

[DOE LETTERHEAD]

March 7, 1997

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

Enclosed is a list of "[critical assumptions](#)" to be used in the preparation of the Department of Energy low-level waste disposal facility performance assessments. Preparation of these critical assumptions is a deliverable pursuant to the commitment in Task Initiative VII.B.1 identified in the Department of Energy's Implementation Plan, Revision 1, for the Defense Nuclear Facilities Safety Board Recommendation 94-2. By letter dated [February 2, 1997](#), I advised you that this commitment would be delayed from a January completion so it could be coordinated with the effort to revise DOE Order 5820.2A, *Radioactive Waste Management*, and with the Department's efforts to issue 10 CFR 834, *Radiation Protection of the Public and the Environment*. The necessary coordination has occurred, and these critical assumptions, along with a rationale for each, are described in the enclosure. These critical assumptions have been incorporated as manual requirements or guidance as part of the DOE Order 5820.2A revision effort.

The critical assumptions were developed to provide consistent guidance to preparers and reviewers of low-level waste disposal facility performance assessments on a range of policy and technical issues. With minor exceptions, these assumptions were conveyed to the field in interim performance assessment guidance documents issued in 1996.

The Department has completed the actions for the performance assessment critical assumptions identified under this commitment and proposes closure of the commitment.

Sincerely,

Alvin L. Alm
Assistant Secretary for Environmental Management

Enclosure

cc: M. Whitaker, S-3.1

**Critical Assumptions for
Department of Energy Low-Level Waste Disposal Facility
Performance Assessments**

1. **Time of Active Institutional Control**

Active institutional control shall be assumed for a minimum period of 100 years. Longer periods than 100 years may be assumed if justified on the basis of documented plans for long-term site use or remediation.

Under authority of the Atomic Energy Act (AEA), DOE is responsible for protecting the public and the environment from hazards associated with all sources of radiation under its purview. This responsibility encompasses LLW disposal facilities and other lands and properties under the Department's control, and continues until the land or property can be safely released or legally transferred to another government agency or party. Criteria for release are contained in Order DOE 5400.5 (or 10 CFR 834 when promulgated).

However, to provide a basis for management of LLW radioactive waste, and to incorporate the concept of defense-in-depth, it is prudent to assume that after a period of 100 years, there may be lapses in institutional control. For some DOE sites, the default period of 100 years may be inappropriately restrictive. Therefore a site has the option of considering longer periods of time provided that the assumption can be justified on the basis of long-term site use and remediation plans.

2. **Relationship of Active and Passive Institutional Periods**

The performance assessment shall consider the efficacy of passive controls (e.g., engineered features, marker systems, etc.) in deterring accidental intrusion into the LLW disposal facility.

The Department intends to exercise control of the LLW disposal facility and other contaminated lands until they can be safely released pursuant to DOE Order 5400.5 (or 10 CFR 834 when promulgated). However, if active institutional control is planned for longer than 100 years it is possible that those active controls could lapse for periods that would not be expected to exceed a few years' time. During such lapses, passive controls (e.g., engineered features, marker systems, etc.) may be effective in deterring accidental intrusion into the LLW disposal facility and should be considered in the performance assessment.

3. **Time(s) of Compliance**

The performance assessment shall provide a reasonable expectation of compliance with the performance objectives for a period of 1,000 years after closure, and shall estimate the maximum projected dose in the sensitivity/uncertainty analysis.

Comparison of the projected performance of the LLW disposal facility with the performance objectives should generally be restricted to a 1,000 year period given the uncertainties in long-term projections and their hypothetical nature. However, to provide an understanding of the behavior of a disposal facility or system model, and the sensitivity of an analysis to parameter values and modeling assumptions, the

sensitivity/uncertainty analysis should include the calculation of the maximum projected dose and the time of the maximum. This information may also be useful in evaluating alternatives which are otherwise equal.

4. **Points of Compliance for Performance Objectives**

The point of compliance shall correspond to the point of highest projected dose beyond a 100-meter buffer zone surrounding the disposed waste. With justification, a site could use a buffer zone of more or less than 100 meters.

Although, as noted in number 2 above, the Department intends to exercise long-term control over contaminated lands, in order to provide for defense-in-depth, the point of compliance should normally correspond to the point of highest projected dose beyond a buffer zone surrounding the disposed waste. The buffer zone should normally be 100 meters. However, with justification, a site could use a buffer zone of more or less than 100 meters. However, the buffer zone shall not extend beyond the boundary of land projected for permanent control by DOE, consistent with specific plans for site use and remediation.

5. **Ownership and Future Land Use Following Closure of a Disposal Facility**

Long-term control of land, consistent with number 2 above, containing LLW disposal facilities (and other contaminated areas) shall be assumed unless there are plans to remediate and release these facilities pursuant to DOE Order 5400.5 (or 10 CFR 834 when promulgated).

However, as noted in number 4 above, it is prudent to assume a more restrictive point of compliance in the performance assessment.

6. **Degree of Certainty Necessary for Compliance Demonstration**

Performance assessments shall provide a reasonable expectation of the performance of the disposal facility.

A performance assessment constitutes a projection of future events, not a prediction. Compliance with performance objectives in the future cannot be demonstrated in the present. Rather, the intent is to provide a reasonable expectation, considering uncertainties in engineered and natural systems over long time periods, that the actual performance of the disposal facility will comport with its design.

