Statement of Dr. Debra Knopman
U.S. Nuclear Waste Technical Review Board
Before the Subcommittee on Energy and Power
Committee on Commerce
U.S. House of Representatives
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Mr. Chairman and members of the Subcommittee. I am Debra Knopman, a member of the Nuclear Waste Technical Board. My full-time job is Director of the Center for Innovation and the Environment of the Progressive Policy Institute. It is my pleasure to act as the Board's representative this morning and to express the views of the Board on progress in the Yucca Mountain site-characterization program. The Board's Chairman, Dr. Jared L. Cohon, sends his regrets at not being able to be here today.

With your permission, Mr. Chairman, I will make some brief summary remarks and ask that my full statement be entered into the hearing record.

The Board's Mandate

Mr. Chairman, when Congress created the Nuclear Waste Technical Review Board in the 1987 amendments to the Nuclear Waste Policy Act (NWPA), it gave the Board a very important —and unique—mandate. That mandate is to conduct an independent review of the technical and scientific validity of activities conducted by the Secretary of Energy in implementing the NWPA, including characterization of the Yucca Mountain site and packaging and transportation of spent nuclear fuel and high-level radioactive waste. Congress intended the Board to communicate its findings and recommendations to the Secretary and to Congress in a timely fashion before important decisions are made, not after the fact.

The Board takes its charge very seriously, Mr. Chairman, and we are pleased to have this opportunity to update the Subcommittee on the Board's view of the Yucca Mountain program before the release of the Department of Energy's (DOE) site recommendation consideration report, or SRCR, which currently is scheduled for the end of this year. In particular, I would like to update the Subcommittee briefly on some of the Board's most recent recommendations on the DOE's safety strategy for the Yucca Mountain site, methods for predicting repository performance, and scientific studies of Yucca Mountain.

The DOE's Site Recommendation Consideration Report

As I mentioned, Mr. Chairman, the DOE intends to issue a site recommendation consideration report on Yucca Mountain at the end of this calendar year. The DOE plans to update the SRCR and use it along with other information called for in the Nuclear Waste Policy Act as the basis of a site recommendation, currently scheduled for mid-2001.

According to the DOE, the SRCR will include four elements: a comprehensive computer model called the "total system performance assessment," or TSPA; a qualitative description of the attributes of the Yucca Mountain site; a repository design and safety case; and an outline of future research needs. Over the last few months, the Board has commented to the DOE on some of these issues. I will briefly summarize some of our most recent comments.

Representation of uncertainties about the Yucca Mountain site. The Board continues to endorse the use of performance assessment, or PA, supplemented by other lines of evidence, for making a site-suitability determination. While the numerical models in a PA help us understand and estimate how a repository might perform at the Yucca Mountain site, the models are based on many assumptions. For example, underlying the models are assumptions about the natural environment, including climate, water movement, chemistry, seismicity, and volcanism, and about the engineered system, including corrosion and other processes. The assumptions may be based on field and laboratory data, on the results of expert judgment, or on detailed conceptual and numerical analyses.

The Board believes that explaining the uncertainties inherent in the PA and the underlying assumptions as clearly and fully as possible is essential for technical credibility and sound decision-making. The Board is concerned that a PA without such an explanation could deprive policy-makers of critical information on possible trade-offs between projected performance and the uncertainty in those projections. For example, one policy-maker might be willing to accept development of a repository that would release half of the permitted dose and have only a 1 in 1,000 chance of exceeding the permitted dose. However, that same policy-maker might decline to develop a repository that is expected to release only a tenth of the permitted dose but that has a 1 in 4 chance of exceeding the permitted dose. Another policy-maker's preferences might be the opposite. Because the uncertainties about repository system performance may be substantial, estimates of uncertainty about doses are at least as important as estimates of performance.

To help decision-makers better understand estimates of repository performance in the PA, the Board recommends that the DOE include in a site recommendation document a description of critical assumptions, an explanation of why particular parameter ranges were chosen, a discussion of data limitations, an explanation of the basis and justification for using expert judgments, and an assessment of confidence in the conceptual models used.

In addition, the Board recommends that the uncertainties associated with the performance estimates be identified and quantified well enough so that the performance estimates can be put in the context of what is well known, what is less well known, and what is unknown (or unknowable) about Yucca Mountain. The DOE and the Board have had numerous exchanges on this point, and we understand that the program is making an effort to respond to the Board's concerns.

