 meeting between the ACNW and the NRC Commissioners, along with the ACNW issued Reports/Letters written for each of the items:

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Items to be Discussed:

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ITEM A
MIXED WASTES

ADVISORY COMMITTEE ON NUCLEAR WASTE
MEETING WITH COMMISSIONERS
MARCH 22, 1991

Regulation of Mixed Wastes

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Background:

In response to a request from Commissioner James R. Curtiss, the Advisory Committee on Nuclear Waste (ACNW) reviewed the problems and issues associated with the disposal of mixed wastes. One focus of this review was the comparability of protection afforded by NRC and EPA regulations when applied to the disposal of mixed wastes. This matter was the subject of an ACNW Working Group meeting held on December 11, 1990, and also a matter for discussion during many of the most recent meetings of the Committee.

Interacting with the Committee were more than a dozen groups representing both Federal agency and commercial perspectives.

As a result of those discussions, coupled with its review of a wide range of background documents, the Committee concluded that at present neither set of NRC and EPA regulations alone satisfies the requirements of the other agency. The Committee also concluded that waste classified as "mixed" can be disposed of under the umbrella of the NRC requirements for low-level wastes (LLW) if these requirements are modified to provide for enhanced groundwater protection.

A copy of the Committee's February 28, 1991 letter report is attached.

Cognizant ACNW Member: D. W. Moeller

Cognizant ACNW Staff: H. J. Larson



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

February 28, 1991

The Honorable Kenneth M. Carr
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Chairman Carr:

SUBJECT: REGULATION OF MIXED WASTES

In response to a request from Commissioner James R. Curtiss, the Advisory Committee on Nuclear Waste (ACNW) has reviewed the problems and issues associated with the disposal of mixed wastes. One focus of this review was the comparability of protection afforded by NRC and EPA regulations when applied to the disposal of mixed wastes. This matter was the subject of an ACNW Working Group meeting held on December 11, 1990, and also a matter for discussion during the 24th, 25th, 26th, 27th and 28th meetings of the Committee. Interacting with the Committee during these meetings were representatives from the California Radioactive Materials Management Forum; Chem-Nuclear Systems, Inc.; the Edison Electric Institute; the Nuclear Management and Resources Council, Inc.; the National Institutes of Health; New England Nuclear (du Pont); the State of Nebraska; the Lawrence Livermore National Laboratory; the Oak Ridge National Laboratory; the Savannah River Laboratory; the U.S. Environmental Protection Agency; the U.S. Department of Energy; and the U.S. Nuclear Regulatory Commission. The Committee also had the benefit of a wide range of documents, some of which are listed at the end of this report.

As you know, the subject of regulation of mixed wastes involves a wide range of issues and has the potential for having an impact on NRC and Agreement-State licensees. Further, the regulatory process will have a significant economic impact on the disposal of these wastes. We provide herein a summary of our findings and our recommendations. We have included some background information as well as highlights of recent and relevant studies and assessments conducted by the NRC staff and other groups.

1. Nature of the Problem

Mixed wastes (i.e., those wastes that contain radioactive materials at concentrations equivalent to low-level wastes and

also contain hazardous waste materials) are subject to regulation by both the NRC and the EPA as a result of congressional actions. Complicating this dual regulation are fundamental differences between the requirements of the two agencies. For example:

- a. The EPA regulations [pursuant to the Resource Conservation and Recovery Act (RCRA)] require that a disposal facility for hazardous wastes be equipped with a dual liner and leachate collection system; the NRC regulations for low-level waste disposal discourage the use of trench liners because of the concern that infiltrating water will be retained and create a "bathtub" effect.
- b. The EPA regulations place primary reliance on active systems (e.g., the leachate collection system) to control releases of the waste; the NRC regulations place primary emphasis on the protection afforded by the waste form and the location and design of the disposal facility.
- c. Treatment and packaging of radioactive wastes are generally performed by the generator prior to shipment of the wastes to the disposal facility; in contrast, hazardous wastes are generally treated at offsite facilities or at the disposal site. In addition, the EPA regulations prohibit the disposal of hazardous wastes that have not been treated in accordance with EPA standards. However, EPA has not published standards for the treatment of mixed wastes.
- d. The EPA regulations require that radioactive wastes containing hazardous materials be subject to sampling and analysis and that mixed wastes in storage be periodically inspected. These requirements were developed without taking into account the risks associated with radioactive wastes and could add to occupational exposures and costs when applied to mixed wastes.
- e. Whereas the NRC regulations for low-level wastes are incorporated into 10 CFR Part 61 and represent a fairly stable set of requirements, the EPA regulations are based on the RCRA, which has been subject to periodic amendment by the Congress and includes an ever-increasing number of substances that the EPA has classified as hazardous.
- f. The NRC regulations for Class C low-level wastes require the construction and operation of a facility designed to retain these wastes for up to 500 years; the EPA regulations for hazardous wastes provide for institutional protection and surveillance for only a maximum of 30

years beyond closure of the disposal facility and appear to require no inherent waste retention beyond that period.