7. **Purpose of Inadvertent Intruder Assessments**

The performance assessment shall include the analysis of the dose to a hypothetical individual who inadvertently intrudes into the disposal facility, assuming a temporary lapse of institutional control measures.

The purpose of an inadvertent intruder assessment is to help determine the acceptability of waste for near-surface disposal, assuming: (1) institutional controls

will continue but may be subject to complacency, (2) long-term waste containment (as opposed to dilution and dispersion) represents a potential hazard should accidental human misuse of a LLW disposal facility occur, and (3) reasonable measures should be implemented for reducing or controlling this hazard, recognizing that there is no conclusive way to characterize intrusion or its consequences, or to reduce the hazard other than by waste dilution or dispersion.

8. **Assumptions Regarding Human Activities Relative to Demonstrations of Protection of Individuals and Inadvertent Intruders**

The performance assessment shall use reasonable assumptions regarding actions of a typical group of individuals performing activities that are consistent with regional human activity, work and housing patterns.

The performance assessment entails projections of doses via all pathways to hypothetical individuals at the point of compliance. There will be significant uncertainties in defining scenarios. Among the largest uncertainties are individual human actions, levels of technology and knowledge, and societal customs and requirements. However plausible today, there is no way of knowing whether any postulated scenario will be reasonable for a future society. The most important factor in determining the reasonableness of a scenario is its credibility considering current regional practices and environmental conditions. It is not necessary to consider the most conservative scenario that could be imagined. Rather, the intent is to consider a limited set of normal activities consistent with local practices, customs, and environmental conditions, and land use history and plans.

9. **Use of Standardized Adult Dose Conversion Factors**

Performance assessments shall use standard adult dose conversion factors (DCFs).

In a performance assessment, one is not attempting to determine doses to known and identified individuals, but projecting hypothetical doses to postulated future individuals. Adult DCFs are appropriate, because performance assessments are conducted assuming that activities that would be performed by an adult in the accessible environment result in hypothetical exposure to radiation or radionuclides over a continuous period spanning several decades.

10. **Extrapolation to Future Environmental Conditions**

Performance assessments shall address reasonably foreseeable processes (e.g., erosion, subsidence, burrowing animals) that might disrupt barriers against release and transport of radioactive materials.

Performance assessments require projections of natural processes and events for long periods of time. Ongoing processes reasonably expected to occur based on current conditions (e.g., precipitation, vegetation progression, erosional and depositional processes) might be subject to change based on long-term climatic trends. Future

events might range from those (such as floods or earthquakes) that would be expected to occur within a reasonable period of time in an area based on its history, to those that are reasonably projected to occur at some distant time in the future (such as glaciation). Finally, there are hypothetical events that may or may not occur (such as severe climate change from global warming) or may be extremely unlikely (for example, volcanism in an area where evidence for such a process is lacking). At issue is the extent to which this range of processes and events should be considered in performance assessments.

As a general principle, long-term calculations should be based on current site conditions (including present rates of natural processes such as precipitation or erosion), allowing for variations in processes, including the occurrence of episodic events such as flooding, that are reasonably projected to occur during the time period of the assessment. It is not the intent to require overly conservative assumptions about future events and processes at a site. Rather, the intent is to generate an analysis that provides a reasonable expectation of the behavior of the total disposal system over time.

11. **Treatment of Radon Dose in Performance Assessments**

Calculated impact from radon and decay products shall be considered separately from the doses from other radionuclides.

It is normal radiological protection practice to consider radon and decay products in air separately from the impacts from other radionuclides. For example, the draft 10 CFR Part 834 imposes a primary annual dose limit of 100-mem (TEDE) from all sources of radiation, allows temporary doses up to 500 mem (TEDE) under unique situations, and considers radon isotopes separately from the overall dose limit.

The performance measure for radon and progeny should be either an average flux of less than 20 pCi per square meter per second at the burial ground surface or a concentration of less than 0.5 pCi per liter of air from all sources at an offsite location.

12. **Interpretation of Groundwater Protection Requirements**

The performance assessment shall provide a reasonable expectation that water resources will be protected, consistent with Federal, state, and local requirements.

Water resource protection should consider both groundwater and surface water, as appropriate for the disposal site and facility.

Assumptions for water resource protection assessment should be selected within the framework of a site's groundwater protection management program and goals. Assumptions for surface water protection, as well as groundwater protection, should identify and reflect the following considerations, if applicable:

1. Compliance with any applicable Federal, State, or local law, regulation, or other applicable requirement for water protection.

2. Compliance with any formal agreement with appropriate State or local officials applicable to water protection.

If these considerations are not applicable, assumptions should be selected based on the goals established in the site groundwater protection management program, and consistent with any formal land-use plan. The groundwater protection management program and hence, the assumptions, should not be inconsistent with State groundwater protection programs.

If not constrained by the considerations noted above, the following default assumptions shall be used:

- a. The performance measure shall not exceed a total effective dose equivalent of 25 millirems in a year through the water pathway alone.
- b. Water resources shall be protected consistent with their usage.
- c. The point of compliance shall be established as discussed in number 4 above.