



UNITED STATES  
**NUCLEAR REGULATORY COMMISSION**  
ADVISORY COMMITTEE ON NUCLEAR WASTE  
WASHINGTON, D.C. 20555

February 11, 1997

The Honorable Shirley Ann Jackson  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Dear Chairman Jackson:

**SUBJECT: TIME OF COMPLIANCE FOR LOW-LEVEL NUCLEAR WASTE  
DISPOSAL FACILITIES**

In this letter, we communicate the observations and recommendations of the Advisory Committee on Nuclear Waste (ACNW) on the time span for compliance of low-level waste (LLW) disposal sites. This letter complements our letter of June 7, 1996, on "Time Span for Compliance of the Proposed High-Level Waste Repository at Yucca Mountain, Nevada," in which we proposed a set of general principles for establishing the time span for compliance of nuclear waste facilities. Building on these principles, we recommend a two-part approach to establishing the time frame for LLW compliance. The first part utilizes a site-specific time span based on an analysis to determine the time at which release and transport of the more mobile radionuclides produce a peak dose to the critical population group. The second part is a qualitative evaluation, not requiring a specific measure of compliance, which is used to identify any significant deficiencies in the performance of the disposal system.

Our observations and recommendations are derived from a working group meeting on "Regulatory Time of Compliance for Radioactive Waste Disposal" held during the 82nd meeting of the ACNW on March 27, 1996, at which the time of compliance for both high- and low-level waste facilities was discussed; a presentation by the Office of Environmental Policy and Assistance in the Office of the Environment, Safety, and Health of the U.S. Department of Energy (DOE) at the 84th meeting of the ACNW on June 27, 1996; and remarks made at both the 84th and 85th meetings of the ACNW on June 27 and August 22, 1996, respectively, by officials of several States involved in developing LLW facilities.

**The Problem**

Performance assessment provides useful information on how an LLW facility may perform over a period of time. Thus, performance assessment is an important tool for demonstrating LLW regulatory compliance as specified in Part 61 of Title 10 of the Code of Federal Regulations (10 CFR Part 61) and related guidance of the U.S. Nuclear Regulatory

Commission (NRC). A critical element of a performance assessment is the length of time over which the calculated dose should be compared to the specified standard or regulation. This is the time span of compliance. The current NRC regulation for LLW disposal facilities (10 CFR Part 61) does not specify this time span. The rule is concerned with minimum times of analyses. For example, 10 CFR 61.7(a)(2) states, "In choosing a disposal site, characteristics should be considered in terms of the indefinite future and evaluated for at least a 500-year time frame." This statement is, in part, the origin of the misconception that 10 CFR Part 61 is a "500-year rule," which only requires a demonstration of compliance for this time period. A time specification of 10,000 years is included in the draft Branch Technical Position (BTP) on Low-Level Waste Performance Assessment and was included in the Draft Environmental Impact Statement (DEIS) for 10 CFR Part 61 (NUREG-0782). However, the Final Environmental Impact Statement (FEIS) for 10 CFR Part 61 (NUREG-0945) does not include a compliance period.

The DOE is preparing radiation protection requirements for the public from its near-surface disposal of LLW and residual radioactivity in soil. DOE officials have informed us that they intend to promulgate regulations (10 CFR Part 834) in the near future. The DOE Format and Content Guide and Standard Review Plan for DOE Low-Level Waste Disposal Facility Performance Assessments specifies a time of compliance of 1,000 years. This decision is not based on a scientific or technical rationale but rather is believed to be consistent with the intergenerational equity principle. This principle states that no generation should needlessly deprive its successors of the opportunity to enjoy a quality of life equivalent to its own and is an often-cited benchmark in establishing policy on time of compliance. In developing guidance on time of compliance, DOE points out that dose analyses beyond 1,000 years could be used in evaluation of facility alternatives, but that these results should be used with caution because of the potential uncertainties. This two-part approach to time of compliance using a shorter, quantitative evaluation followed by a longer, qualitative consideration is widely employed in other national and international regulations and guidance.