These observations summarize the major differences between the EPA regulations for the disposal of hazardous wastes and the NRC regulations for the disposal of low-level radioactive wastes.

2. Protection Provided by EPA and NRC Regulations

Commissioner Curtiss specifically requested that the ACNW compare the protection provided for public health and safety by NRC and EPA regulations. Unfortunately, only minimal direct information appears to be available on this important comparison.

- a. A relevant study conducted by the Nuclear Management and Resources Council, Inc. (NUMARC, 1990) contains a comparison of the doses associated with the disposal of mixed wastes in a generic above-grade or below-grade facility and in a conventional shallow land burial facility. The above-grade facility represented the NRC/EPA conceptual design for a mixed waste disposal facility. To provide a full range of assessments, the facilities were assumed to have been located at two distinctly different sites -- a humid impermeable site (typical of the northeastern United States) and a humid permeable site (typical of the southeastern United States). Although NUMARC stated that its data should be interpreted with caution, NUMARC found that the performance of a shallow land burial facility, designed and constructed in accordance with the NRC regulations, was superior by a small margin. NUMARC concluded that, in general, inclusion of EPA regulation 40 CFR Part 264 design features neither demonstrates nor guarantees that the environmental performance of the mixed waste disposal facility will be superior to a disposal facility based on the requirements of 10 CFR Part 61.
- b. The NRC staff, in apparent contrast, has stated (NRC, 1989) that certain features of the disposal facility based on EPA regulations, such as the double liner and the leachate collection and retention provisions, "appear to offer enhanced protection of groundwater, at least temporarily." In view of the proposed EPA "subsystem requirement" that groundwater contamination be limited so that no offsite person will receive an effective dose rate greater than 0.04 mSv (4 mrem) per year, this potential attribute of the EPA regulations may be important.

- c. A study conducted by the U.S. Department of Energy (DOE, 1987) was designed to provide a comparative evaluation of the predicted performance of a full range of low-level radioactive waste disposal facilities constructed and operated in accordance with the NRC regulations. Six types of disposal facilities were evaluated: shallow land burial, intermediate-depth disposal, below-ground vaults, above-ground vaults, modular concrete canister disposal, and earth-mounded concrete bunkers. One of the conclusions of the DOE study, relevant to the comparative performance of facilities constructed and operated in accordance with EPA and NRC regulations, is that the dominant exposure pathway for an above-ground vault is "through release of radionuclides to surface water, and this results in a peak dose which is approximately one order of magnitude higher than the peak dose for the other (five) concepts." In fact, under the conditions assumed in the study, the above-ground vault concept did not meet the licensing requirements of 10 CFR Part 61 that the maximum effective (whole-body) dose rate to a member of the public be less than 0.25 mSv (25 mrem) per year and that the dose rate to the thyroid be less than 0.75 mSv (75 mrem) per year.
- d. Although one conclusion of the NUMARC study was that all three types of disposal facilities could meet the effective dose rate limit of 0.25 mSv (25 mrem) per year, this was not the case in terms of the protection of the groundwater pathway. That is, for the conditions used to characterize the humid impermeable site and for the assumed design features, all three disposal facilities were projected to exceed EPA's draft proposed environmental protection standards for low-level waste disposal [0.04 mSv (4 mrem) per year if groundwater is involved].

3. Possible Solutions

In evaluating possible solutions to these problems, we have focused our attention on the difficulties of managing dual regulations and on the adequacy of either set of regulations in meeting the requirements of the other agency. Staff members of EPA and NRC have been attempting for some time to develop an approach through which dual regulation of mixed wastes can be made more practical. As a result of these efforts, three joint guidance reports have been issued pertaining to (a) the definition of mixed wastes, (b) siting requirements for a mixed waste disposal facility, and (c) a conceptual design for a mixed waste disposal facility that will meet both EPA and NRC regulations. The efficacy of these joint guidance reports is not entirely clear and discussions with State representatives indicate that additional guidance

is needed. Examples of areas needing to be addressed include joint guidance on the sampling and analysis of wastes in storage, on methods for integrating the administrative licensing procedures in the two sets of regulations, and on procedures for the consultative review and preapproval of State conceptual designs by Federal agencies (LLRWF, 1988). The joint guidance reports do not alleviate the dual regulation burden. Other developments also have bearing on the question posed by Commissioner Curtiss.

