Nuclear Waste Technical Review Board Panel Workshop

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on

Technical Aspects of Interim Storage of Spent Fuel

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A. Overview Generalities

Interim storage is a high priority public safety concern that involves a moderate degree of technical complexity, and is a foreseeable need for the nuclear power utilities.

I. Perspective

Basis:
- More than four decades of experience with similar nuclear power system issues.
- Risk Analysis philosophy background
- Public Perception experience

II. Strategy Framework

1. The issue is not strictly technical. The reality is that embedded institutional doctrine, government policies, and public perceptions all shape and constrict technical options and priorities.

2. An inherent problem in all long-term projects that cover decades is that any system now planned assumes that we know the performance requirements for the useful lifetime of the system -- at least 50 years for a spent fuel interim storage system, and millennia for an eventual repository. History suggest that such persistence of performance criteria is rare (e.g. our national transportation systems).

III. General System Objectives to Meet the Above Framework

1. Flexibility
   All such systems are developmental in nature. First use leads to early modifications. Changing priorities, loads, policies lead to later modifications.

2. Initial Demonstration and Technical Performance Monitoring
   These systems require scientific and engineering data collection throughout their lifetime; most intensively in their first decade, but on a diminished continuous basis after steady operation is achieved – both for prevention and for corrective actions and for public confidence.

IV. Risk Analysis Generalities

1. All problems eventually lead to outcomes. Time and social processes cannot be stopped. Neglect leads to unplanned and ad hoc short term responses that are unpredictable and usually undesirable. Action provides control to the extent of the foreseeable knowledge base. (Neglect may also be a conscious strategic decision not to control.)

2. No solution is perfect in all respects. One seeks the best balance of benefits/costs/risks (including social costs of all kinds).

3. Every end-objective has several strategic planning paths from now to then; what is needed is a comparative risk/benefit/cost analysis of the alternatives. Focusing on only one can be misleading. Need a Probabilistic Safety Analysis (PSA) for each alternative to provide a basis for risk perspective and comparisons, although it is likely that risk may not be the only factor in the final choice.

4. There should not be a zero risk target. Realistically, individuals world-wide commonly have an annual probability of death from nature induced accidents (insects, snakes, lightening, etc.) ranging between 10^{-6}–10^{-7}, or a lifetime risk of 7×10^{-5} to 7×10^{-6}. It may therefore be excessive for society to invest resources to reduce any man-made risk very much below this magnitude, even accounting for the statistical cumulation of such low-level risks. Public risk taking is comparative, not absolute.

5. A system analysis of each alternative should be undertaken to disclose the cost/benefit/risk relationships of each, and their dependence on a range of public safety and intergenerational criteria. Criteria are also cost dependent. A comparative system analysis would provide a basis for selecting a national strategy that applies our resources effectively.

6. Public acceptance of a risk depends on public confidence in its effective management. The public wants visible assurance that it can be monitored, and remedial steps taken if needed.

B. Interim Storage Systems.

I. Relevance of the Generalities

1. The spent fuel flow in the U.S. during the coming decades must be stored. Foreclosure of nuclear power plants would not remove this need. The issue is the choice of systems among the three now being considered: the ultimate repository, the interim storage in a MRS; and on-site interim

storage. Each of the three can be made risk acceptable. They serve different needs and time horizons -- decades, a century, and millennia.

2. The spent fuel flow may continue indefinitely. The present notion that the absence of new nuclear plant orders caps the amount to store in the repository is based on regulatory and cost factors that can change in the coming decades. If natural gas price moves up substantially, or the global warming threat penalizes fossil fuels, nuclear may become a direction of choice -- as it already is in several industrial countries. Thus, near-term schedule accomplishment, while vitally important to the nuclear utilities, is secondary to adequate long term performance of the system.

3. The system chosen must be flexible. After the initial trial, desirable modifications will undoubtedly become evident.

4. System chosen must place a high priority on public concerns as well as on the technical issues. Public worries are different than engineering worries. The real public risks from any of the options selected for spent fuel storage is likely to be immeasurably small. But the public needs reassurance on storage invulnerability to foreseeable scenarios.

