(48)

DOCKET NUMBER
PROPOSED RULE PR-60
(46 FR 35280)

Department of Energy
Washington, D.C. 20545

NOV 5 1981

MEMORANDUM FOR Mr. Samuel Chilk
Secretary, Nuclear Regulatory Commission
Attention: Docketing and Service Branch
Washington, D.C. 20555

The Department of Energy is pleased to respond to the request of the Nuclear Regulatory Commission (NRC) for comments on the proposed amendments to 10 CFR 60, published on July 8, 1981 (46 Fed. Reg. 35280). This submission continues the Department's involvement in the development of a rule by which the disposal of high-level radioactive wastes (HLW) will be governed. Our involvement has included letters commenting on the Advanced Notice of Proposed Rulemaking (ANPR), and meetings with NRC staff. Because of the length of this submission, our comments are contained in two enclosures to this cover letter: the first is a commentary on major issues, including six for which the Commission requested comment; the second is a section-by-section analysis with recommended alternative language where appropriate.

The Commission is to be commended for its considerable efforts and determination to move forward with this most important rule. Many Department concerns with specifics of the rule, some of them major, have already been resolved by the Commission staff. The statement added since the ANPR on the concept of "reasonable assurance" is a major contribution toward a credible regulation. I might note here that we generally support the Commission's position on siting requirements and human intrusion, and we agree that ALARA (as-low-as-reasonably-achievable) principals should not be applied. However, we still have differences of opinion on the proposed rule and have proposed alternative language for parts of the rule which will mitigate these differences.

Specific Comments

Our major concern with the proposed rule is related to the fundamental philosophy used in its preparation. The Department feels that the primary emphasis should be placed upon meeting an overall system performance objective. The final determination concerning levels of performance required of individual subsystems should be made during the preparation of an overall system analysis for a specific site and design. We have long recognized the need for a multibarrier approach and the objectives which the Commission is seeking to achieve. However, as mentioned above, the Department considers that a more appropriate way of accomplishing the objectives expressed by the Commission would be to propose specific subsystem performance goals which are clearly distinguished from requirements by providing the flexibility to select numerical subsystem criteria on a case-by-case basis. As currently written, the performance objectives provide no such flexibility and preclude maximum utilization of engineering ingenuity in meeting the goal of assuring the public's health and safety. Essentially, we believe that: 1) the regulation should be based on achieving an overall system performance requirement, in the manner of the EPA standard; 2) a multiple-barrier system should be proposed by the Department; 3) the performance of intermediate subsystems

Add: Frank Arsenault Michael Bell
Paul Coldberg Regis Boyle
T. Wolf Hubert Miller
John B. Martin

DS10
S41

11/9/81 emp

(barriers) of the system should be proposed by the Department and should support the overall system performance criterion; 4) the numerical criteria should be justified by engineering principles and proven site specific data; and 5) the methods by which compliance is to be demonstrated should be clearly defined.

The Department agrees that the Commission must establish the philosophy in developing this regulation from among alternatives such as those posed in the Federal Register notice. We would find a position closer to alternative 1, as proposed by the Commission in the Supplementary Information Section, to be more appropriate. We are concerned that the imposition of inflexible intermediate component performance requirements as now proposed in the Federal Register notice would distract both the NRC staff and our own from the central issue of the licensing process, which is that of demonstrating that the public health and safety will be protected. The alternative language we have proposed in the enclosure would allow the Department, as a license applicant, to propose performance objectives for the several subsystems on a site-specific basis. These detailed objectives would then reflect the results of site-specific investigations and an improved understanding of the required performance of each individual component.

A second concern is with the treatment of transuranic (TRU) wastes in the proposed rule without appropriate consideration of the comparative hazard of these wastes, relative to high level wastes. We suggest that TRU wastes be eliminated from the rule with provision that they would be considered on a case-by-case basis, with reasonable assurance that the functional performance of the repository system would not be significantly compromised by emplacing TRU wastes in a repository.

We have provided revisions that we believe are needed in the requirement for extending retrievability beyond the operational life. The requirement for a long retrievability period could compromise the primary objective of isolation. Furthermore, we expect a high degree of confidence to result from performance confirmation data taken over 30 or more years of operation. This plan for performance confirmation testing should be available as part of the license application and should provide sufficient basis for an early decision by the Commission on backfilling and decommissioning. Also, it is desirable to have some portions of the repository available for low-heat wastes and to allow an early decision on non-retrievable emplacement of such wastes, without waiting for the decision on high level wastes. We have not been able to quantify the cost impact of maintaining the capability to defer a retrieval decision for 50 years after operation ceases, since a design is highly site-specific, but we believe additional costs will occur in the area of shaft and tunnel maintenance and from provisions for operator safety.

The requirements placed on the sealing of boreholes and shafts appear to be excessive and undemonstrable. We have suggested that rather than requiring seals to match the performance of the native rock and not become preferential pathways for water flow that the requirement be stated in terms that would relate seal performance to the overall performance of the repository.

At various meetings on this rule, the Commission has discussed with the staff the proposed cutoff of the draft EPA regulation (draft 19, 40 CFR 191) at 10,000 years. We concur with the Commission's judgement that a 10,000 year cutoff is appropriate and request that the Commission's position be made a matter of record in the rule.

Given the sum of these comments, we urge a restructuring of the rule, first and foremost to emphasize the overall system performance objective and to provide flexibility in meeting individual barrier design objectives. Compliance with the regulation should be demonstrated by systems analysis techniques and the use of mutually-agreed-upon modeling and testing methods developed into Regulatory Guides. Finally, the rule should be clarified and simplified to permit the maximum utilization of engineering ingenuity in meeting the goal of assuring the public's health and safety.

The Department is deeply concerned with the content of this rule and is ready to provide the services of both Departmental staff and contractors to meet and work further with the NRC staff. The revised language which we have proposed would go a long way toward resolving these concerns. In addition, although we have proposed several alternative definitions, we believe that through continued dialogue between our staffs we will be able to develop a series of definitions that will be consistent and mutually useful.

Sincerely,

Sheldon Meyers

Sheldon Meyers
Acting Deputy Assistant Secretary
for Nuclear Waste Management
and Fuel Cycle Programs
Office of Nuclear Energy

Enclosures

COMMENTARY ON MAJOR ISSUES

The Commission requested specific comments on six issues, namely: (1) the requirement to maintain the retrievability of the waste, (2) the question of human intrusion, (3) the use of an alternative approach in placing criteria on the repository's performance, (4) the definition of a siting requirement related to population density, (5) the nature and quantity of design and construction criteria, and (6) the application of ALARA principles to the performance requirements. This enclosure contains our detailed comments on each of these questions.

The Department has identified three additional issues of a major nature that merit special consideration. These are: (1) the appropriateness of considering TRU waste in this rule, (2) requirements for sealing of boreholes and shafts, and (3) credit for site-specific factors. These issues are also addressed in this enclosure.

RETRIEVABILITY

Issue

The requirement proposed by the NRC in section 60.111(a)(2) that DOE design for a retrievability capability that extends for 50 years beyond completion of waste emplacement appears excessive in view of the site-specific considerations involved, as well as the extensive performance confirmation program to be conducted throughout the period of repository operations.

DOE Position

The duration of the period during which retrieval capability should be maintained should, as the Commission correctly states, be linked to "the expected time needed to execute the performance confirmation program." Studies conducted by DOE[1] have indicated that performance confirmation programs similar to that suggested in 10 CFR 60.137-143 are:

a. Achievable in substantially less time than the period suggested by the Commission

b. Definable only on a site-specific basis.

Having an upper bound number in the rule, as proposed, will very likely compel the Commission to wait that full period before deciding to decommission the repository, even if there would be no objective technical basis for delay beyond the completion of waste emplacement. Further, the Commission may be excessively pessimistic in its statement that "neither the specific nature nor the period needed for execution of the performance confirmation program will be certain until construction of the repository is substantially complete". The scope and timing of such a program can and should be defined as part of the license application process for specific repositories, while maintaining reasonable options for decision-making prerogatives subsequent to the completion of waste emplacement. Moving towards non- etrievability should occur with the Commission on a step-by-step basis including possible early decisions to backfill, to decommission part or

RETRIEVABILITY (continued)

all of the repository, and to determine that the retrievability period is over. Closure of portions of the repository should be permissible prior to closure of the entire repository.

Discussion

Our position on retrievability is derived from several considerations:

- o It is unlikely that emplaced wastes will need to be retrieved. A conservative step-wise site selection program should provide reasonable assurance that the repository will function to provide long-term isolation. We presume that NRC will authorize construction and waste receipt only if this premise is substantiated. Nonetheless, it is prudent and necessary to plan for the retrieval contingency.
- o Confidence in the as-designed, as-constructed disposal system increases with time. As repository development and operations proceed, understanding of the host rock and the natural system, as well as the waste package and near-field performance, will improve. It should also be recognized, however, that the cost and hazards associated with retrieval operations may also increase with time.
- o An initial period of time will be required after waste emplacement is initiated to verify the performance of the specific site and the design for isolation of the wastes. During this period, performance confirmation can be achieved by direct measurement of critical parameters and phenomena. Parameters and phenomena whose effects are measurable generally reach their critical values early in the process, e.g., peak rock temperatures occur fairly early, and the actual values can be accurately extrapolated once the initial gradients and rock response are determined.

RETRIEVABILITY (continued)

- Parameters and phenomena to be measured in a performance confirmation program will vary from site to site. For example, creep closure response may be an issue in salt but not in crystalline rock. Conversely, fracture permeability phenomena may be of little concern in salt.
- The results from the performance confirmation program should support a decision to backfill storage rooms, with such a decision acknowledging the intent to truly dispose of the waste. Backfilling and sealing of storage rooms makes retrieval more difficult but does not rule out retrieval as a future option. As backfilling represents a true disposal condition, monitoring of a representative backfilled area is appropriate as part of performance confirmation.
- The capability to retrieve does in fact exist as long as access to the repository horizon is maintained. Thus, retrieval can be accomplished at any time up until authorization for full decommissioning and sealing of the repository.

This basic approach to retrievability seems compatible with the approach taken by the NRC in the regulation. Both regard retrievability as a planned contingency. Both acknowledge the value of a performance confirmation program yielding the earliest possible results.

However, the proposed regulation deviates from this approach by stipulating that the repository must be designed so that retrieval capability is maintained for an additional period of 50 years following the last emplacement of wastes. To this the NRC suggests adding 30-year allowances for both emplacement and retrieval operations, for a total of 110 years. (This latter figure presumably would increase if emplacement activities extended for longer than 30 years.)

The staff's rationale for the 50-year increment has been presented in the Supplementary Information. It is based on an anticipation that little will be known about specifics of the performance confirmation program before

RETRIEVABILITY (continued)

operations commence and seeks to compensate by preserving flexibility in decisionmaking options regarding repository closure. We note that within the body of the regulation, no linkage is made between the 50-year period and the performance confirmation program.

We have several concerns relative to the 50 year period and believe the supporting rationale to be unduly pessimistic, since the NRC proposed rule includes a requirement that a performance confirmation program be under way during early stages of construction (sections 60.141 and 60.142). We have always assumed that the performance confirmation program, specifically as provided in Subpart F, would be the subject of much of the NRC review of the license application.

Second, the type of information required in Subpart F can be obtained during the period of waste emplacement. Table 1, which provides summary results from one DOE study[1], is an example of how one could establish a time frame for performance confirmation. The bases for the time periods are contained in reference (1). Most of the required data can be obtained in less than one decade of repository operation. We recognize that while the time required will vary from site to site, it is highly improbable that measurements would be needed beyond the waste emplacement phase. Sufficient data will be available from the ongoing verification studies to support the closure decision at that time.