- a. In response to technical considerations and concerns of the public, some State compacts have received proposals to build concrete bunker facilities for the disposal of low-level wastes. These facilities appear to be readily adaptable to meet EPA requirements for the disposal of hazardous wastes. It is our belief that such a facility, when slightly modified, would provide adequate protection of the public health and safety and meet the requirements of both agencies as they apply to mixed wastes. The projected unit costs for the disposal of mixed wastes in such a modified facility would be relatively high compared to those for the disposal of low-level wastes. This high cost is primarily a result of the unusually low volumes of mixed wastes anticipated to be sent to such facilities, and could be exacerbated by difficulties and delays in obtaining the necessary RCRA permits.
- b. Dual jurisdiction of the regulatory process for mixed wastes appears to be wasteful of resources and lacks justification on the basis of benefit to the public. Some groups have urged strongly that the responsibility for regulating mixed wastes be assigned to a single Federal agency. One approach would be to request Congress to resolve this issue, but comments provided to the Committee indicate that this avenue is not likely to be viable at present. A second approach would be for the NRC to exercise the option provided under Section 1006(a) of the RCRA, which allows the Atomic Energy Act to "take precedence in the event provisions or requirements of the two acts are found to be inconsistent." Inquiry by the Committee indicates that the definition of "inconsistent" is subject to considerable controversy and hence exercise of this option would be difficult.
- c. During its review, the Committee learned that most of the mixed wastes present or being produced in the United States result from DOE activities. Although the capability of DOE or its contractors to treat, store, and dispose of such wastes is still limited, the Department is developing plans to manage them. It has been suggested that problems associated with disposal of mixed

wastes generated commercially could be resolved if Congress were to assign DOE the responsibility for managing these wastes, similar to the responsibility assigned DOE for managing greater-than-Class-C wastes. Even though this approach may be difficult, we believe it should be explored.

4. Summary and Recommendations

The Committee concludes that at present neither set of regulations alone satisfies the requirements of the other agency. We make the following comments and recommendations that we believe represent possible steps for resolving the problems of regulating mixed waste disposal and also address the question posed by Commissioner Curtiss.

- a. One action that could lead to a useful result would be for NRC to establish, in accordance with its recently announced policy, a category of mixed waste that is below regulatory concern (BRC). Mixed wastes that are so designated could then be reclassified as hazardous wastes and regulated only by EPA. Information provided to the Committee indicates that more than 90 percent of biomedical wastes would meet the BRC criteria.
- b. In a concurrent action, EPA should be encouraged to develop and implement de minimis criteria for hazardous wastes and for mixed wastes. Further, EPA should reconsider and revise the analysis and sampling requirements for mixed wastes to reduce the risk in such operations due to the presence of radioactivity. Also, EPA should be encouraged to modify its regulations to permit interim storage of mixed wastes awaiting disposal and to develop standards for the treatment of such wastes.
- c. The Committee is convinced that a method for disposal of low-level waste that incorporates enhanced confinement (e.g., concrete bunker disposal for Class B or Class C waste) and adds provisions for groundwater protection (e.g., a leachate collection system in place for at least as long as would be required by EPA regulations) can meet the combination of disposal requirements for mixed wastes specified by NRC and EPA. Such enhanced confinement methodology appears to be within the scope of the currently proposed designs for low-level radioactive waste disposal facilities.

February 28, .

The Committee concludes also that disposal of mixed wastes can be accomplished under the umbrella of NRC requirements for low-level wastes if these requirements are modified to provide for enhanced groundwater protection. Further, if Items 4a and 4b, above, are implemented, the volumes of wastes classified as "mixed" will be significantly reduced and the cost for the disposal of the exempted wastes could be similarly affected. Another benefit of cost reduction and regulatory simplification could be the reversal of debilitating trends by scientists to avoid the use of radioactive and hazardous materials in important research.

We trust these comments are helpful. We plan to continue to review developments in this field as they arise and will keep the Commission informed about the relevance and consequences of these developments.

Sincerely,



Dade W. Moeller
Chairman

References:

[DOE, 1987]. U.S. Department of Energy, "Conceptual Design Report - Alternative Concepts for Low-Level Radioactive Waste Disposal," Report DOE/LLW-60T, Washington, DC, June 1987.

[LLRWF, 1988]. Low-Level Radioactive Waste Forum, "An Assessment of Mixed Waste Management Issues and Federal Guidance," Washington, DC, September 1988.

[NRC, 1989]. U.S. Nuclear Regulatory Commission, Enclosure in letter from Robert M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, to Alan Pasternak, Technical Director, California Radioactive Materials Management Forum, March 8, 1989.

[NUMARC, 1990]. Nuclear Management and Resources Council, Inc., Report on "The Management of Mixed Low-Level Radioactive Waste in the Nuclear Power Industry," 1776 Eye Street, N.W., Washington, DC, January 1990.

ITEM B

DOSE LIMITS - RISKS TO INDIVIDUALS

ADVISORY COMMITTEE ON NUCLEAR WASTE
MEETING WITH COMMISSIONERS
MARCH 22, 1991

Dose Limits - Risks to Individuals

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Background:

During the 25th meeting of the ACNW, an EPA representative requested that the Committee provide the EPA with the bases for incorporating dose and risk guidance into the EPA's Standards for the high-level waste (HLW) repository. The bases for the Committee's position are outlined in the endorsements of individual dose and risk limits for HLW repositories by three international authorities on nuclear safety. These are the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA), and the Radiation Protection and Nuclear Safety Authorities in Denmark, Finland, Iceland, Norway and Sweden (Nordic). All of the three organizations are compatible with the ICRP estimate of 0.1 mSv (10 mrem) or some fraction of 1.0 mSv (100 mrem). Furthermore, the Board on Radioactive Waste Management, National Research Council noted that the EPA is unique in the international community in that all other countries use only a dose requirement.

