



UNITED STATES  
NUCLEAR WASTE TECHNICAL REVIEW BOARD  
1100 Wilson Boulevard, Suite 910  
Arlington, VA 22209

December 13, 1995

NAS Report Comments  
Radioactive Waste Management Branch (6602J)  
Office of Radiation and Indoor Air  
U.S. Environmental Protection Agency  
401 M St. SW  
Washington, DC 20460-0001

On behalf of the U.S. Nuclear Waste Technical Review Board, I welcome the opportunity to comment on the National Academy of Sciences' (NAS) report *Technical Bases for Yucca Mountain Standards*. This report was prepared to address the following issues which were raised in the Energy Policy Act of 1992:

- Whether a health-based standard based upon doses to individual members of the public from releases to the accessible environment ... will provide a reasonable standard for the protection of the health and safety of the general public.
- Whether it is reasonable to assume that a system for post-closure oversight of the repository can be developed, based upon active institutional controls, that will prevent an unreasonable risk of breaching the repository's engineered barriers or increasing the exposure of individual members of the public to radiation beyond allowable limits.
- Whether it is possible to make scientifically supportable predictions of the probability that a repository's engineered or geologic barriers will be breached as a result of human intrusion over a period of 10,000 years.

In answering these questions, the NAS report recommends risk-based standards that emphasize protection of individual members of the public. The report recommends that institutional controls not be relied upon as the means to prevent unacceptable exposures to releases from a repository. The report also finds that there is no scientifically supportable way to predict the probability of human intrusion into a repository.

The Board believes that the NAS report raises a number of very relevant issues and provides a general direction for the EPA to follow in revising its standards for a Yucca Mountain repository. As the report itself notes, many important details related to the standards involve public policy choices among options. These include:

- defining the time period for which the standards are to be applied,
- defining an acceptable level of risk for the individuals who may be affected by releases from a repository,
- defining the "critical group" of individuals (those most at risk from repository releases) for whom the acceptable risk limit would apply and the "exposure scenario" by which the critical group might be exposed to releases,
- determining whether the risks associated with potential gaseous releases of carbon-14 from a Yucca Mountain repository would constitute a "negligible incremental risk" that need not be restricted by the standards, and,
- defining the human intrusion scenario, if any, to be used to evaluate the susceptibility of the repository to an intrusion event.

These (and possibly other) issues remain to be resolved by the EPA through the rulemaking process. In the following paragraphs, the Board offers its technical perspective on these issues.

**Regulatory time period.** The NAS report recommends that standards for the performance of a Yucca Mountain repository apply for a time limited only by "the long-term stability of the fundamental geologic regime — a time scale that is on the order of  $10^6$  years at Yucca Mountain." The report reaches this recommendation, in part, by noting that "potentially important exposures might not occur until after several hundred thousand years." The Board agrees that the fundamental geologic regime at Yucca Mountain should remain reasonably stable and predictable for a time on the order of a million years. However, predictions of repository performance over such long time periods involve considerations other than geologic stability, such as climate change and the performance of engineered barriers. The Board expects that the uncertainties in projected human health risks will increase the farther those projections are extended into the future. Therefore, *if the EPA's standards for a Yucca Mountain repository are to apply for more than about 10,000 years, appropriate language should be included in the standards to accommodate the associated levels of uncertainty.*

**Acceptable level of risk.** The NAS report offers some useful perspectives on the levels of risk associated with the current regulation of radiological hazards by the U.S. Environmental Protection Agency and the U.S. Nuclear Regulatory Commission. The Board notes that *the stringency of the standards will depend as much on the definition of the critical group (and the associated exposure scenarios) as on the acceptable risk level prescribed in the standards.*

**Definition of "critical group."** The Board endorses the general concept of a probabilistic critical group suggested by the NAS panel. *The definition of a critical group suggested by the NAS panel on pages 53-54 of its report seems appropriate.* The Board believes that a probabilistic analysis is the only reasonable way to display both the variabilities in human characteristics and the uncertainties in the locations and lifestyles of members of the critical group. The alternative suggested in the NAS report — a subsistence-farmer critical group — seems overly conservative for a site like Yucca Mountain, which has a harsh climate and lacks arable land. Although there may be some probability that subsistence farming could occur in the general vicinity of Yucca Mountain, a reasonable analysis should consider alternative lifestyles by which individuals could be exposed to releases from a repository. By incorporating alternative lifestyles, a probabilistic approach is able to represent the risks of a repository more realistically than is a deterministic analysis based only on the subsistence-farmer critical group concept. The Board notes the increasing use of probabilistic analyses in other areas of regulation, including evaluation of Superfund sites. Perhaps the concepts used in other areas can be adapted for use with the Yucca Mountain standards.