The basis for this position on the time required for performance confirmation stems from analyses of phenomena and conditions that, if developed, would warrant retrieval. Such conditions, leading to a decision to retrieve, can be categorized as follows:[1]

- Natural Events and Processes. The occurrence of totally new, unknown, and unexpected natural phenomena in the environment of an operating repository which could render it unusable.
- Geologic and Hydrologic Response to Excavation and Waste Emplacement. The design of the repository will be based on data obtained from sampling and testing and on accepted thermal, mechanical,

Estimated Verification Periods* in Years for Selected Reference Repository Designs and Generic Site Characteristics

	Salt	Shale	Granite	Basalt	Verification Approach
ENVIRONMENT VERIFICATION					
Thermal Environment					
Near Waste Package	2	2	2	2	Direct observation of early temperature rise and convergence of estimator-predictor techniques
Repository Region	3	3	3	3	Direct observation of early temperature rise and conservative engineering judgement
Fluid Environments					
Near Waste Package	1	3	N/A	N/A	Direct observation of onset of occurrence and early rates of flow
Chemical Environments					
Radiolysis/Hydrolysis	1	N/A	N/A	N/A	Direct sampling and lab test
Clay Dewatering	N/A	3	N/A	N/A	Direct sampling and lab test
Creep (generating stress)	1	~1**	N/A	N/A	Direct observation of early rates
PHENOMENA VERIFICATION					
Corrosion	2	3	2	2	Verification of thermal and chemical environments near canister and comparison with laboratory testing (includes in situ coupon tests)
External mechanical stress	1	~1**	N/A	N/A	Correlates with verification of creep generated stress environment
Brine/interstitial water movement	1	3	N/A	N/A	Correlates with verification of fluid environments
Radiolysis/hydrolysis	1	N/A	N/A	N/A	Correlates with verification of salt chemical environments
Waste form leaching	2	2	2	2	Verification of environments and compare with laboratory data
Thermal effects near canister	2	2	2	2	Correlates with verification of thermal environments near waste package
Thermal expansion and contractions	3	5	3	3	Verification of thermal environments and effects in repository region and direct observations during the same period, coupled with predicted response
Groundwater chemistry	2	3	2	2	Verification of environments near waste package and comparisons with laboratory testing using waste package materials
Groundwater flow changes	3	3	3	3	Verification of thermal environments in repository region coupled with data gathered before emplacement to improve modeling
Borehole/shaft seals and repository backfill degradation	3	3	3	3	Verification of thermal environments in repository region, direct observation of early backfill material response resulting in improved modeling and analysis
Nuclide migration	3	3	3	3	Verification of thermal and chemical environments and regional groundwater flow changes, coupled with modeling and testing comparison
Repository system operation	1	1	1	1	Direct verification

*All values may vary for a given repository design at a specific site.

**A value from Conasauga Shale observations, but the value may be even more site dependent than others since the creep rate of various argillaceous media may vary considerably.

RETRIEVABILITY (continued)

and hydrologic models. Designs will incorporate margins of safety to accommodate reasonable assumptions of inaccuracies in such design bases. Nevertheless, abandonment of the repository, or a portion of the repository, could conceivably be dictated if performance characteristics indicate that the required degree of confidence in the predicted performance could, for some reason, no longer be provided.

- o Predicted Waste Package Performance. Post-emplacement evaluations could indicate that an excessive number of waste packages have defects or that the engineered barrier design is not performing as predicted. Retrieval of some defective waste packages or of all emplaced waste could be dictated in this event.
- o Repository System Operation. The repository system could be judged not operable due to either an uncorrectable inadequacy of the design basis or small but chronic inadequacies that, with time, would build to an intolerable level.
- o Malicious or Inadvertent Human Intrusion and Repository Disruption.

Performance confirmation programs should address these conditions wherever feasible. However, direct measurements and observations that can be made during repository construction and operation can only contribute to assessments of performance by one of the following approaches:

- o Direct observation or measurement of unacceptable phenomena.
- o Observation or measurement of precursors to unacceptable phenomena; that is, observation of environments or repository system responses that could cause unacceptable phenomena sometime in the future.
- o Observation or measurement of repository environments and responses to define more representative input values for predictive models, thereby improving confidence in performance predictions.

RETRIEVABILITY (continued)

These measurements and observations, and the resulting confirmation of performance (and the time required for this confirmation) will vary from site to site. However, many phenomena and conditions may not be amenable to direct measurement or observation. The following criteria should be used to exclude phenomena from performance confirmation programs following the emplacement of waste:

- The phenomenon has a very low probability of occurrence, e.g., volcanism, or glaciation, during the operational period.
- The phenomenon has very little or no significance on repository long-term performance; e.g., small movements of canisters in salt.
- The phenomenon is of such a nature that its behavior can be satisfactorily evaluated prior to the beginning of waste emplacement. This is the case for the effects of mining on rock integrity.
- There is a very high degree of confidence that the phenomenon can be eliminated through active institutional controls during the period prior to decommissioning or that decommissioning will substantially reduce the probability of impact, e.g., human intrusion or alteration of surface or near-surface utilization.

Using this approach, DOE will identify, as part of the license application, phenomena that should be addressed in a performance confirmation program.

A final argument for requiring a decision on closure of the repository much earlier than the proposed 50-year time period is to put the decision in the hands of those directly involved with the regulation and operation of a specific repository. We propose that those concerned with the initial licensing and operation of the repository are the best qualified to judge its suitability, and permitting delays for the 50-year observation period may in effect preclude these individuals from making such a decision.

RETRIEVABILITY (continued)

However, NRC correctly notes in the Supplementary Information that DOE is now, and will be making, critical decisions regarding the design of repositories which will have a direct effect upon how long the option to retrieve wastes can be reasonably maintained. We recognize the need to maintain these options on behalf of the NRC in their decisionmaking role regarding final repository closure. Therefore, we agree that fixing an upper limit on the retrievability period sufficient to provide some degree of flexibility in closure decisions is a reasonable approach at this time and this limit should be considered on a case-by-case basis during the license application review process.

Recommended changes to sections 60.2 and 60.111 to reflect these comments are included in the detailed section by section comments on the proposed rule (enclosure B, pages 12 and 21).

References

1. ONWI-203, Retrievability: Technical Considerations, Science Applications, Inc. September, 1980.

2. DOE/NE-0007, Statement of Position of the U.S. DOE (Waste Confidence Rulemaking).

3. Draft 40 CFR 191.

4. U.S. Nuclear Regulatory Commission, Proposed Goals for Radioactive Waste Management, NUREG-0300, 1978.

HUMAN INTRUSION

Issue

Deliberate and Inadvertent Intrusion.

DOE Position

The Commission's discussion of deliberate intrusion and inadvertent intrusion in the Supplementary Information of the proposed rule is well-reasoned. The Department supports the Commission's position on this issue.

We endorse the Commissions position and feel the general approach to human intrusion set forth in the Supplementary Information, e.g., avoiding resources to diminish the likelihood of inadvertent intrusion and using long-term communication and identification measures, is reasonable. The potential for exploiting mineral, energy, water, and subsurface land-use resources both now and in the future will be assessed throughout the site-selection process (i.e., via site selection criteria for the National Waste Terminal Storage Program). Beyond site selection factors, additional protective measures will be used to communicate knowledge of the existence and location of repositories to future generations.

Discussion

We endorse the position of the Commission as stated in the Supplementary Information but have a concern with respect to the Commission's consideration of resources presented under "Potentially adverse conditions," section 60.123(b)(3). Our concern is explained in the section-by-section comments on section 60.123.

A Licensing Topical Report to be issued by DOE will elaborate on long-term communication measures the Department could use to forewarn future societies of the existence of repositories, e.g., monuments.

ALTERNATIVE APPROACHES

Issue

Definition of the most effective approach for specifying the performance objectives for the geologic repository.

DOE Position

The NRC should establish a level of performance for the total system and provide that multiple barriers be used for containment and control of release. DOE should be given the responsibility to analyze each site-specific system, define the boundaries of the accessible environment, and propose the barriers and the contribution of each in achieving the level of performance of the total system. In this approach, DOE should be required to show how the specific level of performance for each component contributes to the total performance requirement and the site. It will be necessary to show how the analysis of the system is internally consistent. Alternative language to achieve this approach is provided for section 60.111 among the section-by-section comments attached to this response.

Discussion

In 10 CFR 60, NRC establishes four specific performance objectives for the waste isolation system and its components. The performance objectives include the following:

1. Containment of the radionuclides in the waste package for a specified time (1,000 years).
2. Control of release of the radionuclides from the engineered system (one part in 100,000 of the inventory).
3. Minimum groundwater travel time (1,000 years) between the engineered system and the accessible environment.
4. Maximum quantities of radionuclides that can enter the accessible environment throughout the isolation period. (EPA Standard)

Sections 60.111 and 60.112 of the rule appear to give the greatest emphasis to the first three performance objectives thereby placing greater reliance on individual components than on the total waste isolation system.

ALTERNATIVE APPROACHES (continued)

We believe that this emphasis is unintentional and believe that the alternative language proposed will more properly reflect the desired intent.

The performance of the total waste isolation system will depend on the performance of each of the components that comprise the system. However, if the desired level of performance of the total system is known initially, then the required level of performance of the components must be derived from the total system performance, based on the physical conditions of any portion of the system that is already in place and cannot be changed. Independently establishing generic performance requirements for the total system and its major subsystems without recognition that they are interdependent may severely limit the flexibility of DOE and NRC to design and license the most effective waste isolation system.

We support the requirement to establish a set of regulations that will provide a basis for licensing a waste repository. However, we believe that the current version of the rule contains basic impediments that may make it difficult or impossible to reach closure in the licensing process. The potential difficulties result from the following three factors:

1. Internal inconsistencies in the proposed rule.
2. Failure to consider analysis of the contribution of various barriers, and limits the DOE's flexibility to engineer the total system.
3. Lack of clarity regarding basis for demonstration of compliance.

Internal Inconsistencies in the Proposal Rule

In the introduction to the rule, NRC states that its goal in developing the barrier performance objectives is to ensure that compliance with the draft EPA release limits can be shown. It appears that the selection of the numerical objectives were estimates based on judgement rather than quantitative models, demonstrable engineering considerations or site-specific data. However, it is not clear how the individual performance objectives are related to the EPA release limits using the techniques of performance analysis and an understanding of the geologic and hydrologic environments. The relationship needs to be based on the realities of physics and chemistry that

ALTERNATIVE APPROACHES (continued)

govern the release and movement of radionuclides. Because the proposed numerical performance objectives have no clearly defined technical basis, they appear arbitrary. They become inflexible since there can be no basis for changing them. Should they happen to be insufficient within the context of a specific application, the regulation will be criticized; and should they be too restrictive, cost will exceed what is warranted by radiological safety considerations.

An important factor in establishing the containment period was the time during which the thermal pulse is dominated by the decay heat from the fission products. An indication of the length of this period is the point when the peak temperature is reached. In the NRC Rationale document it is stated on page 28 "The maximum temperature of the repository as a whole is reached during the period of 100 to 500 years after emplacement...". On page 49 it is stated that "...maximum rock temperatures in the underground facility occur at approximately 35 years after emplacement for reprocessed waste and at 75 years after emplacement for disposal of spent fuel. By 100 years after emplacement, near-field rock temperatures have started to slowly decrease for both waste types in all four media...". The length of the containment period should be reexamined in view of these results presented by the NRC staff. Such a review might indicate that the containment period could be on the order of 300 years since the power output of the waste decreases two orders of magnitude over the first 300 years and only half an order of magnitude over the next 700 years.

In support of the 1,000 year containment period, it is argued in the NRC Rationale document that "Containment for 1,000 years also requires only extrapolation by a small factor beyond what the Department has already been considering for bedded salt...". Further, on page 31-32 it states that "Containment for 300 years...appears to be achievable at reasonable cost...". It is argued that the NRC requirement is only a modest extension of technology that is already established. In contrast, the work that is used as the basis for the NRC position is in the early R&D stages and has "the goal of estimating

ALTERNATIVE APPROACHES (continued)

the potential of a material to survive 300 years" (Magnani and Braithwaite, 1980). The cost quoted in this study ($3,000) is for the material for a canister of 304-L stainless steel surrounded by TiCode-12 and not for design, fabrication, testing, QA, and other factors to be included in determination of waste package cost. The study concludes "This material may well survive 300 years or more. However, further study is still necessary to qualify the material for such an extended lifetime." The conclusion drawn by NRC that containment for 300 years appears to be achievable at reasonable cost on the basis of this study is unjustified. The implication that extrapolation from 300 year life-time is essentially trivial is purely unsupported conjecture. The qualification of any package and its material will be based upon extrapolation of short-term tests. Extrapolation to 300 years involves significant uncertainties and extrapolation to 1,000 years can only serve to make these uncertainties greater.

Failure to Consider Analysis of the Contribution of Various Barriers

The NRC has proposed performance objectives for container lifetime, release rate and groundwater travel time for the three major waste isolation subsystems. A preliminary study of the sensitivity of the total waste isolation system to these parameters has been completed.(1). The mathematical models used to study the system included transport processes and the probabilities of important failure events. The model computed the maximum total 70-year whole body dose to the average individual in the local population and expressed the results as a fraction of the equivalent natural background dose. These three subsystem parameters for which performance objectives have been proposed were varied as a basis for evaluating the barriers for three different geologic environments.