The Committee forwarded its recommendations to the Commission in a January 29, 1991 report along with a report on the stringency of the EPA standard. The Commission forwarded these two reports to the EPA Administrator on February 20, 1991.

Cognizant ACNW Member: D. W. Moeller

Cognizant ACNW Staff Member: G. N. Gnugnoli

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

January 29, 1991

The Honorable Kenneth M. Carr
Chairman
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Chairman Carr:

SUBJECT: GUIDANCE ON LIMITS ON DOSES AND RISKS TO INDIVIDUAL MEMBERS OF THE POPULATION

During the 25th meeting of the Advisory Committee on Nuclear Waste (ACNW), held on October 24 and 25, 1990, Mr. Floyd L. Galpin, Chief, Waste Management Standards Branch, Office of Radiation Programs, U.S. Environmental Protection Agency (EPA), requested that the ACNW provide the bases for the recommendation, made in several of our earlier reports to you, that EPA consider incorporating into its high-level radioactive waste repository standards some guidance on limits for doses and risks to individual members of the general population.

The foundations for our position are outlined in the recommendations of the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA) and the so-called "NORDIC" report. As will be noted, all three of these groups endorse the use of individual dose and risk limits in the development of standards for a high-level radioactive waste repository. This approach has also been endorsed by the Board on Radioactive Waste Management, National Research Council. The principal comments and/or recommendations of these organizations are summarized below.

1. Recommendations of the ICRP

The basic principles on this subject, as recommended by the ICRP, are presented in their report on "Radiation Protection Principles for the Disposal of Solid Radioactive Waste," published in 1985. In this report, the ICRP separates the releases from a repository into two categories: (a) those that are gradual and lead to normal releases that are reasonably predictable in terms of estimates of their exposure pattern in space and time; and (b) those that are not gradual and have to be thought of as probabilistic. Included in the latter category are releases that might occur as a result of seismic and tectonic phenomena. (Paragraphs 28 and 29, Reference 1.)

a. Evaluation and Control of Normal Releases

For releases in the first category (i.e., normal releases) the ICRP recommends that its individual dose limits for members of the public should apply. Expanding on this, the ICRP states that its recommendations with respect to the assessment and monitoring of radioactive materials in the environment would also apply, with the results being used in the optimization of protection and in judging compliance of a high-level radioactive waste disposal facility with the applicable dose limits and source upper bounds. (Paragraph 30, Reference 1.)

The ICRP goes on to say that "The application of the individual dose limits to the dose distribution from normal releases from a waste repository is the same as for releases from other types of facilities. Two basic requirements are involved. First, the critical group, i.e. those who are expected to receive the greatest exposure, must be identified. Second, the design and operation of the repository must provide assurance that the average dose in the critical group will not exceed the dose limits" (Paragraph 45, Reference 1.)

b. Evaluation and Control of Probabilistic Releases

The ICRP recommends that risks from probabilistic events should be limited on a similar basis. In this regard, the ICRP states that "Since significant doses might result from events that disrupt the normal behavior of a disposal facility and which have an assumed probability of occurrence, in a given time, less than one, the objective of protecting individuals from all of the exposure events associated with radioactive waste disposal is best achieved by reverting to an individual risk limitation requirement. By dealing consistently in terms of risk, both the probability of an exposure and the magnitude of the exposure can be included. To take account of this, the Commission recommends that a risk limit and risk upper bound be established in direct analogy to the dose limits and upper bounds for normal releases." (Emphasis Added.) (Paragraph 47, Reference 1.)

c. Allowances for Future Activities and Individuals

"To allow for dose contributions from present practices and to provide a margin for unforeseen future activities, the Commission recommends that national authorities select a fraction of the dose limits as a source upper bound for each source of exposure, to ensure that the

exposure of individuals will remain below the relevant dose limit." (Paragraph 54, Reference 1.)

"In a manner similar to the establishment of the source upper bound, the Commission recommends that national authorities select some fraction of the risk limit as a risk upper bound for the source being evaluated." (Paragraph 57, Reference 1.)

Expanding on this theme, the ICRP recommends ". . . that risks to future individuals should be limited on the same basis as are those to individuals living now." (Paragraph 50, Reference 1.)

2. Recommendations of the IAEA

Recommendations of the IAEA on this subject are presented in their preliminary draft report, "Safety Principles and Technical Criteria for the Underground Disposal of High-Level Radioactive Wastes." In this document, the IAEA separates the releases from a repository into those that result from "gradual processes" and those that result from "disruptive events." Since the annual dose limit for prolonged exposure to individuals within the critical group due to releases arising through "gradual processes" is 1 mSv, the IAEA recommends that the dose rate due to "gradual processes" occurring within a single repository be limited to some fraction of this value. For "disruptive events," the annual dose limit for individuals within the critical group is that which has an associated ". . . risk of health effects of one in a hundred thousand per year." On the basis of estimates made at the time, this would correspond to a dose rate limit of 1 mSv per year. (Sections 3.2.1 and 3.2.2, Reference 2.)