The ACNW has a long-standing interest in the development of guidance by the NRC for LLW performance assessment, as evidenced in numerous discussions with the Division of Waste Management, Office of Nuclear Material Safety and Safeguards, and several letters over the past half decade to the Chairman of the Commission. The time frame for performance assessment has been of special concern. In our letter of June 3, 1994 (Appendix A), we pointed out the need for a specified time of compliance in the LLW regulations. Later, in a letter to the Chairman of the Commission on regulatory policy issues in LLW performance assessment dated June 28, 1995 (Appendix B), the Committee again suggested the need for a maximum time frame for analyzing the safety of an LLW disposal site. The Committee pointed out that much larger quantities of long-lived radionuclides are being disposed of as LLW than was anticipated in the DEIS/FEIS, resulting in the potential for peak dose times in excess of 10,000 years. A letter received by the Committee from James M. Taylor, Executive Director for Operations, dated May 17, 1996 (Appendix C), confirms the staff's continuing interest in this topic. Subsequently, a

working group on regulatory time of compliance and deliberations and discussions led to our letter of June 7, 1996, in which we outlined a set of principles for establishing a regulatory time of compliance for the proposed high-level waste repository at Yucca Mountain.

### **Considerations Regarding LLW Disposal Time of Compliance**

We seek to devise a rational basis for selecting a time of compliance that relates the characteristics of a disposal site and its impact on public health and safety. The principles stated in our letter of June 7, 1996 (Appendix D) provide a rational approach for establishing a time span of compliance. The period of time must be short enough so that meaningful evaluations can be made without excessive uncertainty, but long enough to permit the evaluation of processes that may lead to the loss of integrity of the facility and transport of the radionuclides to the critical group. These principles need to be sufficiently generic so that they can be applied to a variety of LLW disposal facilities.

The regulatory principles involve a two-part approach. In the first part, the time of compliance should be established by the estimated time at which transport of the more mobile radionuclides produce a peak dose to the critical group. This time estimate is based on a systems analysis using data from site characterization, modeling, analogs, and experimental studies. The specified time of compliance is not a direct measure of the facility's performance, but defines the span of time over which the performance of the facility is assessed by comparing the calculated dose with the standard. This definition leads to an apparent paradox in that a disposal facility with superior containment qualities has a longer time of compliance than a site of lesser quality. However, in the proposed methodology, the time of compliance is not a measure of safety, but is the time at which the calculated dose from the facility must meet the standard. The goal is not to set a specific time that would be enforced like the dose standard. On the contrary, the objective is to allow the regulator to evaluate the dose versus time relationship from the site-specific performance assessment calculations that will serve as a benchmark of facility performance and an indicator of long-term safety. The specified time of compliance may be of such a long duration that the procedure could lead to the calculated doses having unacceptably large uncertainties. In this case, a time of compliance shorter than that calculated on the basis of transport should be specified using the time history of the source term hazard as a criterion.

The second part of our proposed regulatory approach generally pertains to facilities for which the highest dose occurs as a result of less mobile radionuclides. These instances require calculation of a point estimate of the dose to the critical group at the time of overall peak dose, which is compared with the standard. The latter comparison should be only qualitative because of the anticipated long periods required to reach the peak dose and the attendant uncertainties in both the time period and dose. This calculation permits the identification of important performance factors that define risk to the critical group. Ameliorating actions such as modification of the source term or waste form may be needed to minimize the difference between the calculated dose and the standard. We believe, as

stated in our letter of June 7, 1996, that this latter comparison should not become a *de facto* regulation because of the potential for large uncertainties in the assessment of performance and risk. In addition, as stated in our previous communication on time of compliance, the specified time is strongly influenced by assumptions about the reference biosphere and the critical group. As such, the procedures for identifying and documenting the assumptions for a specific facility are an integral part of the regulations and guidance.

Several significant features that are unique to the LLW program should be recognized.