(1) H.C. Burkholder, Engineered Components for High-Level Radioactive Waste Isolation Systems--Are They Technically Justified?, ONWI-286, Office of Nuclear Waste Isolation, Battelle Memorial Institute (Draft Report).

ALTERNATIVE APPROACHES (continued)

The results of these calculations are compared with proposed 10 CFR 60 criteria in Figures 1, 2, and 3. Although this study used spent fuel as a source term solidified HLW from reprocessing should give qualitatively similar results. Doses resulting from human intrusion are not included in this analysis.

The effect of varying the delay time for water to penetrate the containment over a range of five orders of magnitude is shown in Figure 1. For all three geologic environments, the analysis shows that the effect of a 1,000 year lifetime package is not significantly different from that of a 100 year lifetime package. In all cases the analysis indicates that the maximum exposure is below background.

Once containment has been breached, the effect of varying the release rate over a range of four orders of magnitude is shown in Figure 2. There is no significant change in calculated population dose as the waste release rate is increased from the proposed maximum criterion of 10^{-5} fraction per year to a rate of 10^{-4} per year for a nominal repository. Of course, further reductions of release rate toward the theoretical zero release would marginally reduce computed release to the accessible environment, but it is very doubtful that the additional reduction in the maximum exposure below the already extremely low level would be justified.

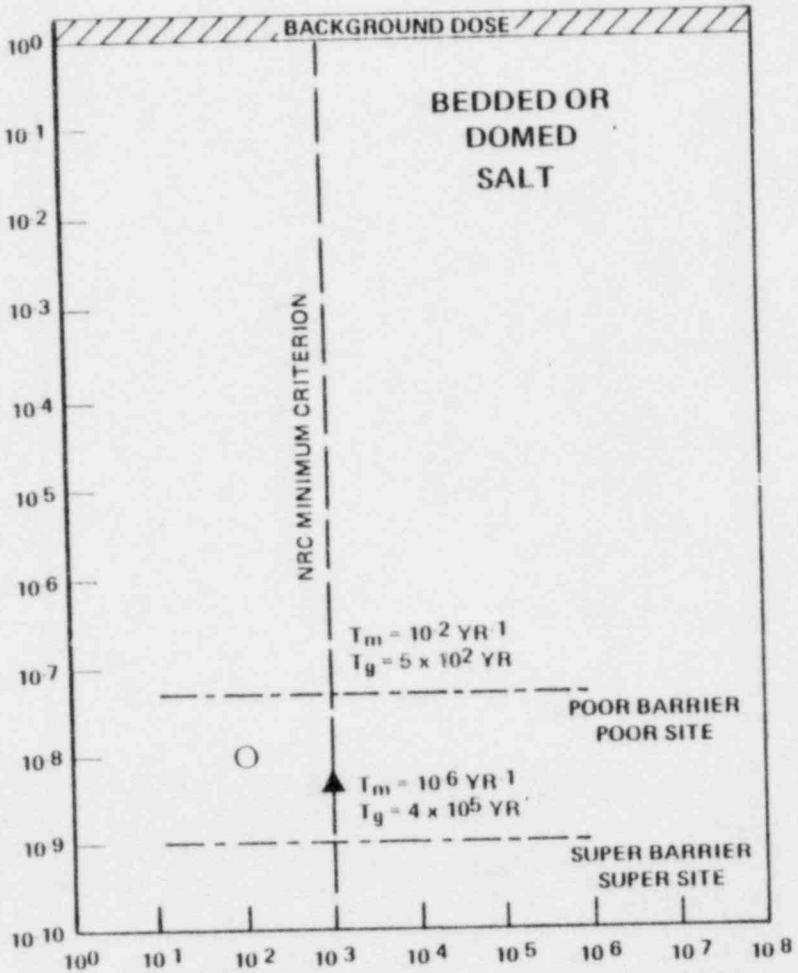
The effect of varying the groundwater travel time from the waste to the biosphere over a 3,000-fold range is shown in Figure 3. The population dose decreases as the travel time is increased over the entire range for both extremes. Thus, it can be seen that the isolation system is by far more sensitive to groundwater travel time than to the performance of the engineered barriers.

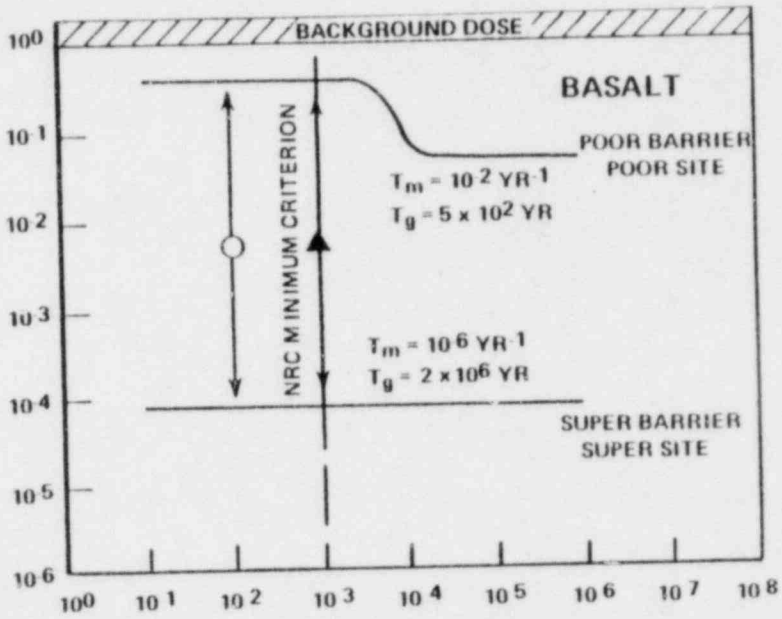
(2) M.D. Hill, "The Effect of Variations in Parameter Values on the Predicted Radiological Consequences of Geologial Disposal of High-Level Waste," Scientific Basis for Nuclear Waste Management, 2, 753 (1980).

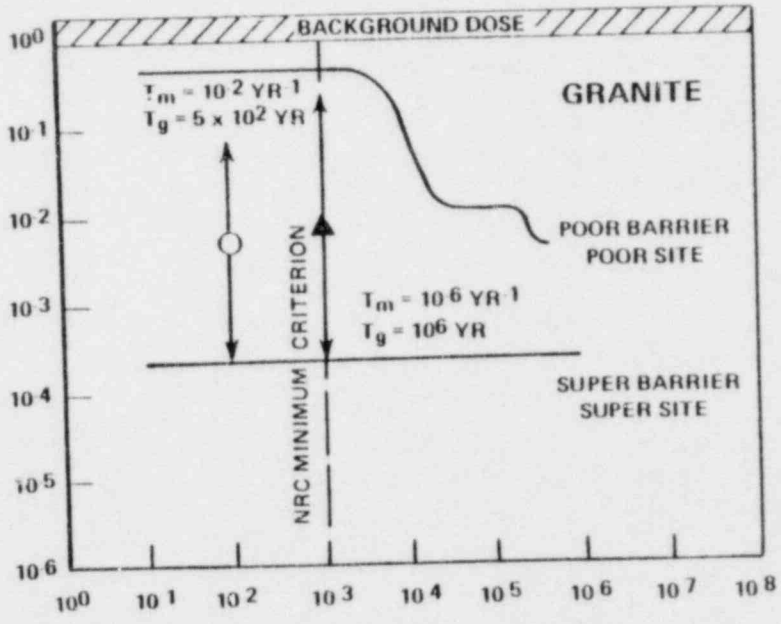
COMPARISON OF SYSTEMATIC PARAMETERS WITH NRC CRITERIA
EFFECT OF DELAY TIME OF WATER REACHING WASTE

		NRC CRITERIA ▲	NOMINAL WASTE SYSTEM ○
RELEASE DELAY TIME, YR	T_i	1000	100
BARRIER RELEASE RATE, YR^{-1}	T_m	10^{-5}	10^{-4}
WATER TRAVEL TIME, YR	T_g	1000	10,000

NO HUMAN CAUSED INTRUSION
SPENT FUEL WASTE







RATIO OF MAXIMUM POPULATION DOSE TO BACKGROUND

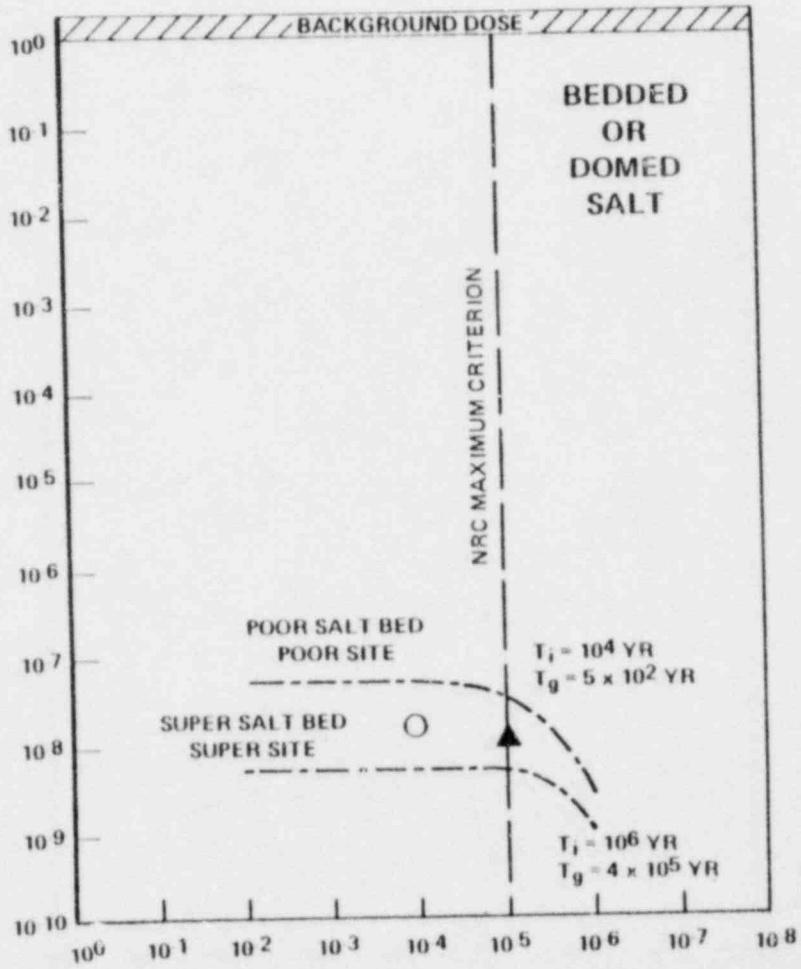
RELEASE DELAY TIME, YR

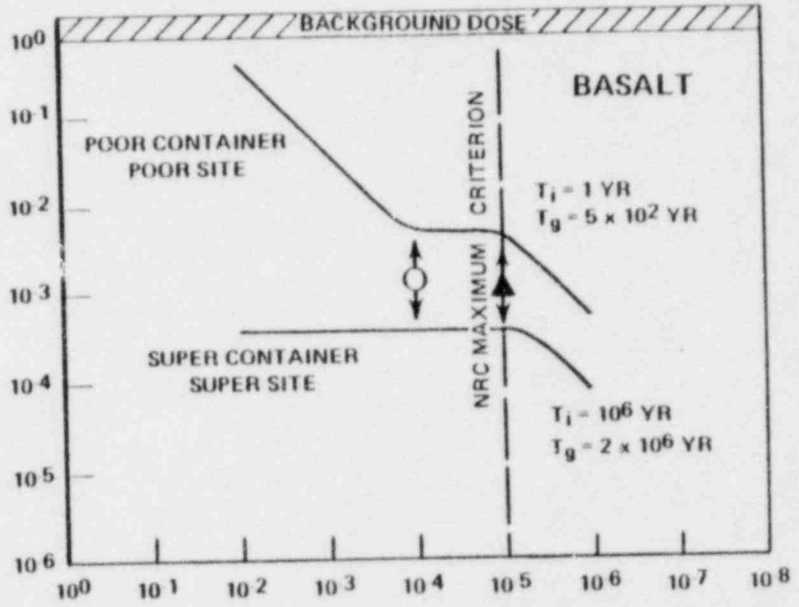
Figure 1

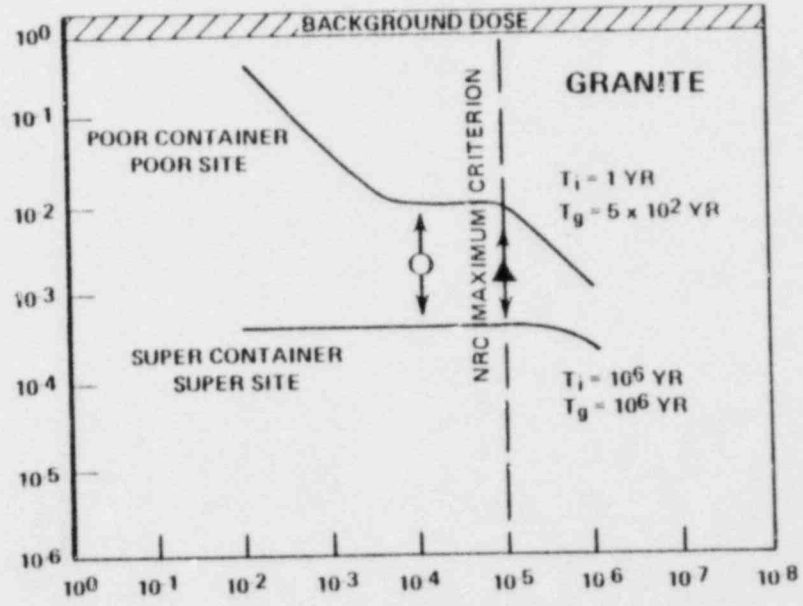
COMPARISON OF SYSTEMATIC PARAMETERS WITH NRC CRITERIA
EFFECT OF MAN-MADE BARRIER

