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Secretary  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555-0001  
Attention: Rulemakings and Adjudication Staff

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OFFICE  
RULE  
ADJUDICATION

I wish to offer the enclosed comments on the Proposed Rulemaking for Disposal of High-Level Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada, that appeared in the Federal Register on February 22, 1999. I offer these comments as a private citizen, I am not employed in any way related to the Yucca Mountain Project.

Sincerely,



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*Template = SECY-067*

Acknowledged by card

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*SECY-02*

## **COMMENTS BY R.M. BERNERO ON PROPOSED RULE FOR DISPOSAL OF HIGH-LEVEL WASTES IN A PROPOSED GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA**

### Background

At page 8641 of the Federal Register Notice (FRN), the Commission indicates that it might provide informal hearings for both construction authorization and licensing to receive and possess waste. I support the use of legislative type hearings along the lines suggested by Commissioner McGaffigan in his November 13, 1998, Notation Vote. These repository licensing actions will be sufficiently unique that I believe the Commission itself should be the hearing board.

### NAS Conclusions and Recommendations

NAS concluded that there is no scientific basis for incorporating the ALARA principle into the EPA standard or NRC regulations. I agree if one applies the ALARA principle as calculating individual or collective doses far in the future and comparing alternative doses which are highly uncertain. However, the principle can be applied in the repository performance assessment as optimization of system elements as indicated by the sensitivity of the outcome to those elements. An example is the drip shield over the disposal canister that I understand is being considered now. No one should seek to calculate the 10,000 year doses with and without the drip shield to select doses which are ALARA. Instead, one should seek to optimize the disposal system design, making it as robust as reasonably achievable. Design features that can significantly extend the canister life or slow its rate of failure once penetration has occurred are desirable. It may be difficult to quantify their benefit, but the developer should systematically explore the use of such alternatives, adopting those that promise to make the system as-robust-as-reasonably-achievable (ARARA). This recommendation is not the same as going back to the Part 60 subsystem performance criteria. The performance standard should remain as the overall system performance without segmentation of subsystem performance.

### Individual Protection Standard for Postclosure Repository Performance

I strongly support the Commission's use of clear language "To identify an appropriate objective for repository performance..." as set down on page 8644 of the FRN. I recommend consideration of Table 1 as a context for identifying and clarifying the performance objectives for the repository. Table 1 identifies seven orders of magnitude for the consequences of human exposure to ionizing radiation. The International Commission on Radiological Protection (ICRP) sets limits for public exposures from all sources at 1 mSv/yr (100 mrem/yr) and for about one tenth of that for any single permitted or licensed practice. This is a desirably strict acceptance standard for controlling human exposure to ionizing radiation, and is consistent with the Commission's choice of 0.25 mSv (25 mrem) as the annual dose limit for those closest to the repository. I hope that the Environmental Protection Agency (EPA) will adopt this general standard. I believe the Commission should proceed further now, beyond the general standard, to address the implementation of the standard through the NRC licensing process.

Table 1- Perspectives on Exposures to Ionizing Radiation

The following radiation exposure levels are given simply as dose. The higher levels are usually associated with short time exposure in accidents or emergency situations. Those at the lower end of the spectrum are usually associated with chronic exposures from releases or direct radiation, i.e., annual doses.

10 Sv (1000 Rem)	Certain death
1 Sv (100 Rem)	Floor for exposure threatening prompt death, Clearly predictable proportion to threat of induced cancer, Clinically detectable effects of radiation exposure, Exposure limit for rescue workers in nuclear war or emergency.
0.1 Sv (10 Rem)	Floor for clearly predictable proportion to threat of induced cancer (based on bomb survivor data), Typical standard for limit of public individual accident exposure.
0.01 Sv (1 Rem)	Clearly acceptable annual exposure limit for radiation workers, Tolerable level of public exposure in recognized situations which are difficult to change, e.g., radon in the home, high natural background radiation, Average total background radiation is about a factor of 3 Below this level, dominated by radon exposure which varies considerably.
1 mSv ( 100 mrem)	Clearly acceptable annual exposure to a member of the public from all permitted sources, Typical background radiation from terrestrial and cosmic ray sources, Additional cosmic ray exposure suffered by frequent flyers.
0.1 mSv (10 mrem)	Typical proposed limit for exposure of the public from waste releases or a single permitted source, Too small to be discerned as a change in background radiation.
0.01 mSv (1 mrem)	Negligible individual exposure.

With the standard for disposal set at such a strict, low tier of Table 1, it is easy to see why the calculation of doses below this level for ALARA purposes is not warranted. The doses calculated would be collective doses aggregated from many exposures at levels below the level of negligibility for individual exposures.

I believe it is useful to state clearly not only the primary objective of the regulation but any other objectives and implementation aspects as well. Here it could be stated that the Commission intends that those future persons most closely affected by the releases from the repository will be reasonably assured of the same level of protection that we would require today at a licensed facility. Performance standards for licensed facilities are typically set in a conservative manner and compliance analyses are similarly conservative. Thus, in repository licensing, the outcome of the performance assessment is not to determine whether the exposure standard is the most likely outcome, perhaps higher perhaps lower. Rather, I believe the Commission intends that the performance assessment outcome will provide reasonable assurance that the exposure standard will not be exceeded. At page 8651 and elsewhere the Commission says this will be achieved through the "calculation of an expected annual dose." I recognize that to the specialist the "expected" value of the annual dose is the mean value of the dose, a level not likely to be exceeded. However, to many people the word "expected" implies the most likely outcome. I do not think that the mean value derived from the performance assessment is the most likely outcome, it is instead a level not likely to be exceeded. I recommend that the Commission should clarify this and other points with further clear language on objectives and implementation.

