



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

November 14, 1996

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

Dear Chairman Jackson:

**SUBJECT: A "ROAD MAP" TO THE ACNW'S RECOMMENDATION FOR TIME SPAN FOR COMPLIANCE OF THE PROPOSED HIGH-LEVEL WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA**

Introduction

On June 7, 1996, the ACNW sent a letter to Chairman Jackson laying out a procedure for establishing a time of compliance (TOC) for the proposed high-level waste (HLW) repository at Yucca Mountain, Nevada. This letter outlined a general two-part approach in defining a compliance period for nuclear waste facilities and recommended a site-specific approach to the Yucca Mountain Repository compliance period that is based upon scientific and technical insights gained from site studies. The recommended approach deviates from the generic TOC established in 10 CFR Part 60, which the Committee found to be without strong scientific basis, and also deviates from the peak dose compliance period suggested in the report of the National Research Council, "Technical Basis for Yucca Mountain Standards." As a result, several questions have arisen regarding the ACNW's recommendations, especially as related to implementing a TOC. To answer these questions and improve understanding of the advantages and limitations of the recommendations, the Committee has prepared this brief explanatory memo, which provides a "road map" to its proposal.

Time of Compliance - Definition and Problem

The TOC is the period of time over which the risk of adverse consequences from a repository must comply with a specified standard. Over this stipulated time span, the integrity of the whole repository system must be maintained. In itself, the TOC is not a measure of safety; rather dose (or risk) is the appropriate indicator of safety for a repository. The TOC specifies the minimum time span over which the repository system must meet the dose limits.

The dilemma in developing a TOC is that the time span must be sufficiently long to permit evaluation of potential processes and events leading to the loss of integrity of the repository and transport of radionuclides to the critical population. Yet the period must be short enough that inherent uncertainties in processes and events and in the biosphere and critical population group, which will increase with time, will not invalidate the results of the evaluation. Reasonable confidence must exist that the uncertainties in the reference calculation for the time span can be identified and quantified in a probabilistic format.

### The ACNW Recommendation

The Committee recommends a generic two-part approach for determining the TOC. The first part involves determining the TOC on a repository-specific basis, that is, on the basis of an analysis using modeling, analogs, and experiments to specify the time for release and transport of radionuclides to the critical population group. This analysis considers site and waste characteristics, site design, and engineered barriers. The TOC must confirm the ability of the total repository system, including the geosphere, to prevent radionuclides from reaching the biosphere for a minimum of several thousand years.

The second part of the recommendation requires a point estimate calculation of the time for the potential release of radionuclides to reach peak dose. Performance assessment is used to determine the magnitude of the dose at this time. Comparison of the calculated peak dose with the standard will indicate whether the repository performance complies and will identify deficient performance factors that may require redesign or reconsideration of the repository. This part does not require a definitive measure of compliance in the sense of a numeric evaluation between the standard and the calculated dose because of the limitations in the calculations imposed by the breadth of the uncertainties in processes and events.

### Implementation of the Recommendation

The enclosed flow chart provides a road map for implementing the Committee's recommendation on TOC for the proposed HLW repository at Yucca Mountain. Implementation flows from the top of the chart downward. The process is based on input provided by the site characterization, the engineering design of the repository, the waste characteristics, and the design of the waste containment. Part #1 involves determination of the TOC and evaluation of the repository in terms of the specified standard. Part #2 also is a requirement but does not involve a numerical evaluation. It is an advisory component, not a de facto regulation.

The implementation process should be defined in the regulation, but the actual TOC need not be specified. The time span only can be determined when the site characterization and repository design are completed.

The steps in the implementation of the TOC are indicated on the flow chart:

**Input**

1) Site characterization, the engineering design of the repository, the waste characteristics, and the waste containment design provide input to the first part of the TOC. The engineering, waste characteristics, and waste containment are subject to redesign, depending on the results of the performance evaluation for the TOC. In addition, it may be necessary to further investigate specific components of the natural setting as a result of the assessment of the performance and the range of uncertainties in the performance of the repository.

**Part #1**

2) Analysis of the input characteristics using empirical and theoretical modeling, analog studies, and results from laboratory and in situ experiments will determine the anticipated time for release and transport of radionuclides to the critical population group on the basis of the defined reference biosphere. The critical population group and the reference biosphere should be delineated in the regulation. Note that this time is not the ground water travel time, but, tying it to the dose standard, it is the time for transport of radionuclides from the repository to the critical population group. This time should be based for example on the peak dose or the beginning of the decrease from the peak dose of the most mobile (i.e., high-solubility, low-retardation) radionuclides such as  $^{129}\text{I}$  and  $^{99}\text{Tc}$  that are anticipated from possible leakage of the repository.

3) A base-level TOC is required to eliminate the consideration of a low-integrity repository system. If the anticipated TOC is less than a few thousand years (e.g.,  $\sim 3 \times 10^3$  years) the repository is rejected or the engineered system and waste containment are redesigned to increase time for release and transport of radionuclides to the critical population.

4) If the calculated time is greater than a few thousand years, total systems performance assessment is used to compare repository performance with the anticipated Yucca Mountain standard (40 CFR Part 197).

5) If comparison of the calculated performance with the standard shows that the repository performance is deficient, the repository should be rejected or redesigned. However, if the repository performance complies with the standard at the TOC the repository evaluation process should continue with Part #2.

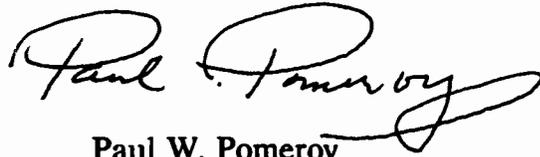
**Part #2**

6) The performance assessment analysis used in Part #1 to establish the TOC should be continued until peak dose is obtained and repository performance should be evaluated at that time. The uncertainties in the system should be identified and quantified in a

probabilistic format on the basis of the best available information, and their effect should be determined through bounding calculations.

7) If the comparison of the calculated performance shows that at the time of peak dose the repository is significantly deficient, for example, an order of magnitude or more, compared to the anticipated standard, the major sources of the deficiency should be identified and possible remedial actions designed and carried out. If these actions are not possible or ineffective the repository may be rejected. However, if the bounding calculations indicate that the repository complies with in an order of magnitude of the standard, the proposed repository performance is deemed acceptable.

Sincerely,

A handwritten signature in black ink, appearing to read "Paul W. Pomeroy". The signature is fluid and cursive, with a large initial "P" and a long, sweeping underline.

Paul W. Pomeroy  
Chairman

Enclosure: as stated

# Flow Chart for Implementing a Two-Part Approach to the Time Span For Compliance of a Specific HLW Repository