	NRC CRITERIA ▲	NOMINAL WASTE SYSTEM ○
RELEASE DELAY TIME, YR T_i	1000	100
BARRIER RELEASE RATE, YR^{-1} T_m	10^5	10^4
WATER TRAVEL TIME, YR T_g	1000	10,000

NO HUMAN CAUSED INTRUSION
SPENT FUEL WASTE







RATIO OF MAXIMUM POPULATION DOSE TO BACKGROUND

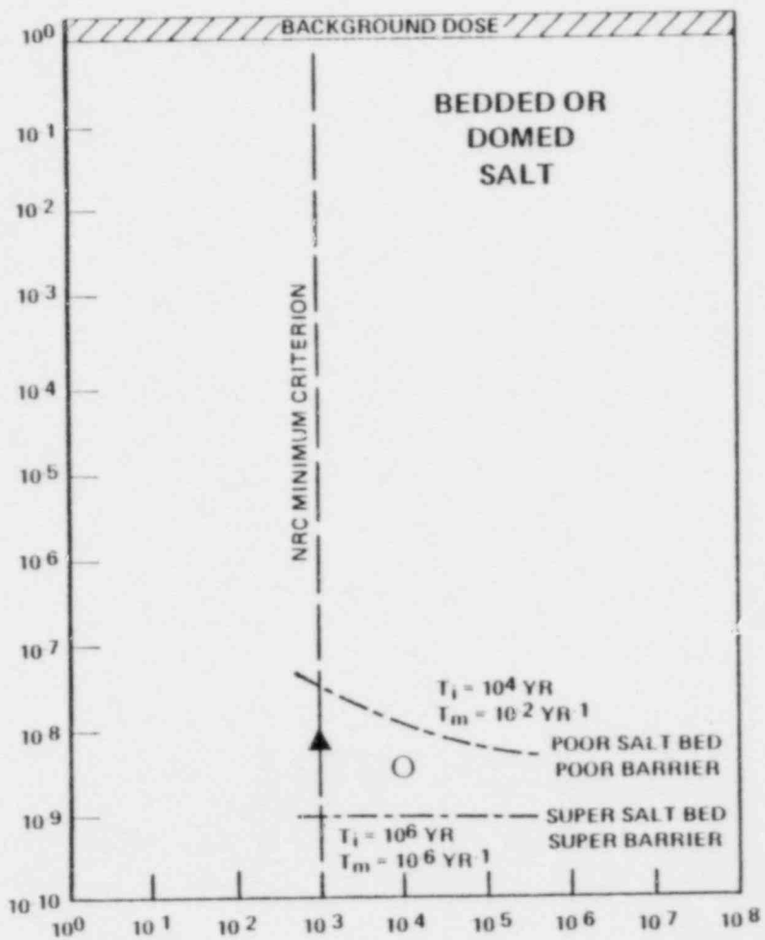
RELEASE RATE THROUGH BARRIER, YR^{-1}

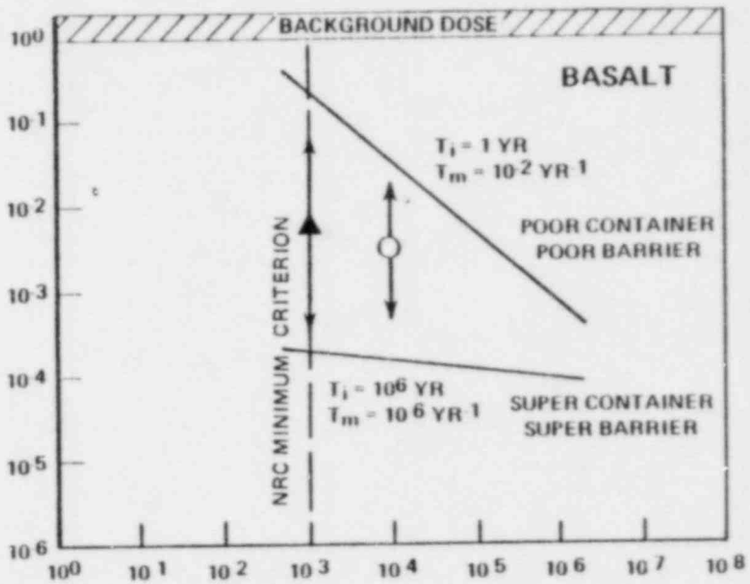
Figure 2

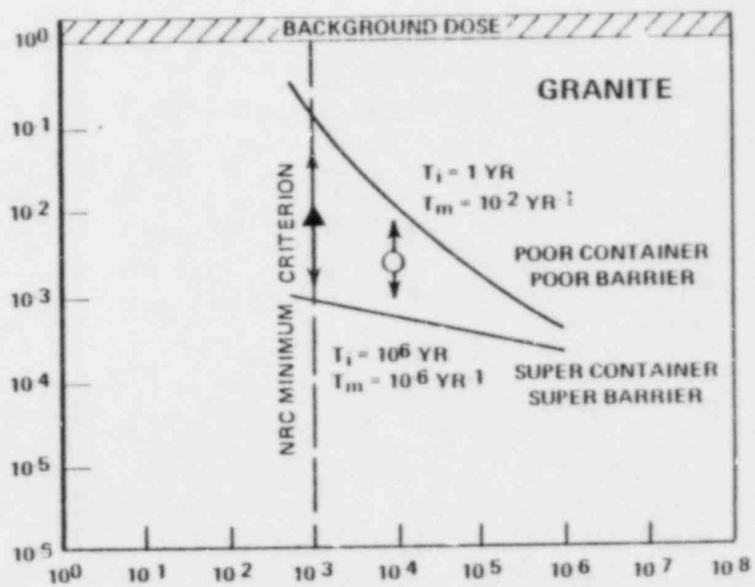
COMPARISON OF SYSTEMATIC PARAMETERS WITH NRC CRITERIA
EFFECT OF SITE ISOLATION

	NRC CRITERIA ▲	NOMINAL WASTE SYSTEM ○
RELEASE DELAY TIME, YR T_i	1000	100
BARRIER RELEASE RATE, YR^{-1} T_m	10^{-5}	10^{-4}
WASTE TRAVEL TIME, YR T_g	1000	10,000

NO HUMAN CAUSED INTRUSION
SPENT FUEL WASTE







RATIO OF MAXIMUM POPULATION DOSE TO BACKGROUND

GROUND WATER TRAVEL TIME, YEARS

Figure 3

ALTERNATIVE APPROACHES (continued)

Because detailed site-specific modeling has not yet been done, these calculations were conducted to compare effects. Conclusions from these figures should not be extended to doses at real sites. However, this study does indicate the relative difference each of the barriers make in the isolation of the waste.

Another study performed by Hill (1980)[2] on high-level waste in a non-salt repository indicated that delay of initiation of waste transport could only affect maximum dose if delay time was large compared to the groundwater travel time, the time for complete dissolution of the waste form, and the half-life of the major nuclides contribution to dose.

A study performed by Sutcliff, et al. (1981)[3] which considered sensitivities and uncertainties of system performance showed that maximum discharged rates were insensitive to container lifetime.

The above mentioned studies used differing assumptions in their analyses, and yet resulted in similar conclusions. No study performed to date has shown otherwise.

In view of the results of these studies, we are concerned about the significance these specific numerical values will have on the outcome of the licensing review and recommend restructuring section 60.111 as noted in the section-by-section comments attached.

Lack of Clarity Regarding Basis for Demonstrating Compliance

The NRC explains that the engineered system is a means to deal with uncertainty in the performance of the site. However, in establishing the engineered system NRC has created additional engineering uncertainties since several of the critical concepts will lack the definitions that are necessary to facilitate design. For example, the boundary of the engineered system over

(3) W.G. Sutcliff, et al. Uncertainties and Sensitivities in the Performance of Geologic Nuclear Waste Isolation Systems, UCRL-53142, University of California, Lawrence Livermore National Laboratory, Livermore, CA (1981).

ALTERNATIVE APPROACHES (continued)

which the release rate of one part in 10^5 must be evaluated is inadequately defined. It is not clear whether the engineered system includes any of the geologic formation or whether it is limited to the waste package and the tunnel backfill.

With regard to the 1,000 years for containment, when considering a population of 50,000 waste packages, the total significance of the 1,000 years is unclear. Does it represent a mean value or a minimum value? If it is a minimum value, no waste package failure could be allowed in 1,000 years. Allowing for probabilistic variations, it must be concluded in any design that some chance of failure exists.

Another detailed issue concerns the identification of the actual failure mode leading to loss of containment. There are numerous degradation mechanisms that could lead to failure and one or two may be dominant. We have considered the issue of the elimination of the non-important failure modes that may be active over 1,000 years based on, say, 5 years experience. The data needed to allow confident selection between the important and unimportant failure modes must be carefully developed. This decision on the required data will be important for establishing a rational design basis for the waste package.

The NRC requirements state that "The engineered system shall be designed so that....the waste packages will contain all radionuclides for at least 1,000 years...." This requirement is stated in absolute terms, implying that any release before the 1,000 year period ends would constitute noncompliance.

Even extraordinarily high reliability factors and safety margins for the waste package will not meet the absolute wording of the performance objectives in the proposed rule. To achieve a single-package reliability of 0.9999 that the minimum lifetime is 1,000 years would require a median design lifetime between 10,000 years and several million years. Achieving this level of reliability even for systems that operate in the short term under relatively well-defined conditions is unprecedented. Proving that

ALTERNATIVE APPROACHES (continued)

this reliability can be achieved for a system that is to operate for 1,000 years under less well-defined conditions will be a requirement well beyond any previous engineered system. Therefore, rather than achieving the objective of reducing uncertainty and simplfying the licensing process, the use of such a waste package quantitative performance objective could, instead, complicate the licensing process with additional uncertainties. In view of the incomplete understanding of the demonstration of compliance, we recommend caution regarding the premature commitment to numerical values without fully defining their meaning and without providing flexibility to adjust the requirements for each component for specific sites in order to collectively perform to meet the overall system criteria.

POPULATION DENSITY AND SITING

The Commission has invited comment on whether population-related siting requirements should be included in the final rule, and how any requirement might be implemented. The request did not distinguish between operational and postclosure population proximity considerations. These considerations for the operational phase surface facilities are distinctly different than for postclosure.

Because air pathways are the predominant mechanism for radioactive release from surface facilities during the operational phase, the objective should be to consider release mechanisms (and the consequences of release) to the same extent they are considered in licensing other fuel cycle facilities. The regulation requires DOE to meet 10 CFR 20 requirements and EPA standards for radiological exposures or releases, thereby accomplishing this objective. DOE believes no further requirement is needed, especially given the practical considerations that:

- Low population density and distance from population centers would normally be viewed as favorable conditions.
- NRC will review each application on a case-by-case basis, and would critically analyze the proposed use of any site in close proximity to a large population or within a zone of high population density.

For the postclosure phase, population considerations do not provide a valid basis for regulation. After a repository is filled and sealed, the most likely mechanism for the escape of radionuclides to the biosphere is by dissolution and transport in groundwater. Such action is likely to occur only after the long-term decomposition of engineered barriers, thus permitting a slow rate of release into the host rock and surrounding geologic environment (the far-field) over periods of thousands of years. There, in the far-field, natural geochemical mechanisms of sorption and precipitation would work in concert with long groundwater travel time and radioactive decay to delay and reduce any releases to the accessible environment. Because potential future release points may be distant from the repository, and future population

POPULATION DENSITY AND SITING (continued)

trends over hundreds or thousands of years also cannot be predicted, current population density near a repository has very little safety significance during the post-closure period. Release rates, or dose to a maximum individual, provide a more meaningful basis for judging the suitability of a proposed isolation system. While reference-sized populations may be useful for comparing sites or establishing limits on release, site-specific population factors should not be used as the critical basis for licensing a site.