In essence, the IAEA report endorses the recommendations of the ICRP.

3. Recommendations of the Nordic Countries

The recommendations of the Nordic countries pertaining to the disposal of high-level radioactive wastes are presented in a report, "Disposal of High Level Radioactive Waste - Consideration of Some Basic Criteria - A Consultative Document," issued in 1989. Recommendations of this group on standards for a high-level radioactive waste repository are specified in terms of four general objectives and principles. Statements of significance are as follows:

The Nordic group endorses the ICRP recommendation by stating that "The predicted risks to human health and the effects on the environment from waste disposal, at any

time in the future, shall be low and not greater than would be currently acceptable. The judgement of the acceptability of a disposal option shall be based on radiological impacts to individuals irrespective of any national boundaries." (Emphasis added.) (Paragraph 66, Reference 3.)

In terms of radiation protection criteria, the Nordic countries recommend that "The predicted radiation dose to any individual, excluding doses from unlikely disruptive events, shall be less than 0.1 mSv per year. In addition, the probabilities and consequences of unlikely disruptive events shall be studied, discussed and presented in qualitative terms and whenever practicable, assessed in quantitative terms in relation to the risk corresponding to a dose of 0.1 mSv per year." (Paragraph 85, Reference 3.)

As in the case of the IAEA, the Nordic group endorses the recommendations of the ICRP.

4. Comments of the Board on Radioactive Waste Management, National Research Council

The most recent recommendations of the Board on this subject are presented in their report, "Rethinking High-Level Radioactive Waste Disposal," published in 1990. In the recommendations included at the end of this report, the Board makes the following statements:

"The Environmental Protection Agency, during its revision of the remanded 40 CFR Part 191, should reconsider the detailed performance standards to be met by the repository, to determine how they affect the level of health risks that will be considered acceptable. In addition, EPA should reexamine the use of quantitative probabilistic release criteria in the standard and examine what will constitute a reasonable level of assurance (i.e., by what combination of methods and strategies can DOE demonstrate that those standards will be met?).

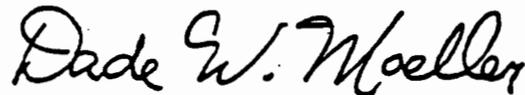
"All other countries use only a dose requirement. In setting regulatory standards and licensing requirements, the EPA should consider using only dose requirements." (Emphasis added.) (Page 35, Reference 4.)

As may be seen, all four of the organizations and/or groups cited endorse standards for a high-level radioactive waste repository that have an associated limit on dose for normal or gradual releases and an associated limit on risk for

disruptive or probabilistic releases. In all cases, the limits apply to individuals within a critical population group. The reasons that the ACNW endorses this approach, and is critical of the EPA approach, may be summarized as follows:

- a. The high-level radioactive waste repository standards, currently proposed by EPA, are based on limiting the "global" collective dose, and estimates of the associated health effects, to a certain value (i.e., 1,000 health effects in 10,000 years). In taking this approach, neither the population to be protected nor the associated dose or risk limits are specified. Any advantage to using collective dose as a method for avoiding the dilution and dispersion of radioactive wastes in the environment will be offset by the difficulties in determining compliance with standards based on this approach. There are other regulatory approaches that can be applied to prohibit unacceptable disposal practices such as these.
- b. The projection of collective dose estimates far into the future (as is necessary to comply with the high-level radioactive waste repository standards as proposed by EPA) is extremely difficult. Factors that complicate such estimates include errors in predictions of regional and global population demographics (size and location) and of potential radionuclide pathways (groundwater flow and agricultural practices). In contrast, long-range projections of the locations and living habits of individuals who may reside near a repository are relatively straightforward, and estimates of their potential doses can be made with greater certainty.
- c. It appears that the EPA is alone in the approach that it recommends. No other country or agency endorses this approach.

Sincerely,



Dade W. Moeller
Chairman

References:

1. International Commission on Radiological Protection, "Radiation Protection Principles for the Disposal of Solid Radioactive Waste," Publication 46, Annals of the ICRP, Vol. 15, No. 4 (1985).
2. International Atomic Energy Agency, "Safety Principles and Technical Criteria for the Underground Disposal of High-Level Radioactive Wastes" (Preliminary Draft, 1989).
3. "Disposal of High Level Radioactive Waste - Consideration of Some Basic Criteria - A Consultative Document," Report of The Radiation Protection and Nuclear Safety Authorities in Denmark, Finland, Iceland, Norway and Sweden (1989).
4. Board on Radioactive Waste Management, National Research Council, "Rethinking High-Level Radioactive Waste Disposal," National Academy Press, Washington, DC (1990).

