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

ACNWR-0045

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.

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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

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

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.