We believe, therefore, the treatment of population in the proposed 10 CFR 60 is appropriate.

DESIGN/CONSTRUCTION REQUIREMENTS

The DOE comments on the Advanced Notice of Proposed Rulemaking (ANPR), contained in a letter dated July 15, 1980, noted that in many cases design solutions to perceived problems were incorporated into the rule rather than technical criteria or performance objectives. We note that the proposed rule is substantially improved from the ANPR in this area. We believe that sections 60.130 through 60.134 are generally at an appropriate level of detail to allow the NRC to regulate design and construction while still giving DOE the necessary flexibility to provide the appropriate design. There are still a few areas where the level of specificity is unwarranted or the rule may otherwise deviate from past practice. These are presented in the detailed comments in enclosure B.

ALARA

We agree with NRC's position not to apply ALARA to performance requirements dealing with containment and control of releases. Calculated releases of radionuclides from a repository are made far into the future. Good estimates of regional populations in the distant future cannot be made, and thus population doses cannot be calculated and the benefit of making changes to the engineered system cannot be quantitatively evaluated. Also, the natural features of a site, the geologic setting, cannot be modified once a site is chosen. Therefore, we agree with NRC's position that ALARA requirements should not be applied to repository performance requirements.

INCLUSION OF TRU WASTES IN THE RULE

Issue

Inclusion of TRU wastes in the rule.

DOE Position

We believe that it is inappropriate to issue specific requirements for commercial TRU waste disposal in this rule.

Discussion

Transuranic (TRU) waste consists of a diverse mixture of materials and equipment that have been contaminated by association with transuranics. Generally, fission product levels are very low and heat generation rates average a few hundredths of a watt per container. The physical and chemical properties of this waste inventory can be highly variable and quite unlike high-level waste (HLW).

In many cases it will be impractical to process such waste to the extent that may be required to meet the 1×10^{-5} annual fractional release rate, and in some cases, it may be impossible. A considerable body of knowledge on migration of transuranics in geologic media exists and shows that such restrictive package release rates are not necessary to protect the environment and maintain public health and safety.

Because of the variability of TRU waste it is difficult to assess the reasonableness of the NRC requirements as they are presently formulated. It is not clear that in light of the relative hazard of TRU waste as compared to HLW that the requirements in 10 CFR 60 are justifiable. Knowledge (of commercial TRU waste) that needs to be gained to determine the impact of these requirements (and in our opinion, to develop appropriate requirements) includes: 1) the quantities and radionuclide composition of TRU waste; 2) lifetime of TRU waste packages; 3) the release rate from various TRU waste

INCLUSION OF TRU WASTES IN THE RULE (continued)

forms as a function of temperature; 4) potential effects of TRU wastes on the repository performance; 5) cost of processing and packaging TRU waste; 6) hazard index for TRU as compared to HLW; 7) and the cost/benefit trade-offs of the options for disposing of TRU wastes in a repository.

Defining TRU waste in this rule as any material containing over 10 nCi/gm of activity from transuranics suggests that any such material must be disposed of by geologic isolation. The draft rule on low-level waste, 10 CFR 61, states that waste exceeding 10 nCi/gm is unsuitable for shallow land burial disposal but that other modes of land disposal giving greater confinement are possible for these higher-activity wastes and that detailed technical criteria for such disposal are to follow at a later date. We believe that separate guidance or case by case handling would be the proper way to address TRU waste and it is suggested that direct references to TRU waste be dropped entirely from the 10 CFR 60.

Such guidance should recognize the unique nature of the waste type and the hazards associated with it. It should not be merely a duplication of the high-level waste rule but based on available information on the behavior of TRU waste elements in the disposal environments including any temperature constraints, containment requirements, etc. This approach could fully consider all aspects of TRU disposal and result in requirements that provide totally adequate protection and are also practical to implement.

Finally, we are unaware of any statutory authority for Commission exercise of regulatory control over the disposal of TRU waste by DOE.

BOREHOLE AND SHAFT SEALING

Issue

How to specify requirements for borehole and shaft seals.

DOE Position

Setting criteria on the individual components of the system defeats the full utilization of the "systems approach" as discussed in the "Alternative Approaches" section beginning on page A-11. However, if NRC decides to set component criteria, it is inappropriate to allow minimum repository seal performance to vary as a function of the site's isolation capabilities (10 CFR 60.133(b)(2)).

Stating minimum performance of seals in terms of site isolation capabilities is attractive because it does not allow a good site to be compromised by inferior seals. However, if a site's permeability is so low that the best state-of-the-art seals cannot match it, then it would seem that an otherwise excellent site might have to be rejected from further consideration. That does not seem to be reasonable and probably is not the intent of the proposed rule.

Discussion

The proposed rule states: "Shaft and borehole seals shall be designed so that ... sealed shafts and boreholes will inhibit transport of radionuclides to at least the same degree as the undisturbed units of rock through which the shafts and boreholes pass." This is interpreted as meaning that the radionuclide migration through a vertical column of rock containing a shaft or borehole shall not exceed the radionuclide migration through a vertical column of undisturbed rock of the same size. Thus the rule, in effect, requires that the ratio of radionuclide releases through boreholes and shafts to releases from the repository as a whole shall not exceed the ratio of the total cross-sectional area of boreholes and shafts to the horizontal areal extent of the repository.

BOREHOLE AND SHAFT SEALING (continued)

A practical application of section 60.133, with negative results, can be illustrated with a simple example comparing two potential sites. If we assume a repository of 1,500 acres (65 million square feet) and 5 shafts at 30 feet diameter each, or 3,600 square feet, the fraction of total releases that could be attributed to the shafts is 5.4×10^{-5}.

If we further assume that the best possible design for shaft and borehole seals has a total release rate of 50 arbitrary units (in terms of either dose or quantity), then, if a site is found that has a total release rate of one million arbitrary units, and if the one million units met the EPA standard, the repository would be acceptable. However, if another site could be found where the total radionuclide release was 500,000 arbitrary units, it could be disqualified because the best possible design for shaft and borehole seals could not meet section 60.133--even though this is the better site in terms of total release.

This example illustrates why the performance of sealed shafts and boreholes should not be keyed to site isolation capabilities.

Alternative Criterion

The actual quantitative specification should be developed on a site-by-site basis to suit the actual repository design and seal design conditions.

Recommended changes to section 60.133 to reflect these comments are included in the detailed section-by-section comments on the proposed rule, enclosure B, beginning on page B-40. Quantitative limits can be incorporated into Regulatory Guides as additional design information and as EPA standards become available to both the DOE and the NRC.

Finally, the term "shafts" in the sealing context includes both the vertical shaft and the access tunnel through the shaft pillar. Seals for this combination of penetrations will be designed as a system. This condition is reflected in the suggested alternative language to section 60.133(b)(1), (2), and (3).

CREDIT FOR SITE-SPECIFIC FACTORS

Issue

The NRC proposed role does not specify credit for site-specific factors.

DOE Position

DOE feels credit for site-specific factors should be specified.

In a DOE letter to NRC, dated May 29, 1981, concern was expressed that the DOE would be required to calculate exposures from radionuclide transport, with no assurance from NRC or the draft regulation regarding what assumptions and site-specific mitigating factors might be applied in the calculations. Consequently, DOE expressed concern that the licensing process may be unnecessarily protracted by debate over the related systems-safety objective, and how it might be achieved.

Section 60.21 adequately specifies what site conditions and assessments the DOE safety-analysis report should contain, and therefore largely alleviates DOE's concern. However, as in the case of nuclear-reactor facilities, DOE suggests that NRC develop, as part of its Regulatory Guide Series, guides for implementation of 10 CFR 60. The DOE would be pleased to assist NRC staff in the development of such guides.

SECTION BY SECTION COMMENTS

This portion of our comment on the proposed rule presents comments on individual sections of the rule. To assist the reader for each section addressed we have provided (1) the NRC proposed language, (2) the DOE recommended revision, and (3) our rationale for the recommended change.

In some cases the recommended revisions reflect our positions as presented in the previous sections where we discussed several issues raised by either the Commission or ourselves. In other cases the change reflects our intent to obtain consistency, simplification, and maximized opportunity to use engineering initiative.

Discussion of the Supplementary Information Section of 10 CFR 60

This section provides much needed insight into the staff's intent and thought processes and has proved to be very helpful. We do have certain specific comments on portions of this section.

Specifically, we noted the staff's comment on earlier DOE program plans that emphasized fully saturated geologic formations. Since opportunities may arise for exploratory studies in unsaturated structures, we request that the NRC staff reexamine the rule and make whatever changes (i.e., rewording, insertion or deletions) they deem necessary to ensure that the rule will apply to all geologic media.

We wish to reemphasize our support for the development of a multi-barrier repository system. This concept is basic to our waste isolation program, as is the development of a high-integrity long-lived waste package. However, we believe that inflexible numerical criteria for individual components should not be established at this time but instead specifications should be derived from an overall system performance standard and supported by technical justification for a specific site.

SECTION BY SECTION COMMENTS (Continued)

We have noted the Commission's discussion with the NRC staff relative to the cut-off of the EPA's regulation at 10,000 years. We concur with those expressed opinions and suggest that it would be appropriate to make the Commission's position a matter of record in the rule.

In its discussion of the role of the site the staff has indicated their desire to have the Safety Analysis Report contain a projection of the expected performance of the repository, giving the rates and quantities of the expected releases as a function of time. Given this additional requirement we question the necessity of precisely specifying the performance of subsystems of the waste disposal system.

Within the discussion on the major features of the rule we note that the repository depth was required to be 300 m below the surface. This appears inconsistent with the intent of section 60.122 - Favorable Conditions and, if an editorial oversight, we trust it will be rectified.

10 CFR 60.2:

General Comments:

The comments below pertain to the definitions of terms given in the proposed section 60.2--Definitions, as well as related terms discussed under section 60.102 - Concepts; the NRC should strive to obtain consistency between these two sections and eliminate any redundancies.

The objectives of our comments are to obtain clear, consistent usage of terms within 10 CFR 60 and to strive for a consistency, or at least an understanding of the differences, of terms used by the NRC, DOE, EPA, and other interested parties. Unnecessary terms should be deleted to improve the readability of the regulation. It is proposed that the Commission consider the following recommended revision of definitions. For those revisions adopted by NRC we suggest you provide an appropriate discussion under section 60.102 based on the concepts expressed in the attached comments and rationale statements.

We are eager to work closely with the NRC staff to develop a consensus on a common set of definitions. It is proposed that discussions be held between representatives of the NRC, DOE, and, where necessary, the EPA, to reach agreement on such definitions before the rule is finalized. The attached comments would provide a useful starting point for these discussions.

10 CFR 60.2 "Accessible Environment"

NRC Proposed Wording:

"Accessible Environment" - those portions of the environment directly in contact with or readily available for use by human beings.

10 CFR 60.2 "Accessible Environment" (continued)

Recommended Revision:

Reword to be consistent with EPA definition.

Rationale:

The definition of "accessible environment" in 10 CFR 60 should be consistent with the EPA definition of the term; however, as proposed it is not consistent with the wording given in the latest draft of 40 CFR 191. Furthermore, any changes made in the EPA definition when it becomes final should be reflected in 10 CFR 60. While DOE has not developed a complete alternative definition at this time, we recommend that groundwater to be considered as part of the accessible environment should be limited to significant quantities of readily available potable water located at, or past, a distance (site specific) from the repository. Further discussions between NRC, EPA, and DOE are warranted to develop a commonly accepted definition of this term.

10 CFR 60.2 "Container"

NRC Proposed Wording:

10 CFR 60.102(e)(2) states: "The container which is the first major sealed enclosure that holds the waste form."

Recommended Revision:

Delete the term "container" and, if such a term is necessary, replace with "canister" with the following definition in section 60.2: Canister - a component of the waste package that provides the means of safely handling the waste form after production, during waste package

10 CFR 60.2 "Container" (continued)

assembly, or during any required movements or transport between the sites of production of the waste form and assembly of the waste package.