ITEM C

STRINGENCY OF THE EPA STANDARDS

ADVISORY COMMITTEE ON NUCLEAR WASTE
MEETING WITH COMMISSIONERS
MARCH 22, 1991

Stringency of U.S. EPA HLW Repository Standards

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Background:

The Committee, in several of its reports, has indicated that the standards developed by EPA for a high-level radioactive waste repository were overly stringent. During its 25th meeting an EPA representative requested that the ACNW provide further information as to the bases for its statements on the stringency of those standards.

These bases were outlined in the attached January 29, 1991 letter report which noted the following four examples of excessive stringency:

- (1) restrictions that limit the probability of exceeding the release limits by even a small amount to an order of magnitude less than that for a natural ore body;
- (2) the application of inappropriate methodology in calculating collective doses that, in turn, were used to establish radionuclide release limits from a repository;
- (3) the establishment of release limits for certain radionuclides, most notably carbon-14, to amounts that are only a small fraction of the quantities naturally present within the environment; and
- (4) the inconsistencies of the risk standards proposed for the repository and those for other radiation sources, such as indoor radon.

Cognizant ACNW Member: D. W. Moeller

Cognizant ACNW Staff: H. J. Larson



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

January 29, 1991

The Honorable Kenneth M. Carr
Chairman
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Chairman Carr:

SUBJECT: STRINGENCY OF U.S. ENVIRONMENTAL PROTECTION AGENCY
HIGH-LEVEL RADIOACTIVE WASTE REPOSITORY STANDARDS

During our 25th meeting, October 24 and 25, 1990, Mr. Floyd L. Galpin, Chief, Waste Management Standards Branch, Office of Radiation Programs, U.S. Environmental Protection Agency (EPA), requested that the Advisory Committee on Nuclear Waste (ACNW) provide EPA the bases for the statements, made in several of our reports to you, that the standards developed by EPA for a high-level radioactive waste repository were overly stringent.

There are several factors and considerations that served as a basis for our statements. These are summarized below.

1. Comparison of a Repository to a Natural Ore Body

The introductory information provided in the EPA standards (Reference 1) implies that one of EPA's goals was to ensure that the health impacts of a repository were no greater than those that would have been associated with a comparable amount of unmined uranium ore. Although conservative in its own right, this appeared to be a reasonable approach. Later we learned that this approach did not, in the final version, serve as a basis for the EPA standards. Rather, EPA based its standards for the repository on what was considered to be achievable using modern technology. Nonetheless, the manner in which the existing standards are presented implies that they were based on releases from a comparable ore body. As a result, most groups, including the ACNW, have evaluated the EPA standards with this consideration in mind.

If one assesses the EPA standards for a repository on the basis of a comparable ore body, there appear to be at least two steps taken by EPA that have led to undue stringency:

- a. Reports published by EPA (Reference 2) of analyses of actual uranium ore bodies (assuming 100,000 MTHM) indicate that annual releases of Ra-226 over a 10,000-year period would range from 300,000 to 3,000,000 curies.

The limit on releases for Ra-226 in the EPA standards is 10,000 curies. In a similar manner, estimates of the associated health effects (deaths) due to radionuclide releases from existing ore bodies over a 10,000-year period ranged from 1,000,000 to 10,000,000. The limit in the EPA standards is 1,000.

- b. An unmined uranium ore body represents a continuous source of release of radioactive materials into the environment. In other words, the chance or probability that the ore body would cause radiation exposures to neighboring populations is one. In translating the estimated health effects from unmined ore bodies into a table of equivalent radionuclide releases from a high-level radioactive waste repository, EPA stated that there must be no more than one chance in ten of exceeding the given radionuclide release limits (or more than one chance in one thousand of exceeding ten times the release limits) over the initial 10,000-year period of operation of the repository. In other words, EPA added a factor of ten conservatism to releases from a high-level waste repository that are only slightly greater than releases from an unmined ore body.

2. Limits for Individual Radionuclide Releases

In setting permissible limits for releases of individual radionuclides from the repository, EPA assumed that the releases affected the population of the entire world -- projected to number a constant level of 10 billion people over the 10,000-year assessment period. In taking this approach, EPA did not specify a "critical" population group, nor did it specify a dose limit for the people who might be exposed. Rather, it summed the resulting collective doses over the population of the world and set the individual radionuclide release limits so as not to exceed a given collective dose limit (which, in turn, was used to predict the associated health impacts).

Data indicate that a major contribution to the collective dose apparently consisted of dose rates to individual members of the world's population of 0.01 mSv (1 mrem) per year or less. This calculational methodology is in sharp contrast to the procedures recommended by the National Council on Radiation Protection and Measurements (NCRP, Reference 3). To be specific, the NCRP recommends that ". . . assessments of increments of collective annual effective dose equivalents from any particular individual source or practice should exclude those individuals whose annual effective dose equivalents from such a source is 0.01 mSv (0.001 rem) or less." (Section 20, Reference 3.)

The overall impact of the calculational approach used by EPA is to "inflate," by a considerable margin, estimates of the health impacts of radionuclide releases from a repository. This, in turn, results in the allowable quantities of specific radionuclide releases from a repository to be overly conservative; that is, too low.