Table 1 also provides a useful context in which to understand that pledge of protection for future generations as one prepares to deal with the uncertainties of assessing repository performance to estimate the likelihood of the critical population group suffering these exposures. As the Table illustrates the exposure of these closest people could exceed the Commission's objective by more than an order of magnitude while still being an exposure our society tolerates today without intervention. This can provide useful perspective when evaluating exposures from very long-lived soluble species such as I-129 and Tc-99. No credible container can hold these isotopes for many half-lives of decay. These isotopes will ultimately escape the container after only a little decay. Because of the great efforts to make a very long-lived container, the failures, and releases of I-129 and Tc-99 will occur gradually over a span of many years. The performance assessment will calculate the doses they can cause taking into account this slow failure mechanism. A simple sensitivity analysis should be performed to establish whether simultaneous release and transport to the biosphere would result in anything exceeding a tolerable individual exposure. I suspect it would not, and that would constitute an acceptable risk in my opinion. Here too I recommend that the Commission extend the discussion with further clear language on objectives and implementation.

#### Reference Biosphere and Critical Group

The presentation at page 8645 of the FRN provides an excellent basis for compliance analysis with the assumed critical group and reference biosphere. I recommend that the Commission supplement the compliance analysis with sensitivity analyses of pessimistic

alternatives, such as a subsistence farmer up-gradient, to evaluate the significance of these using the measure of whether they exceed tolerable doses. As with the simultaneous release of all the I-129 and Tc-99, the subsistence farmer up-gradient is not a likely situation. A useful insight is provided if the sensitivity analysis shows that even in this unlikely situation the consequences are not grave.

#### Compliance Period

The 10,000-year compliance period is well justified. I believe it will be useful for the record to include additional analyses for performance at 1,000 years and 100,000 years. I was told in Sweden recently that the local populations around the candidate sites focus on concern about their children and their grandchildren suffering exposure; they have difficulty with conceiving of doses to people a millenium from now. Of course, Sweden is more recently out of the last ice age and expected to be sooner into the next one, which does affect their perspective. The Swedish authorities seem to be converging on 1,000 years as their compliance time with other periods being the subject of supplemental analyses to evaluate what they call the "risk picture". I believe the Commission would benefit if by rule or by guidance an analysis was done for 1,000 years. The uncertainties that would be an obstacle to very high confidence of containment for 1,000 years would be associated with juvenile failure of the waste package. It is good to identify such vulnerabilities, and the ways that DOE can reduce the likelihood and consequences of such juvenile failures.

A supplemental analysis at 100,000 years, or even later, can provide a useful projection of the final transport of waste from the repository. The longer term supplemental analysis is another way to deal with the very long-lived isotopes, such as I-129 and Tc-99.

#### Multiple Barriers and Defense in Depth

As indicated on page 1 of these comments, I do not support dose-based ALARA analysis, but favor barrier optimization by the developer to make the system as-robust-as-reasonably-achievable (ARARA). I believe the Commission's proposed approach as explained starting at the end of page 8649 is the correct approach.

#### Institutional Controls

The discussion of institutional controls is reasonable, consistent with the EnPA, and not very different from the approach in other regulated areas. However, Part 63.52 speaks of terminating the license after final closure. This is in contrast to the practice at Title I mill tailings sites, where NRC issues DOE a general license and continues active regulatory surveillance. For other closed sites, I am not sure there are clear processes. I support the approach described here for Part 63. Leaving one Federal agency responsible indefinitely is the correct choice. It is the license termination and oversight approach for other sites that needs to be reexamined.

#### Preclosure Performance Objective and Integrated Safety Analysis of Activities

The Geologic Repository Operations Area (GROA) has long been considered similar to a Monitored Retrievable Storage (MRS) site with a hole in it. The expected activities are

the receipt and handling of heavy loads which require radiation shielding, packaging and unpacking, and other activities expected in an MRS. For almost 20 years the Commission has had a regulation, 10CFR Part 72, for the MRS and privately owned spent fuel storage systems. There is extensive experience in applying this regulation and its now many guidance documents. Part 60 approaches the GROA as an MRS.

I see no reason to adopt the Integrated Safety Analysis (ISA) approach of the new Part 70 to the GROA. The ISA process, which I strongly support, is derived from chemical process safety analysis and is appropriate for the chemical and physical process lines of most fuel cycle plants. I do not believe it is appropriate for the GROA. There is not yet much experience in regulating with the ISA. If the Commission proceeds to require the ISA there will be inevitable references to Part 72 applications for comparison or guidance.

The Commission already relies on Part 72 for Quality Assurance and Emergency Planning. I recommend that the Commission revert to the requirements of Part 72 for design and operation in the GROA.

#### Material Control and Accounting

Part 63.78 requires that DOE implement a program of material control and accounting (MC&A) and accidental criticality reporting that is the same as for Part 72. As such these programs will apply as long as the license applies. The DOE program should develop the processes by which these programs can be phased out. For example, a spent fuel assembly is periodically inspected, by serial number accounting to verify its presence. When spent fuel assemblies are combined into a single canister, that canister with its listed contents is subject to periodic inspection to verify the continued presence of the spent fuel assemblies within it. The periodic inspections will continue after the canisters are loaded into disposal canisters or overpacks, perhaps with the MC&A inspectors travelling up and down every filled gallery, receiving some fairly substantial radiation exposures. A rationale and process are needed, with joint NRC and DOE agreement on how and when to terminate MC&A surveillance, to declare the fissile material permanently disposed.

#### Monitoring and Testing Waste Packages

Part 63.134 requires a program to monitor and test waste packages. As written, the regulation could be used to drive a very large, costly program of testing at full scale. I found no statement of objectives or criteria for the monitoring and test program. I recommend that the objectives and criteria be stated in advance of the rule.