Rationale:

In the comments on The Advanced Notice of Proposed Rulemaking, DOE noted that "canister" is a more commonly used term than "container" and further that NRC's definition included the unclear term "first" and that the canister may or may not be a sealed component of the waste package. These comments still apply since, although the definition of "container" was removed from 60.2, the term "container" remains in 60.102. (Note that the definition of canister does not preclude the canister from performing an isolation function, but does permit the assignment of such functions to other components of the waste package.) References to "container" might be appropriately replaced with references to "overpack".

10 CFR 60.2 "Containment Period"

NRC Proposed Wording:

While not defined in 60.2, the discussion of "containment" in 60.102 states, "Early during the repository life, when radiation and thermal levels are high and the consequences of events are especially difficult to predict rigorously, special emphasis is placed upon the ability to contain the wastes by waste packages within an engineered system. This is known as the containment period."

10 CFR 60.2 "Containment Period" (continued)

Recommended Revision:

In section 60.2 define "containment period" as: "The time after closure of the repository when the containment of the radioactive waste must be virtually complete within the engineered system."

Rationale:

The concept as expressed in section 60.102 is not clear and would benefit from a definition in section 60.2. The discussion in section 60.102 could then be amended to explain that for HLW and spent fuel, the containment period would coincide with the time period when radioactivity levels and heat production within the waste are dominated by fission product decay. This period is more precise than the stated "when levels are high and the consequences of events are especially difficult to predict rigorously."

10 CFR 60.2 "Decommissioning"

NRC Proposed Wording:

"Decommissioning", or "permanent closure", means final backfilling of subsurface facilities, sealing of shafts, and decontamination and dismantlement of surface facilities.

Recommended Revision:

"Decommissioning" or "permanent closure" means the final backfilling and sealing of underground excavations, including main entries, shafts, and boreholes; the decontamination and dismantlement or retirement of surface facilities; the off site transport of any

10 CFR 60.2 "Decommissioning" (continued)

materials not disposed of on site; and site restoration work. This does not preclude decommissioning of portions of the repository earlier than the time of permanent closure.

Rationale:

The clarification of the excavations to be backfilled during decommissioning emphasizes the differences between "final backfilling" and room backfilling which may be performed prior to decommissioning. The dismantlement of surface facilities should not be mandatory as it may be desirable to leave portions of the facilities as markers or to employ them for other purposes; hence, retirement from use as a component of the waste disposal system should be an option. Material disposal and site restoration work should be included in the definition to ensure that such activities are considered within the scope of decommissioning activities.

10 CFR 60.2 "Disposal"

NRC Proposed Wording:

"Disposal" means the isolation of radioactive wastes from the biosphere.

Recommended Revision:

Disposal - the permanent emplacement of radioactive waste in a geologic repository to isolate the wastes from the biosphere.

10 CFR 60.2 "Disposal" (continued)

Rationale:

The definition as currently stated would appear to be applicable to storage as well as permanent placement. The recommended revision recognizes that disposal is an act which is performed with the intent to achieve isolation.

10 CFR 60.2 "Disturbed Zone"

NRC Proposed Wording:

"Disturbed zone" means that portion of the geologic setting that is significantly affected by construction of the subsurface facility or by the heat generated by the emplacement of radioactive waste.

Recommended Revision:

"Disturbed Zone" means that portion of the geologic setting whose physical or chemical character has changed as a result of subsurface facility construction or from heat generated by the emplaced radioactive wastes such that the resultant changes of character may have a significant effect on the performance of the disposal system. Investigations of the disturbed zone conducted in accordance with section 60.123(b) will not determine the real extent for the establishment of controls required by section 60.121(b).

Rationale:

"Significantly affected" could be interpreted to apply to any measurable effect, whether or not it would have any impact on the performance of the waste isolation system. The recommended revision ties

10 CFR 60.2 "Disturbed Zone" (continued)

the concept of disturbances to significant effects on the performance of the disposal system. Note that changes in actual values would not necessarily result in changes in character of the geologic setting. Induced changes which would not significantly affect performance should not be considered to be disturbances. Also, the proposed phrasing could be rigidly interpreted to refer to the frictional heat generated between canister and emplacement hole, because of the wording "heat generated by the emplacement of radioactive waste" rather than "heat generated by emplaced radioactive waste". Section 60.123(b) requires certain investigations to be conducted at specific distances. We recommend the addition of the last sentence to avoid the possibility that the distance, chosen for those investigations, would determine the real extent for the establishment of controls required by section 60.121(b).

10 CFR 60.2 "Engineered System"

NRC Proposed Wording:

"Engineered system" means the waste packages and the underground facility.

Recommended Revision

"Engineered System" - Includes the repository waste package, backfill and seals, and includes a portion of the host rock. The extent of this inclusion of the host rock will be determined on a case-by-case basis.

10 CFR 60.2 "Engineered System" (continued)

Rationale:

Since "underground facility" excludes shafts, boreholes, and seals, the above definition implies that these entities, along with surface facilities, are not engineered. If the intended concept is "engineered barrier system", that term should be used with a clarification in the concept section. However, note that the control of release requirement which is placed on the engineered system would, in fact, become a requirement on the waste package. While we believe that the proposed 10^{-5} release rate criterion should be dropped or modified, in the event that the Commission chooses to retain this criterion, DOE would recommend that some acknowledgement be made of the isolation capabilities of the host rock. The extent of the rock, or rocks, which will be included in the engineered system will be proposed in the license application related to a specific site.

10 CFR 60.2 "Geologic Repository"

NRC Proposed Wording:

"Geologic repository" means a system for the disposal of radioactive wastes in excavated geologic media. A geologic repository includes (1) the geologic repository operations area, and (2) the geologic setting.

Recommended Revision:

Repository - The surface and sub-surface areas where waste handling activities are or have been performed.

10 CFR 60.2 "Geologic Repository" (continued)

Rationale:

The 10 CFR 60 definition as currently written would include the geologic setting which is generally considered to be distinct from the repository but part of the waste disposal system. The repository is designed to act in conjunction with the geologic setting and the waste packages to provide isolation of nuclear wastes and to permit the necessary waste handling operations associated with waste disposal. Note the recommended definition for "waste disposal system" on page B-15; this term should be used in place of "geologic repository" when the intent is to include the entire system.

10 CFR 60.2: "Geologic Repository Operations Area"

NRC Proposed Wording:

"Geologic repository operations area" means a HLW facility that is part of a geologic repository, including both surface and subsurface areas, where waste handling activities are conducted.

Recommended Revision:

Delete the term.

Rationale:

Refer to our recommended revision (page B-10) to the NRC term "geologic repository". It is suggested that "geologic repository operations area" be replaced by the term "repository". This would eliminate the need for defining an additional term which is not in general use, thereby increasing the clarity of the regulation.

10 CFR 60.2: "Geologic Setting"

NRC Proposed Wording:

"Geologic setting" or "site" is the spatially distributed geologic, hydrologic, and geochemical systems that provide isolation of the radioactive waste.

Recommended Revision:

"Geologic setting" is the spatially distributed geologic, hydrologic, and geochemical systems at and around the site.

Rationale:

It is recommended that geologic setting not be synonymous with site. The term "site", while related to geologic setting, is sometimes applied in a broader sense than geologic setting, to mean a geographical location. An example of this appears in section 60.21(c)(1)(ii)(A) which refers to the meteorology of the site. (A recommended definition for site as a separate term is included later.) The geologic setting should be considered to be the geologic features of the site and the surrounding region. Note also that while some portions of the geologic setting provide isolation, other aspects of the geologic setting may have no role in providing isolation.

10 CFR 60.2: "Overpack"

NRC Proposed Wording:

"Overpack" means any buffer material, receptacle, wrapper, box, or other structure, that is both within and an integral part of a waste

10 CFR 60.2: "Overpack" (continued)

package. It encloses and protects the waste form so as to meet the performance objectives.

Recommended Revision:

The "overpack" is a component of the waste package to contain the waste during the containment period.

Rationale:

The recommended revision avoids listing the various possible configurations of the overpack and more clearly states the functions of that waste package component commonly referred to as a overpack.

10 CFR 60.2: "Retrieval"

NRC Proposed Wording:

This term is not defined in 10 CFR 60.

Recommended Revision:

Retrieval - The act of intentionally removing radioactive waste from the underground location at which the waste had previously been emplaced for disposal.

Rationale:

Some of the concerns over the retrieval requirements in 10 CFR 60 may be alleviated by providing a definition of the term and a discussion of the concept.

10 CFR 60.2: "Retrieval" (continued)

It should be noted in the discussion of the concept that retrieval is performed in the event that the specific waste isolation system has demonstrated an inability to meet its established performance objectives and that waste is considered to have been retrieved when it has been removed from the subsurface facility.

10 CFR 60.2: "Site"

NRC Proposed Wording:

Defined as synonymous with geologic setting.

Recommended Revision:

Site - The location, both at and below the surface, where the repository is constructed.

Rationale:

(See previous comments on geologic setting). The proposed definition conveys the fact that the site is a tract of land to be characterized and controlled by DOE. The site would include surface features within the specified area and the geologic setting underlying this area. Note that site characterization, as defined in 60.2, would actually consist of geologic setting characterization for a particular site.

10 CFR 60.2 "TRU Waste"

NRC Proposed Wording:

"Transuranic wastes" or "TRU wastes" means radioactive waste containing alpha emitting transuranic elements, with radioactive half-lives greater than five years, in excess of 10 nanocuries per gram.

Recommended Revision:

Delete definition of TRU wastes in 10 CFR 60.

Rationale:

It is not appropriate to consider TRU wastes in the context of this regulation (see related comments in enclosure A, page 30). If the Commission should decide to keep TRU waste provisions in 10 CFR 60, DOE recommends that a common definition be adopted by EPA, NRC, and DOE for TRU waste and included in 60.2.

10 CFR 60.2: "Underground Facility"

NRC Proposed Wording:

"Underground facility" means the underground structure, including openings and backfill materials but excludes shafts, boreholes, and their seals.

Recommended Revision:

Delete the term and replace references to it with references to subsurface facility.

10 CFR 60.2: "Underground Facility" (continued)

Rationale:

The necessity for using two terms, "underground facility" and "subsurface facility", is not obvious. The similarity between the two terms could be a source of confusion to the reader. Unless there is a specific need for both terms, DOE recommends deleting the term "underground facility."

10 CFR 60.2: "Waste Disposal System"

NRC Proposed Wording:

This term is not defined in 10 CFR 60.

Recommended Revision:

Define Waste Disposal System as: "The configuration of man-made and natural features which provides for the handling, disposal, and isolation of nuclear wastes. This system includes: waste packages, the repository, the site, and those portions of the geologic setting which provide for isolation of the wastes." Replace references to geologic repository with references to the waste disposal system.

Rationale:

(See comments on Geologic Repository.) The term geologic repository is used in the draft 10 CFR 60 to refer to the entire waste disposal system. It is recommended that this new term be introduced to more clearly describe the system.

10 CFR 60.2 "Waste Package"

NRC Proposed Wording:

"Waste package" means the airtight, watertignt, sealed container which includes the waste form and any ancillary enclosures, including shielding, discrete backfill and overpacks.

Recommended Revision:

"Waste Package" means the waste form, canister, canister overpack, and any additional enclosures or materials (including backfill) that separate the radioactive waste from the unexcavated host rock.

Rationale:

The definition as currently stated in 10 CFR 60 is not consistent with the waste package concept used by the DOE program as the definition requires that the outer-most part of the waste package be airtight, watertight, and sealed (hole backfill would thus have to be within this enclosure). The components of the waste package, with the exception of the overpack and the waste form, should be optional at the discretion of the waste package designer. The recommended definition encompasses all material between the waste and the host rock, and hence by definition the waste package is in contact with the host rock. This raises concern that the 10^{-5} release rate criterion applies only to the waste package itself as it is not possible to take credit for the isolation capabilities of the host rock (see comments on the definition of engineered system). Obtaining agreement between DOE and the Commission on the definition of waste package is essential for rational discussions during the licensing process.

10 CFR 60.10(c)

NRC Proposed Wording:

As provided in section 51.40 of this chapter, ...

Recommended Revision:

None, but we wish to state our understanding of the intent of this section.

Rationale:

DOE believes that this section, when read together with the procedural provisions of Parts 51.40, 60.10(a) and 60.21(a), provides (1) that DOE is to include in its license application site characterization of alternative sites in accordance with NEPA and the requirements of Part 60.10; (2) that the information regarding the alternative sites, as identified in the Site Characterization Report, are to be described fully in the license application and accompanying environmental report, and are provided so that the NRC will be able to evaluate alternative sites in accordance with NEPA; and (3) that the standard by which the NRC will determine the adequacy of DOE's selection of alternative sites and its preferred site is whether the alternative site analysis was performed in accordance with NEPA.