II. Interim Storage Alternatives

1. The interim storage at a Monitored Retrievable Storage (MRS) or at on-site storage are technically similar. They differ primarily on the centralization of responsibility. (Example: Should the Treasury's gold bullion be stored in many bank vaults or at Fort Knox.) The public may feel more confident in the long-term existence of a central government vs. that of utilities.

2. The difference between an eventual repository, such as Yucca Mtn., and an interim storage is the series of barriers between the radioactive sources and the public. The eventual repository is a

mix of natural geologic barriers which are site sensitive, and man-made (engineered) barriers which are site insensitive. The interim storage depends only on engineered barriers, and on a short-term basis has less uncertainty in the estimated public risk.

3. The proposed "MultiPurpose Canister" (MPC) embodies engineered barriers based on present knowledge and predictable performance for at least a century or more.

4. All three systems share in common a need for transportation some time. The MPC should easily meet this need safely.

5. An eventual repository (Yucca Mtn.) must be considered initially (i.e., today), as a development program because the natural geologic barriers are complex and only partially predictable, and their long-term interaction with a man-made system may reveal characteristics that require physical re-engineering or accommodation. Thus, for the first century, the eventual repository should permit access, measurement, and retrievability. The MPC would permit this, and its design could substantially reduce the dependence on the geologic barriers.

III. Technical Aspects

1. The MPC and the MRS are traditional engineering, design, and fabrication projects. They obviously should be able to meet all current public risk criteria. Public perception that it does so can be supported by physical demonstrations of its integrity: e.g., railroad collisions, explosive detonations, etc. (e.g., the U.K. demonstration).

2. The key long term question relates to the eventual interaction of the MPC outer shell with the geologic repository, and thus the appropriate choice of materials for the longest life and integrity. This is a flexible choice if the MPC is retrievable from the eventual

repository for a century or more. It is not an issue for the interim MRS where materials such as Ductile Cast Iron or the equivalent provide a core enclosure of extreme durability. However, it would be useful to have a specialized research facility at the MRS to study the spectrum of outer shell possibilities for the geologic repository.

3. The capital cost of both the MPC and the MRS is unlikely to be as significant as the continuing cost of spent fuel handling, monitoring, supervision, and institutional administration. Thus the design objective should be to minimize these long term operating costs.

3. The interim storage combination of the MPC and MRS can be designed, constructed, and placed in operation on a relatively short time scale compared to the implementation of a permanent repository. It thus would provide time for explorative studies of the geologic repository and also meet the foreseeable needs of the nuclear utilities. Most importantly, it would provide an opportunity to establish public confidence in the program strategy.

4. Because interim storage in an MRS would substantially relieve the performance requirements of a subsequent geologic storage, it would have a permanent value in any eventual spent fuel system.

IV. Importance to the Nuclear Industry

1. The disposition of spent fuel has obviously become the "Achilles' heel" of the nuclear power industry. Some nuclear utilities are facing this issue today, and eventually all must. It is both an economic and managerial issue and cannot be avoided, even though it may not be as immediately urgent as current operating costs and regulation.

2. The performance of other countries in implementing spent fuel repository systems suggests that our difficulties are institutional rather technical.

3. The present federal government commitment to assume this responsibility unilaterally has been difficult to fulfill. The split of responsibility and authority among the several federal agencies involved has resulted in discordant views, objectives, and implementing tactics. While the agencies are sympathetic to the utilities' needs, realistically they have only weak political pressure to meet schedules or operating targets. Their only persuasive client is Congress and its committees.

4. As the most vulnerable stakeholder, the nuclear industry should now seek an active participative role in this program, to protect itself against the real possibility of an indefinite lack of progress while the industry bears the continuing cost burden.

V. The Ideological Issues

Nuclear Power continuous to grow worldwide. The eventual storage of spent fuel will be a global necessity for the foreseeable future as a key part of the back end of the nuclear power fuel cycle. It is relevant that most nuclear power countries have incorporated interim storage in their total spent-fuel systems. This topic has been subjected to much ideological debate based on imaginative scenarios of potential environmental and security threats. Regardless of their merit, these concerns must be allayed in the political debate establishing a U.S. national strategy for the next half century.