Building a case for repository safety. Although we endorse the use of PA, the Board believes that PA modeling should not be used as the sole source of guidance about the features, events, and processes that might affect the long-term performance of the repository system. Therefore, the Board supports the DOE's use of multiple and independent lines of argument and evidence, including defense-in-depth, safety margin, natural analogs, and performance confirmation testing, to supplement the TSPA in its case regarding Yucca Mountain site suitability. These additional elements, combined with a clear description of uncertainty as described above, will present a more technically defensible demonstration of repository safety than would any element by itself. In other words, this is a matter of not putting all the scientific eggs in one basket of computer modeling. The Board believes that the program is making an effort to develop these additional lines of evidence, but it is unclear at this time how far along DOE will be in their development at the time of the SRCR.

Connections between repository design and uncertainties in the safety case. One way to address uncertainties is to reduce them by modifying repository design. In early1999, the Board recommended to the DOE that it analyze alternatives to the repository and waste package designs included in the DOE's 1998 viability assessment. In particular, the Board suggested that the DOE investigate the effects of heat on the waste packages, repository tunnels, and hydrologic and hydrogeochemical processes at the site. The Board made this suggestion because higher temperatures, especially if water is present in repository tunnels, appear to carry additional uncertainties in estimating repository system performance in comparison to lower-temperature, below-boiling conditions in the rock surrounding the tunnels. In the past, the DOE has maintained that above-boiling repository designs have the potential to vaporize water in the rock surrounding the repository tunnels, thereby keeping the waste packages essentially dry for up to a thousand years.

Understanding the differences in estimated performance and associated uncertainties under different temperature conditions is an important component of our overall understanding of potential repository performance at the Yucca Mountain site. However, the Board is concerned that PA may not

in its current state of development capture adequately how the thermal, hydrologic, mechanical, and chemical processes in the mountain interact. If this is the case, then the PA model may not accurately represent the uncertainty associated with above-boiling designs. A below-boiling design may have the potential to reduce concerns about these "coupled processes." Nonetheless, more thorough analysis is needed before any judgment is made about the optimal thermal conditions for repository operation.

In any case, Mr. Chairman, the Board believes that an analysis of the tradeoffs between estimates of performance and the uncertainties in those estimates is essential before a technically-defensible decision can be made on repository design. The Board is pleased that the DOE has begun preliminary work in this area.

Important scientific studies continue at Yucca Mountain. An important aspect of reducing uncertainties is obtaining relevant data. For example, the Board believes, on the basis of current knowledge, that the DOE has chosen the best materials available for the waste package. However, experience with the materials extends over only a few decades—a short time relative to the tens of thousands of years in their intended life in a repository. The Board is closely following the DOE's efforts to address questions about stress corrosion cracking and about dissolution of the passive layer that acts as a corrosion barrier in the alloy that has been selected for the exterior of the waste package. Answering these questions should help reduce uncertainties and increase confidence in predictions of waste package performance that are extrapolated from present-day experience.

The east-west cross drift recommended by the Board and completed in October 1998 by the DOE continues to yield dividends in scientific information that help to address some of the current questions about the properties of the layer of rock where most of the waste would be placed and about how liquid water and water vapor will move within that layer. In addition, the ongoing drift-scale heater test, now in its third year, should provide important information on the general effects of heat on the mountain.

Conclusion

In conclusion, Mr. Chairman, on the basis of what we know at this time, the SRCR will provide an important analysis of key issues that are likely to be included in a final technical document accompanying a site recommendation. Although the Board cannot say whether the SRCR itself will be sufficient for determining site suitability, the Board believes that the DOE's efforts to develop the SRCR have been very useful in helping the DOE identify issues that would have to be resolved or clarified in a final site recommendation report.

At this point, the DOE has not encountered any issue in characterizing the Yucca Mountain site that automatically eliminates it from consideration as the location of a permanent repository for spent nuclear fuel and high-level radioactive waste. However, important technical questions remain about Yucca Mountain, especially about the effects of heat on the movement of water in the mountain and on the associated transport of radionuclides. The DOE is taking steps to address these questions, but some uncertainty will inevitably continue about predictions of the performance of a potential repository system. This may be true to some extent at any site.

At the time a decision is made on site recommendation, the Board and the scientific community are likely to be asked at least two questions: (1) Is the underlying science broadly regarded as technically credible and sound? and (2) Are the uncertainties in estimates of performance displayed clearly and openly, especially about the major factors that may lead to a potential radioactive release? A major question for policy-makers at that point may be whether the site is suitable, given the level of uncertainty associated with the DOE's site-suitability determination. The Board believes it is critical that the DOE not only offer estimates of performance but also clarify the extent and significance of the technical and scientific uncertainties. Understanding uncertainties is vital for sound decision-making.

Thank you very much for this opportunity to provide the Board's views. I will be happy to respond to questions.