- Surface and near-surface LLW facilities are subject to deleterious surficial processes such as erosion and flooding. Rates of surficial processes may be altered by climatic change. Such considerations should be factored into the performance assessment.
- In many areas of the Nation, LLW facility sites could be located within a few tens of meters of the saturated zone, resulting in relatively short periods for water to move from the surface through the facility and through the unsaturated zone to the water table. This situation, coupled with the possibility of a limited distance to the critical group from the disposal site in many regions of the United States, may lead to relatively short times of compliance when the waste containers and engineered barriers of the facility fail.
- The concrete vault disposal system proposed in some LLW facilities may delay releases for long periods, but the time period over which the concrete is able to withstand degradation is not well established.
- The potential for significant quantities of certain long-lived radionuclides, such as uranium in near-surface LLW sites, is greater than was anticipated in the DEIS for 10 CFR Part 61. The result is that peak doses may not occur until a long period of time has passed, perhaps tens or hundreds of thousands of years. In addition, the risk from some decay products may be higher than that of the parent. If the calculated doses at very long periods exceed the standard by significant factors, the LLW disposal system may require modification.

#### **Recommendations for an LLW Disposal Time of Compliance**

On the basis of the regulatory principles and observations discussed above, the ACNW recommends that the LLW disposal regulations or guidance include a generic, two-part approach to the time of compliance used in assessing the capability of an LLW site to protect the public health and safety. This approach will lead to different compliance times, depending on the waste, the facility, the associated geosphere, the specified reference biosphere, and the critical group.

- The first part of the approach requires compliance with the numerical standard over a specified period of time. This time span should be no shorter than an estimate of

the anticipated time it takes for the more mobile radionuclides to produce a peak dose to the critical group and no longer than a time period over which scientific extrapolations can be convincingly made. This time period should be determined on the basis of site-specific characteristics of the entire disposal system using modeling, analog studies, and results from laboratory and *in situ* experiments. If the disposal system fails to meet the standard during the specified time period, ameliorating actions should be required or the site should be rejected.

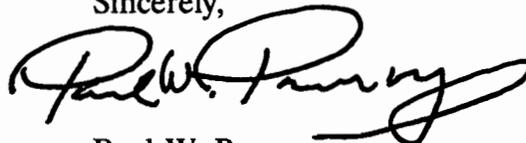
- The time period of compliance must be defined in concert with the reference biosphere and the critical group. Thus, the regulations also must include requirements and guidance for defining the latter on a facility-specific basis using known site characteristics and effects of long-term processes that are technically supported.
- In certain cases, the calculated time of compliance should be replaced with a maximum time of compliance such that uncertainties in performance assessment can be reasonably bounded.
- The second part of the compliance regulation is designed to be used in evaluation of the robustness of the facility over the range of external processes and events that may affect the performance of the facility over long time periods. This evaluation also will ensure that no significant changes in the dose from the disposal site will occur in the near term after the calculated time of compliance. Estimates of the peak dose from the facility beyond the time of compliance are qualitatively compared with the dose standard. This part should not become a *de facto* regulation.

### **Summary**

The ACNW recommends implementation of regulations that will establish procedures and guidelines for setting the regulatory time of compliance for LLW disposal facilities. The recommendation proposes a two-part approach that is based on generic regulatory principles modified for LLW. This approach is supportive of the two-part program being discussed by the NRC staff and views held by a variety of national and international regulatory agencies.

We believe that our recommendations can be used to shape a robust and defensible regulation.

Sincerely,



Paul W. Pomeroy  
Chairman

## **Appendix A**

Excerpt from ACNW letter to Chairman Selin, dated June 3, 1994, entitled "Review of the Low-Level Radioactive Waste Performance Assessment Program," Item B.6 concerning time of compliance.

### **B. Branch Technical Position**

6. The Committee believes that there is significant uncertainty about the required time frame for PA. The presently used arbitrary numerical values (e.g., 10,000y) lack bases in either standards or regulations. The Committee recommends that, as a minimum, the time frame for site-specific PA should be guided by the dose-time profile as depicted in the draft BTP and used in conjunction with an explicit upper time limit. The NRC staff is urged to develop a position on the appropriate time frame and submit it to the Commission for discussion, review, and approval.