10 CFR 60.10(d)(1)

NRC Proposed Wording:

Investigations to obtain the required information shall be conducted to limit adverse effects on the long-term performance of the geologic repository to the extent practical.

10 CFR 60.10(d)(1) (continued)

Recommended Revision:

"Investigations to obtain the required information shall be conducted in a manner to limit adverse effects ..."

Rationale:

The NRC proposed language does not place the emphasis of the sentence properly.

10 CFR 60.21(c)(1)(i)(B)

NRC Proposed Wording:

The presence and characteristics of other potential pathways such as solution features, breccia pipes, or other permeable anomalies.

Recommended Revision:

Change last phrase "or other permeable anomalies" to "or other potentially permeable features".

Rationale:

An "anomaly" is a deviation from normal, an abnormality. The statement clearly refers to salt. Although they are deviations from the majority of the salt body, solution features and breccia pipes are not unusual features in salt bodies. They are neither necessarily anomalous nor permeable; some are less permeable than some other parts of the salt body. It is, of course, important and necessary to describe and assess the significance of these features--we just don't believe it proper for the rule to state the results in a prejudicial way (i.e. "permeable").

10 CFR 60.51(a)(2)(ii)

NRC Proposed Wording:

Placement of records of the location of the geologic repository operations area and the nature and hazard of the waste in the archives of local and Federal Government agencies, and archives elsewhere in the world that would be likely to be consulted by potentional human intruders.

Recommended Revision:

Replace "geologic repository operations area" with "repository".

Rationale:

Consistency with recommended revisions to Section 60.2.

10 CFR 60.111

General Comment:

We have noted several concerns relating to the requirements of this section in our Issue Commentary on retrievability, TRU waste, and the alternative approach. Because these concerns are so fundamental, we believe that significant revision to this section is in order. This revision could take the form of alternative language and/or the insertion of major qualifying statements. We believe that the details of alternative language might well be the topic of further interagency staff discussions and are providing revised language for portions of 60.111 for your consideration.

10 CFR 60.111(a)(2)

NRC Proposed Wording:

(2) The geologic repository operations area shall be designed so that the entire inventory of waste could be retrieved on a reasonable schedule, starting at any time up to 50 years after waste emplacement operations are complete. A reasonable schedule for retrieval is one that requires no longer than about the same overall period of time that was devoted to the construction of the geologic repository operations area and the emplacement of wastes.

Recommended Revision:

"The repository shall be designed so that any of the emplaced waste could be retrieved on a reasonable schedule, starting at any time up to 50 years after waste emplacement operations are initiated. This time period may be considered on a case-by-case basis for each repository consistent with the planned performance confirmation program. This requirement shall not preclude a decision by the Commission to allow backfilling or decommissioning part or all of the repository prior to the use of the designated retrieval period."

Rationale:

The discussion of the DOE position on retrievability, including the rationale for our recommended revision, is included in the enclosure labeled Issue Commentary.

10 CFR.60.111(b)

NRC Proposed Wording:

(Not repeated here due to length.)

Recommended Revision:

(b) Performance of the geologic repository after permanent closure.

(1) Overall system performance

The geologic setting shall be selected and the engineered system shall be designed so as to provide reasonable assurance that, following permanent closure, the release of radionuclides into the accessible environment is within the limits defined by the generally applicable environmental standards established by the Environmental Protection Agency.

(2) Performance of the engineered system

(i) Containment of waste

The engineered system shall be designed so that there is reasonable assurance that containment of the HLW will be virtually complete during the period when the radiation and thermal output are dominated by fission product decay. As a performance objective, this period of containment will be a nominal 1000 years after permanent closure of the repository unless it is established to the satisfaction of the Commission that an acceptable level of overall system performance can be achieved with a shorter containment period. Among the factors that may be taken into account in proposing an alternative containment period are the radionuclide content and the thermal output of the waste. The

10 CFR.60.111(b) (continued)

capability of the engineered system to meet the performance objective after permanent closure shall be evaluated on the basis of anticipated processes and events and the assumption, where appropriate, that available void spaces in the underground facility are filled with groundwater. During the containment period, the nominal annual fractional rate of release of radionuclides from the engineered system need not be zero but should be less than one part in 100,000 or 1×10^{-5} of the inventory at the time of release. Those radionuclides whose contribution is less than 0.1% of the curie inventory at the time of release need not be included in any consideration or calculation relative to this objective. This requirement shall not be construed to mean that there shall be no releases during the containment period; the standard of compliance will be "reasonable assurance".

(ii) Control of releases

The engineered system shall be designed so that there is reasonable assurance that any release should be a gradual process which results in small fractional release rates extending over long times, and will not cause the overall performance standard on releases at the accessible environment to be exceeded. As a performance objective this annual fractional release rate shall not exceed one part in 100,000 of the inventory after the containment period unless it is established to the satisfaction of the Commission that an acceptable level of overall system performance can be achieved at other expected release rates. Among the other factors that may be taken into account in proposing an alternate release rate are the radionuclide

10 CFR.60.111(b) (continued)

content and the thermal output of the waste. The capability of the engineered system to meet the performance objective after the containment period shall be evaluated on the basis of anticipated processes and events and the assumption, where appropriate, that available void spaces in the underground facility are filled with groundwater. Those radionuclides whose contribution is less than 0.1% of the curie inventory at the time of release need not be included in any consideration or calculation relative to this objective.

(3) No change recommended.

Rationale:

The rationale for these changes is presented in the Issue Commentary enclosure to this response, under "Alternative Approach."

10 CFR 60.121(a)

NRC Proposed Wording:

Requirements for ownership and control of the geologic repository operations area.

(a) Ownership of the geologic repository operations area. The geologic repository operations area shall be located in and on lands that are either acquired lands under the jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use. ...

10 CFR 60.121(a) (continued)

Recommended Revision:

(a) Ownership of the site. The geologic site shall be located in and on ... .

Rationale:

DOE has substituted the term "site" for geologic repository operations area to be consistent with our recommended revision of the definition of "geologic repository operation area."

10 CFR 60.122

NRC Proposed Wording:

Each of the following conditions may contribute to the ability of the geologic setting to meet the performance objectives relating to isolation of the waste. In addition to meeting the mandatory requirements of section 60.112, a geologic setting shall exhibit an appropriate combination of these conditions so that together with the engineered system, the favorable conditions present are sufficient to provide reasonable assurance that such performance objectives will be met.

Recommended Revision:

Each of the following conditions are likely to enhance the ability of the geologic setting to meet the performance objectives of the geologic waste disposal system. The presence of one or more of any of these conditions will be considered as a favorable factor during the license application review. In addition to meeting the mandatory requirements of section 60.112, a geologic setting should exhibit one or more of

10 CFR 60.122 (continued)

these conditions so that together with the engineered system, the favorable conditions present are sufficient to provide reasonable assurance that such performance objectives will be met.

Rationale:

While we recognize the staff's intention is to enumerate conditions that would be considered as favorable attributes, we do not feel that the proposed language properly identifies the intent of the section.

10 CFR 60.122(a) and (b)

NRC Proposed Language:

(a) The nature and rates of tectonic processes that have occurred since the start of the Quaternary Period are such that, when projected, they would not affect or would favorably affect the ability of the geologic repository to isolate the waste.

(b) The nature and rates of structural processes that have occurred since the start of the Quaternary Period are such that, when projected, they would not affect or would favorably affect the ability of the geologic repository to isolate the waste.

Recommended Revision and Rationale:

Reference is made to structural processes (in 60.122(b)) right after reference to tectonic processes in 60.122(a). The distinction between structural and tectonic processes is not clear to many, and could be interpreted differently. Therefore, we strongly urge that these terms be explained or defined clearly so that the intended distinction between structural and tectonic processes is clear to any reader or reviewer.

10 CFR 60.122(h)

NRC Proposed Wording:

(h) Mineral assemblages that, when subjected to anticipated thermal loading, will remain unaltered or alter to mineral assemblages having increased capacity to inhibit radionuclide migration.

Recommended Revision:

"will remain unaltered, or if altered such alternation will not reduce their capacity to inhibit radionuclide migration to an extent that the overall system performance objective would not be met."

Rationale:

The text states that mineral assemblages, when subjected to anticipated thermal loading, should remain unaltered or altered so as to have increased capacity to inhibit radionuclide migration. While this sounds good, it may rule out some otherwise favorable sites which, upon thermal loading, might have a diminished capacity to inhibit radionuclide migration but which may still be acceptable in regard to radionuclide migration.

10 CFR 60.123(a)(5)

NRC Proposed Wording:

A fault in the geologic setting that has been active since the start of the Quaternary Period and which is within a distance of the disturbed zone that is less than the smallest dimension of the fault rupture surface.

10 CFR 60.123(a)(5) (continued)

Recommended Revision:

Add: Or, where the length of the smallest dimension is unknown, a fault in the geologic setting that has been active since the start of the Quaternary Period and whose active segment is within 1 km of the disturbed zone.

Rationale:

The potential structural condition described is unclear. First, definition of the smallest dimension of the fault rupture surface is difficult. Does the Commission use last movement or total length as the critical dimension? Secondly, there appears to be no direct correlation between the nature of the fault rupture surface (earthquake fault plane) and the magnitude of an earthquake. Once the magnitude of an earthquake is defined, the peak acceleration as a function of distance can be more credibly extrapolated. We are not sure that this adverse condition, as defined, is beneficial in defining the waste isolation characteristics of the repository.

10 CFR 60.123(b)

NRC Proposed Wording:

Adverse conditions in the disturbed zone. For the purpose of determining the presence of the following conditions within the disturbed zone, investigations should extend to the greater of either its calculated extent or a horizontal distance of 2 km from the limits of the underground facility, and from the surface to a depth of 500 meters below the limits of the repository excavation.

10 CFR 60.123(b) (continued)

Recommended Revision:

"... of 500 meters below the repository horizon. Within the limits of the engineered system such investigations will be made by non-invasive methods such as geophysical sensing, wherever possible, to reduce creation of potentially adverse conditions.

Rationale:

The NRC wording could be interpreted to suggest that these investigations would be made only by boreholes or other invasive procedures within the repository boundaries. We believe that such a requirement is too restrictive and inconsistent with other portions of the rule.

10 CFR 60.123(b)(2)

NRC Proposed Wording:

(2) Evidence of drilling for any purpose.

Recommended Revision:

Add: "other than repository siting or construction."

Rationale:

The proposed languages fails to allow for exploratory activities.

10 CFR 60.123(b)(3)

NRC Proposed Wording:

(3) Resources that have either greater gross value, net value, or commercial potential than the average for other representative areas of similar size that are representative and located in the geologic setting.

Recommended Revision:

Delete " ... that are representative of and located in the geologic setting."

Rationale:

The evaluation of the resource potential at a site by comparison with an equivalent potential in a larger geographic area is a valid approach. However, we are concerned that restricting the range of evaluation to "areas of similar size" located in the geologic setting (i.e., site) may be inappropriate because unique structured formations may be unnecessarily discriminated against. Specifically, we note that a salt formation is a unique feature in the geologic setting and may be considered a resource. But the ubiquitous nature of salt does not make a particular small body of salt an important resource. We do not believe that the Commission's intent is to eliminate salt from consideration as a potential host rock, given its many particular advantages.

10 CFR 60.123(b)(9)

NRC Proposed Wording:

More frequent occurrence of earthquakes of higher magnitude than is typical of the area in which the geologic setting is located.

Recommended Revision:

Delete the section.

Rationale:

Whether there is "more frequent occurrence of earthquakes" is irrelevant; what matters is whether the frequency and/or intensity of earthquakes is at an acceptable level.

10 CFR 60.123(b)(14)

NRC Proposed Wording:

Groundwater conditions in the host rock, including but not limited to high ionic strength or ranges of Eh-pH, that could affect the solubility and chemical reactivity of the engineered systems.

Recommended Revision:

Change last clause to: "...that could increase the solubility of the radionuclides and chemical reactivity of the engineered system, thus increasing the rate of release and migration of radionuclides.

10 CFR 60.123(b)(14) (continued)

Rationale:

As written, the emphasis is on the engineered system. We suggest that the materials of concern are the radionuclides and that the section be reworded for clarity.

10 CFR 60.123(b)(15)

NRC Proposed Wording:

Processes that would reduce sorption, result in degradation of the rock strength, or adversely affect the performance of the engineered system.

Recommended Revision:

"...would reduce sorption of radionuclides, result in ..."

Rationale:

For clarity we suggest the insertion.

