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.)
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> 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?).
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> "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

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).