## **Appendix B**

Excerpt from ACNW letter to Chairman Selin, dated June 28, 1995, entitled "Regulatory Issues in Low-Level Radioactive Waste Performance Assessment."

### **TIME FRAME FOR PERFORMANCE ASSESSMENT**

The Committee believes there is merit in choosing a generic maximum time frame for analyzing the safety of an LLW facility. We do caution the staff against letting time-frame limits detract from focus on the actual performance of a site-specific LLW facility.

One important attribute of the LLW field is the variability in the radionuclide content of LLW. For example, much larger quantities of long-lived radionuclides are being disposed of as low-level waste than was previously anticipated. The result is that at some sites, peak doses will occur at times longer than 10,000 years. We believe the application of peak dose calculations to be an important issue and plan to report to you on this subject after a timely review of this topic. Again, the Committee urges the principle of completeness by assessing first the safety of a specific facility and then being satisfied that it is in compliance with the regulations. Nevertheless, the BTP should identify a time period such as 10,000 years for which performance

assessment of an LLW site should be completed and beyond which such analyses should not be required.

### **Appendix C**

Excerpt from enclosure to letter of May 17, 1996, entitled "Regulatory Issues in Low-Level Waste Disposal Performance Assessment," from James M. Taylor, Executive Director for Operations, to the ACNW.

#### **Regulatory Issue 3. - Timeframe for PA**

The staff appreciates ACNW's support on the selection of a 10,000-year generic maximum timeframe for analyzing the safety of an LLW facility. The staff shares ACNW's concern that a generic timeframe should not distract from assessing actual facility performance in cases where large amounts of long-lived radionuclides are being disposed of. In particular, the staff is concerned about the appropriateness of disposing of very large quantities of uranium at near-surface LLW disposal facilities and believes that further discussions on uranium disposal are needed with U.S. Department of Energy and U.S. Environmental Protection Agency staff.

### **Appendix D**

Excerpt from ACNW letter to Chairman Jackson, dated June 7, 1996, entitled "Time Span For Compliance of the Proposed High-Level Waste Repository at Yucca Mountain, Nevada."

#### **Regulatory Principles for Establishing the Time Span for Compliance**

On the basis of the preceding considerations, the ACNW recommends that a two-part approach to definition of the compliance period be established for nuclear waste facilities. The first part involves the following three elements:

- (1) The time period for compliance should be based on the estimated time for release and transport of the radionuclide contaminants to reach the critical group. This time estimate should be based on geologic, geochemical, and hydrologic characterization of the site and its environs, as well as regional study of geologic processes and their potential effects on the site, and total systems performance assessment. This estimate must confirm the ability of the repository system to retain radionuclides for a minimum of several thousand years. The selection of the time of compliance must be evaluated along with the specification of the reference biosphere and critical group.

- (2) The reference biosphere and the lifestyles of the critical group should be defined on the premise that no major changes will occur in society that will significantly affect their lifestyles as they relate to risk from the repository and that the climate can be reasonably bounded. The minimum distance from the boundary of the repository to the critical group will be a major decision.
- (3) The compliance time should be sufficiently short such that extrapolations of significant processes and their rates can be made robustly with reasonably modest uncertainties.

The second part of the compliance period regulations should be based on assessments extending from the specific compliance period to the calculated time of the peak risk to the critical group. There is no definitive measure of compliance in the sense of a numeric match between a standard and the calculated peak risk, and this second part should not be allowed to become a de facto regulation. A comparison between the standard used in the first part and the calculated peak risk should lead to identification of important performance factors that define risk to the critical group. Depending upon the extent to which the peak risk exceeds the standard, ameliorating actions to reduce this difference should be initiated, such as increasing the integrity of the engineered barriers, improving site characterization to more closely bound uncertainties, or, in the extreme, abandoning the candidate site.