10 CFR 60.124(b)

NRC Proposed Wording:

The effect of the potentially adverse human activity or natural condition on the geologic setting has been adequately evaluated using conservative analyses and assumptions, and the evaluation used is sensitive to the adverse human activity or natural conditions; and ...

10 CFR 60.124(b) (continued)

Recommended Revision:

"The effect of the potentially adverse human activity or natural condition on the geologic setting has been adequately evaluated using realistic yet conservative analyses and assuming anticipated processes and events, and the evaluation used is sensitive to the adverse human activity or natural condition; and"

Rationale:

The term "conservative analyses and assumptions" could be construed to mean the speculative scenarios that have been used often in reactor siting. What is required in waste isolation is a realistic yet conservative analysis which assumes anticipated processes and events.

10 CFR 60.130(b)(1)(vi)

NRC Proposed Wording:

"A radiation alarm system to warn of increases in radiation levels,"

Recommended Revision:

"A radiation alarm system to warn of increases approaching a safety set point value below maximum permissible levels,"

Rationale:

Increases in very low levels need not be alarmed.

10 CFR 60.130(b)(1)(vi)

NRC Proposed Wording:

"The alarm system shall be designed with redundancy and in situ testing capability."

Recommended Revision:

"The alarm system shall be designed with high reliability and in situ testing capability."

Rationale:

Consistent with nuclear power plant practice, not all radiation alarms in the repository operations area need be redundant.

10 CFR 60.130(b)(2)(i)

NRC Proposed Wording:

"The structures, systems, and components ... shall be designed ... to accommodate the effects of environmental conditions so as to prevent interference with normal operation ... ."

Recommended Revision:

"The structures, ... to prevent interference with necessary safety functions during the entire period of construction and operation."

10 CFR 60.130(b)(2)(i) (continued)

Rationale:

The goal of the design of safety systems should be the maintenance of the safety of the facility, not normal operations. It would be unnecessary to design the facility to operate normally through a tornado or an earthquake.

10 CFR 60.132 (d)(2)

NRC Proposed Wording:

"Ensure sufficient structural stability of openings and control of groundwater to permit the safe conduct of waste retrieval operations,"

Recommended Revision:

"Ensure ... groundwater to permit the safe conduct of waste emplacement operations. Structural support shall be provided, as required to ensure structural stability of the openings upon removal of any backfill material which may have been emplaced, or upon preparation of the unbackfilled storage rooms prior to retrieval and for the duration of retrieval operations in each module;"

Rationale:

The regulation should not arbitrarily preclude backfilling emplacement areas prior to decommissioning.

10 CFR 60.132(e)(3)(v)

NRC Proposed Wording:

"The ability to construct the underground facility as designed so that stability of the rock is enhanced."

Recommended Revision:

"The ability to construct the underground facility as designed so that the stability of the rock is not significantly reduced."

Rationale:

It is impossible to "enhance" the stability of the natural formation while driving tunnels through it.

10 CFR 60.132(g)(6)

NRC Proposed Wording:

"If linings are required, the contact between the lining and the rock surrounding subsurface excavations shall be designed so as to avoid the creation of any preferential pathway for groundwater or radionuclide migration."

Recommended Revision:

Change "avoid the" to "minimize the potential for".

10 CFR 60.132(g)(6) (continued)

Rationale:

It may be impossible in a practical sense to "avoid" the contact being a preferential pathway. At the time of decommissioning, isolation will be established by the sealing system covered in section 60.133.

10 CFR 60.132(h)(2)

NRC Proposed Wording:

"Permit continuous occupancy of all excavated areas during normal operations through the time of permanent closure;"

Recommended Revision:

"Permit continuous occupancy of all open and operationally active areas ... ;"

Rationale:

There is no obvious personnel or nuclear safety basis for this requirement. An emplacement room that has been filled can be sealed off from the repository by doors and the ventilation to that room dampered off with no safety consequences. This requirement would needlessly preclude backfilling of emplacement rooms prior to repository decommissioning and would also not allow for monitoring of backfilled areas as part of the performance confirmation program.

10 CFR 60.132(i)(2)

NRC Proposed Wording:

Barriers shall create a waste package environment which favorably controls chemical reactions affecting the performance of the waste package.

Recommended Revision:

Relocate to section 60.135 and revise to: "Backfill shall, to the extent possible, assist in creating a waste package environment ... ."

Rationale:

Barriers (backfill) alone can alter the chemical environment only to a degree, e.g., backfill cannot absorb all the oxygen that was introduced during the operational phase.

10 CFR 60.132(i)(3)

NRC Proposed Wording:

"Backfill placed in the underground facility shall be designed as a barrier.

(i) Backfill placed in the undergrond facility shall perform its functions assuming anticipated changes in the geologic setting.

(ii) Backfill placed in the underground facility shall serve the following functions:

(a) It shall provide a barrier to groundwater movement into and from the underground facility,

10 CFR 60.132(i)(3) (continued)

(b) It shall reduce creep deformation of the host rock that may adversely affect (1) waste package performance or (2) the local hydrological system,

(c) It shall reduce and control groundwater movement within the underground facility,

(d) It shall retard radionuclide migration.

(iii) Backfill placed in the underground facility shall be selected to allow for adequate placement and compaction in underground openings."

Recommended Revisions:

Relocate to section 60.133 and revise as follows:

Backfill placed in the underground facility shall:

(i) Perform its functions assuming anticipated changes in the geologic setting

(ii) Serve one, or more, of the following functions as appropriate:

(a) Provide a barrier to groundwater movement into and from the underground facility,

(b) Reduce creep deformation of the host rock that may adversely affect (1) waste package performance or (2) the local hydrological system,

(c) Reduce and control groundwater movement within the underground facility,

(d) Retard radionuclide migration.

(iii) Be selected to allow for adequate placement in underground openings.

10 CFR 60.132(i)(3) (continued)

Rationale:

This is an excessive requirement. Requiring all backfill in the repository to serve all possible functions of backfill is probably not possible and is certainly not necessary. Backfill at each location in the repository will be selected to perform a specific set of design functions which is not necessarily the same as for backfill at some other location. Backfill that is part of the waste package may be designed to keep groundwater from reaching the canister, backfill in the emplacement rooms may be designed for support, and tunnel backfill may be designed to inhibit radionuclide migration. Backfill that is a "jack of all trades" will probably be a "master of none".

10 CFR 60.133(a)

NRC Proposed Wording:

"Shafts shall be designed so as not to create a preferential pathway for migration of groundwater and so as not to increase the potential for migration through existing pathways."

Recommended Revision:

"Shafts shall be designed to minimize to the extent practicable the potential to create a preferential pathway for groundwater or radionuclide migration or to increase migration through existing pathways."

Rationale:

Shafts will continuously be preferential pathways until they are sealed at decommissioning.

10 CFR 60.133(b)(1), (2), and (3)

NRC Proposed Wording:

(b) "Shaft and borehole seals. Shaft and borehole seals shall be designed so that:

(1) Shafts and boreholes will be sealed as soon as possible after they have served their operational purpose.

(2) At the time of permanent closure sealed shafts and boreholes will inhibit transport of radionuclides to at least the same degree as the undisturbed units of rock through which the shafts or boreholes pass. In the case of soluble rocks, the borehole and shaft seals shall also be designed to prevent groundwater circulation that would result in dissolution.

(3) Contact between shaft and borehole seals and the adjacent rock does not become a preferential pathway for water."

Recommended Revision:

Combine paragraphs (1), (2), and (3) into the following single paragraph:

At the time of permanent closure, shafts and access tunnel systems and boreholes will be sealed so that the seal material, the seal contact with the rock, and the adjacent rock do not become pathways that compromise the engineered system and the site's ability to meet the overall performance objectives.

Rationale:

The statement that shaft and borehole seals shall be designed so that at the time of permanent closure, sealed shafts and boreholes will

10 CFR 60.133(b)(1), (2), and (3) (continued)

inhibit transfer of radionuclides to at least the same degree as the undisturbed units of rock through which the shafts or boreholes pass, etc., creates a problem. It is inappropriate to specify performance criteria for shaft design and shaft and borehole seals by comparison with the undisturbed units of rock. As illustrated by the example in the Issue Commentary section of this response, for a very good site with highly impermeable rock, it may be impossible to design seals to meet the specified criterion. Thus, a very good site might tend to be rejected from consideration.

Moreover, the requirement that the contact zone between the seal and the rock does not become a preferential pathway is probably impossible to meet. Further, how we might demonstrate compliance with such a requirement by normal engineering techniques is unknown. The goal of seal design is to reduce leakage through this preferential pathway to an acceptable level.

10 CFR 60.133(c)(5)

NRC Proposed Wording:

"Hoists important to safety shall be designed to include two independent indicators to indicate when waste packages are in place, grappled, and ready for transport."

Recommended Revision:

Delete

10 CFR 60.133(c)(5) (continued)

Rationale:

This requirement is a design specification rather than a performance requirement. This assumes a method of hoisting waste packages that may or may not be the method actually used. Also there may be "hoists important to safety" that will never handle waste packages.

10 CFR 60.134(e)

NRC Proposed Wording:

"Control of explosives. If explosives are used, the provisions of 30 CFR 57.6 (explosives) issued by ... shall be met ... ."

Recommended Revision:

Delete.

Rationale:

This paragraph is needlessly redundant to 60.130(b)(10).

10 CFR 60.134(f)

NRC Proposed Wording:

"Water control. The construction specifications shall provide that water encountered in excavations shall be removed to the surface and controlled in accordance with design requirements for radiation control and monitoring."

10 CFR 60.134(f) (continued)

Recommended Pevision:

Delete "for radiation control and monitoring,"

Rationale:

Prior to emplacement, there is no public health and safety reason for treating the water as if it were contaminated.

10 CFR 60.143(c)

NRC Proposed Wording:

The waste package monitoring program shall include laboratory experiments which focus on the internal condition of the waste packages. To the extent practical, the environment experienced by the emplaced waste packages within the repository during the waste package monitoring program shall be duplicated in the laboratory experiments.

Recommended Revision:

Either delete the section or replace the word "shall" with "may", in both locations.

Rationale:

We believe that requiring the performance of laboratory experiments in which field conditions are simulated at the same time that in situ testing is under way is unnecessary and technically ill-advised. We agree that on a site-specific or medium-specific basis, ongoing testing in laboratories may be desirable, but such testing could easily

10 CFR 60.143(c) (continued)

be initiated or continued if deemed needed at that time. To require such a testing program would unnecessarily restrict scientific judgment or engineering flexibility from the confirmatory program.

10 CFR 60.150(B)

NRC Proposed Wording:

Quality assurance is a multidisciplinary system of management controls which address safety, reliability, maintainability, performance, and other technical disciplines.

Recommended Revision:

"Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements."

Rationale:

We suggest using the wording above which comes directly from 10 CFR 50, Appendix B.

10 CFR 60.151

NRC Proposed Wording:

The quality assurance program applies to all systems, structures, and components important to safety and to activities which would prevent

10 CFR 60.151 (continued)

or mitigate events that could cause an undue risk to the health and safety of the public. These activities include: exploring, site selecting, designing, fabricating, purchasing, handling, shipping, storing, cleaning, erecting, installing, emplacing, inspecting, testing, operating, maintaining, monitoring, repairing, modifying, and decommissioning.

Recommended Revision:

"The quality assurance program applies to all systems, structures, and components important to safety and to those activities which would prevent or mitigate events that could cause an undue risk to the health and safety of the public. These activities include: site characterization, facility and equipment construction, facility operation (including performance confirmation), and decommissioning. Construction comprises all those activities that are required to build a repository."

Rationale:

All site characterization activities, not just exploring or site selecting, should be subject to quality assurance programs.

Suggest lumping all activities into four categories: (1) site characterization, (2) facility and equipment construction, (3) facility operation (including performance confirmation), and (4) decommissioning. This categorization would seem to be consistent with the wording in section 60.102[d]. Construction is an all-inclusive term which comprises equipment, materials, design, fabrication, examination, testing, inspection, and all those activities required to build a facility (Reference: ASME Code Section III, NCA-1100).

Also, suggest deletion of section 60.153 (see comments on section 60.153).

10 CFR 60.153

NRC Proposed Wording:

The quality assurance program shall include the program of tests, experiments and analyses essential to achieving adequate confidence that the emplaced wastes will remain isolated from the accessible environment.

Recommended Revision:

Delete section 60.153.

Rationale:

Performance confirmation is addressed in Subpart F of the proposed regulation and will be conducted during the repository's operational phase. It would be more appropriate to include performance confirmation in section 60.151 as one of those activities subject to quality assurance. This paragraph is redundant and should be deleted.