**Negligible incremental risk.** The average individual risk associated with gaseous carbon-14 releases from a Yucca Mountain repository has been estimated to be on the order of  $10^{-10}$  per year, assuming a linear relationship between radiation dose and risk. To the Board's knowledge, society rarely, if ever, attempts to regulate risks as small as this. The NAS report suggests that this level of risk should be considered negligible and should not be restricted by the EPA in its Yucca Mountain standards. The NAS report further notes that there may be no risk at all from such releases. The Board believes that *the incremental risk, if any, associated with gaseous carbon-14 releases from a Yucca Mountain repository should be considered negligible and beyond regulatory concern.*

**Definition of human intrusion scenario.** The Board agrees that there is no scientific basis for predicting the probability of inadvertent human intrusion over the long times of interest for a Yucca Mountain repository. The NAS report recommends that a "stylized" calculation of the consequences (but *not* the probability) of a human intrusion scenario be carried out to provide assurance that the risk from such a scenario to the public would be no greater than the allowable level of risk for an undisturbed repository. The Board believes that the assumptions underlying even this limited analysis would be highly uncertain and that the results of the analysis would be met with great skepticism. Accordingly, *the Board believes that intrusion analyses should not be required by the EPA's*

*standards* and should not be used during licensing to determine the acceptability of the candidate repository. The regulations of the U.S. Nuclear Regulatory Commission already contain a number of criteria related to potential human intrusion. If additional analyses like those suggested by the NAS report are to be performed, they should be used only to develop insight into the way a repository might respond to an intrusion. An appropriate vehicle for public review of intrusion analyses might be an environmental assessment or environmental impact statement for the candidate repository.

Finally, the Board notes that the form of the standards may have significant implications for the design of the repository. A primary effect of some components of the geologic repository, including waste packages, some engineered barriers, and geologic strata (e.g., the Calico Hills formation beneath Yucca Mountain), is to delay releases through containment or retardation. If the repository standards are of unlimited duration, there may seem to be little merit in spending money to develop engineered barriers or to explore natural barriers that merely delay releases. Also, it may be difficult to capture the value of delayed releases in standards of the type suggested by the NAS. However, the Board believes that the longer the waste can be contained, or significant releases delayed, the better. Waste packages can probably be designed to provide thousands of years of containment; other engineered and natural barriers may add several thousand to hundreds of thousands of years of delay at a suitable repository site.

In summary, the NAS report provides a clarified scientific basis for the EPA to follow in revising its standards for a Yucca Mountain repository, while recognizing that certain matters of public policy must be considered by the EPA in a rulemaking process. The Board encourages the EPA to keep in mind the limits of scientific knowledge and the need to develop standards consistent with those limits. The Board particularly encourages the EPA to *keep it simple*. The complexity of the previous standards (40 CFR Part 191), including the cumulative release limits, led many observers to conclude that the standards were orders of magnitude more stringent than standards for regulation of other nuclear and non-nuclear activities. The Board believes standards can be developed that will be consistent with the suggestions of the NAS report and, at the same time, will be simple enough and consistent enough with regulations for other radioactive and non-radioactive hazardous wastes to avoid the controversy engendered by the previous standards.

The Board is encouraged by reports that the EPA plans to proceed quickly on a rulemaking that reflects consideration of the NAS recommendations. Doing so will rectify a long-standing area of regulatory uncertainty that the U.S. high-level waste program has had to face.

Sincerely,

A handwritten signature in black ink that reads "John E. Cantlon". The signature is written in a cursive style with a large initial "J".

**John E. Cantlon**  
Chairman

cc:  
Robert Fri, NAS