In making this comment, it is important to acknowledge that the NCRP recommendation was not published until June 1, 1987. Now that it has been issued, however, EPA should be encouraged to reassess its calculations.

3. Release Limit for Carbon-14

Over the past year or two, an increasing number of comments and papers in the literature indicates that gaseous emissions, specifically carbon-14 in the form of carbon-dioxide, may prohibit the proposed Yucca Mountain repository from complying with the EPA standards. The permissible release limits for this radionuclide, as specified in the EPA standards, are one more example of its stringency. This is illustrated by the following examples:

- a. The total inventory of carbon-14 in a repository containing 100,000 MTHM is estimated to be about 100,000 curies. This compares to a global production of carbon-14 by cosmic radiation of 28,000 curies per year, a global inventory of about 230 million curies, and an atmospheric inventory of 4 million curies (Reference 4). In fact, release of all of the carbon-14 inventory in a repository would increase the atmospheric inventory by only about 2 percent; this compares to natural variations in the atmospheric inventory of 10 percent to 40 percent.
- b. Based on an assumed inventory of 100,000 MTHM, the permissible rate of release of carbon-14 from a repository would be about 1 curie per year. Experience shows that any carbon-14 that is released would rapidly mix in the atmosphere, and estimates are that the accompanying dose rate to a person on top of Yucca Mountain would be far less than 0.01 mSv (1 mrem) per year. It is also interesting to note that the limit on the release rate of 1 curie per year for a repository compares to an average release rate of 10 curies per year from a typical 1,000 MWe light water reactor (Reference 4).

At the time the EPA standards were developed, considerations were limited to evaluations of a saturated site. In such a case, water transport and geochemical barriers would have been strongly influential in retaining the carbon-14. Subsequent

January 29, 1980

consideration of Yucca Mountain (an unsaturated site) makes the existing EPA standards inappropriate, overly stringent, and in need of revision.

4. Indoor Radon

The Office of Radiation Programs of the U.S. Environmental Protection Agency has the responsibility for setting limits for indoor radon as well as setting standards for the high-level waste repository. A comparison of the risks for indoor radon and those for the repository indicates that the health effects resulting from radon exposures at permissible levels indoors will be significantly greater than those from the repository.

In summary, the statements by the ACNW that the EPA standards are overly stringent are based on: (1) restrictions that limit the probability of exceeding the release limits by even a small amount to an order of magnitude less than that for a natural ore body; (2) the application of inappropriate methodology in calculating collective doses that, in turn, were used to establish radionuclide release limits from a repository; (3) the establishment of release limits for certain radionuclides, most notably carbon-14 to amounts that are only a small fraction of the quantities naturally present within the environment; and (4) the inconsistencies of the risk standards proposed for the repository and those for other radiation sources, such as indoor radon.

Sincerely,



Dade W. Moeller
Chairman

References:

1. U.S. Code of Federal Regulations, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," 40 CFR Part 191.
2. U.S. Environmental Protection Agency, EPA 520/3-80-009, "Population Risks from Uranium Ore Bodies," October 1980.
3. National Council on Radiation Protection and Measurements, Report No. 91, "Recommendations on Limits for Exposure to Ionizing Radiation," 1987.
4. National Council on Radiation Protection and Measurements, Report No. 81, "Carbon-14 in the Environment," 1985.

ITEM D

10 CFR PART 60 SUBSYSTEM PERFORMANCE REQUIREMENTS

ADVISORY COMMITTEE ON NUCLEAR WASTE
MEETING WITH COMMISSIONERS
MARCH 22, 1991

10 CFR Part 60 Subsystem Performance Requirements

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Background

In response to a request from Commissioner Curtiss, the ACNW examined the subsystem performance requirements of 10 CFR Part 60.113 and their relationship to the EPA standards. The Committee held discussions on the subsystem requirements at their September 1990, December 1990, and January 1991 meetings. They also had the benefit of a staff presentation on the background and rationale for the subsystem requirements at the December 1990 ACNW meeting. These discussions resulted in a report to the Commission at the February 1991 meeting.

As a result of their deliberations on this topic, the Committee concluded that no nexus between the EPA standards and NRC requirements was intended. They further concluded that meeting the subsystem requirements does not ensure that the EPA standards will be met, nor is the converse true. There is no technical relation between the two sets of regulations; this situation does not impact the health and safety of the public and is primarily a regulatory issue, not a technical issue.

Cognizant ACNW Member: M.J. Steindler

Cognizant ACNW Staff: C.E. Abrams



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

March 1, 1991

The Honorable Kenneth M. Carr
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Chairman Carr:

SUBJECT: COMMENTS ON 10 CFR PART 60.113, SUBSYSTEM REQUIREMENTS

In response to a request from Commissioner James R. Curtiss, the Advisory Committee on Nuclear Waste has for the past several months examined the subsystem performance requirements of 10 CFR Part 60, with specific attention being directed to the following two questions:

1. If a site meets the standards for a high-level radioactive waste repository as promulgated by the U.S. Environmental Protection Agency (EPA, 1985), does that ensure that the site will meet the subsystem performance requirements of the U.S. Nuclear Regulatory Commission (NRC, 1983a) in 10 CFR Part 60?
2. If a site meets the NRC subsystem performance requirements, does that ensure that the EPA standards will be met?

The answer to both of these questions is "No." In the course of our deliberations we examined a range of issues on this subject. Through this letter, we share with you our observations and recommendations.

Subsystem Performance Requirements

According to the NRC regulations, a mined geologic repository will limit the rate of waste (radionuclide) release to the accessible environment by means of an engineered barrier system (EBS) and the geologic setting (natural system). The two systems differ in their contribution to isolation and in the associated degree of confidence. The EBS is expected to be the main barrier during the times or conditions when the response of the system is most uncertain, and the geologic setting will provide the major barrier to releases over the long term. This approach conforms with the long-established NRC policy of providing for defense in depth.

March 1, 1977

Of the three subsystem performance requirements specified in 10 CFR Part 60.113, the first two relate to the EBS, the third relates to the geologic setting, as follows:

1. "Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission ... provided that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository"
2. "The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure"
3. "... pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment shall be at least 1,000 years"

In addition to these requirements there is a statement (10 CFR Part 60.112) that the overall system performance objective is to have the repository "conform to ... environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events." The NRC regulations also include language that permits the Commission to allow flexibility in the application of each of its subsystem requirements, "... provided that the overall system performance objective, as it relates to anticipated processes and events, is satisfied."

Relation Between Subsystem Requirements and the EPA Standards

Interaction with the NRC staff has revealed that no deliberate attempt was made to relate the NRC subsystem requirements to the EPA standards.

1. Information developed by the NRC staff clearly tends to confirm the lack of a nexus. For example, Table 1, Appendix A, of the EPA standards provides maximum release limits for a range of radionuclides anticipated to be present in an HLW repository. Calculations show that, if radionuclides are annually released at a rate of one part in 100,000 of the inventory at 1,000 years (as specified in the NRC subsystem requirements), the quantities of certain isotopes of plutonium and americium released could be much larger than the limits specified in the EPA standards (NRC, 1983b).

March 1, 1990

2. It is also probable that compliance with the EPA standards might be accomplished without conforming to one or more of the NRC subsystem requirements. For example, a repository that meets the EPA standards might very well have a groundwater travel time of less than 1,000 years.
3. Commissioner Curtiss inquired also about the stringency of the NRC subsystem requirements. The necessity of complying with two sets of regulations would appear to place an added burden on the licensee. The stringency of the NRC requirements, however, cannot readily be evaluated against the EPA standards because (a) the NRC subsystem requirements were not based on the EPA standards and (b) a comparison of the NRC and EPA requirements needs to be site specific.

Summary Comments

In summary, our conclusions and observations are as follows:

1. There is no nexus between the EPA standards and the NRC subsystem requirements. This is not an oversight; apparently no nexus was intended. As long as the NRC regulations include 10 CFR Part 60.112, this situation is primarily a regulatory issue, not a technical issue. It is not a matter that will compromise the protection of public health and safety.
2. Meeting the subsystem requirements specified in the NRC regulations does not ensure compliance with the EPA standards; the converse is also true. The NRC staff should be encouraged to continue to issue statements clarifying the subsystem requirements so that they are less subject to misinterpretation.
3. Both the EPA standards and the NRC regulations include statements that are designed to permit flexibility in their application. Implementing the flexibility, however, may be difficult particularly (as pointed out by Commissioner Curtiss, 1990) under the intense public scrutiny anticipated at the time the licensing process will be underway.
4. It appears likely that the applicant for an HLW repository license will need to address the NRC and the EPA requirements separately. This appears to be true not only because there seems to be no technical relation between the two sets of regulations, but also because demonstration that the facility can meet both sets of requirements appears as an inherent part of the regulations. In our opinion, the health and safety of the public is not likely to be impaired by this situation. We are not able to comment on the purely regulatory or legal aspects of the dual regulatory impacts of the subsystem requirements.

March 1, 1991

We trust these comments will be helpful.

Sincerely,



Dade W. Moeller
Chairman

References:

[Curtiss, 1990]. Curtiss, James R., "Repository Performance -- The Regulatory Challenge," Paper presented at Symposium on Radioactive Waste Repository Licensing, National Academy of Sciences, National Research Council, Washington, DC, September 17, 1990.

[EPA, 1985]. U.S. Environmental Protection Agency, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," Title 40, Part 191, Code of Federal Regulations, Washington, DC, 1985.

[NRC, 1983a]. U.S. Nuclear Regulatory Commission, "Disposal of High-Level Radioactive Wastes in Geologic Repositories," Title 10, Part 60, Code of Federal Regulations, Washington, DC, 1983.

[NRC, 1983b]. U.S. Nuclear Regulatory Commission, "Staff Analysis of Public Comments on Proposed Rule 10 CFR Part 60, 'Disposal of High-Level Radioactive Wastes in Geologic Repositories,'" Report NUREG-0804, Washington, DC, December 1983.