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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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MAY 07 1987

NOTE TO: Robert Johnson, Co-Chairman
Seth Coplan, Co-Chairman
SCP Review Planning Task Group

WM Record File 109.2

WM Project 1
Docket No.
PDR ✓
LPDR

FROM: Pauline Brooks Pauline Brooks

SUBJECT: PREPARATION FOR REVIEW OF DOE'S PERFORMANCE ALLOCATION IN THE SCPs

Distribution:
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The purpose of this note is to propose some generic criteria for reviewing the DOE's performance allocation in the SCPs. The proposed criteria are based on the following materials, which have been enclosed: (1) meeting summaries for the generic NRC/DOE meetings about performance allocation on April 17, 1985, September 26-27, 1985, and March 3-4, 1987, and (2) a draft Performance Allocation Guide provided by the DOE in pre-meeting materials for the March meeting, along with a summary of the issues hierarchy taken from "Issues Hierarchy for a Mined Geologic Disposal System" (OGR/B-10, September, 1986).

The review criteria that we might apply to performance allocation in the SCPs. should cover, at a minimum, the following basic questions:

1. Does the subsystem performance allocation meet the post-closure performance objectives set by Part 60?

2. Is the performance allocation complete in the sense that for each system element to be relied upon, a performance goal, an indicated level of confidence and rationales relating the performance goal to performance objectives and to the test program are provided?

   Is the basis for the desired confidence level provided - professional judgment, bounding analysis, statistical analysis? If the desired confidence is stated qualitatively, are the terms such as "high", "medium" and "low" defined?

3. Is the performance allocation complete and coherent in the sense that primary elements of the system that are being relied upon would cover the functions necessary to meet performance objectives?

   Are secondary barriers and reserve barriers identified? (See second page of Performance Allocation Guide) If systems that are specified as secondary or reserve systems were to be needed in a subsequent revised performance allocation, would completeness be preserved?

4. Do the performance goals make physical sense?

5. Does the performance allocation provide for sufficient redundancy in light of high uncertainties prior to site characterization?

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6. Are the parameter needs for the performance measures for which performance goals are selected completely identified in terms of completeness of the set of parameters, ranges of their values and indication of desired confidence?

   Is the basis for the desired confidence - sensitivity analysis, judgment, statistical analysis - described?

   Is the desired confidence in the parameters commensurate with the desired confidence in the performance measure?

Additional general questions relative to the test program as based on the performance allocation are as follows:

1. Has the need for testing for deleterious effects on primary elements in the performance allocation by system elements being held in reserve been included?

2. Does the test definition include the relationship between parameters needed and the properties to be measured?

3. Does the rationale for the test or sites of tests include the relationship of the test to the selected performance goals and confidence levels?

4. Does the confidence achievable for the measured properties lead to the required confidence level for the parameter?

If you have any questions or wish to discuss performance allocation, please contact me at X74797.

Enclosures:
As stated

cc: John Linehan
King Stablein
Paul Hildenbrand

SUMMARY OF
NRC/DOE MEETING
ON PERFORMANCE ALLOCATION

DATE/LOCATION OF MEETING:

April 17, 1985
Willste Building, Rm. 106
Silver Spring, MD

ATTENDEES/ORGANIZATIONAL AFFILIATION:

A list of attendees is attached as Enclosure 1.

BACKGROUND/FACTS:

A copy of the agenda is attached as Enclosure 2. Prior to the meeting DOE provided a copy of the issue paper attached as Enclosure 3 to serve as a basis for discussion.

The meeting started with a DOE presentation summarizing the issue paper (Enclosure 4) and a presentation by NRC summarizing the reasons for its position regarding performance allocation and its concerns with the points made in the issue paper (Enclosure 5).

OBSERVATION/AGREEMENTS/OPEN ITEMS:

1. Approach for Assigning Performance Goals

There was agreement that the NRC logic diagram for assigning performance goals presented in Enclosure 5 and the DOE approach for assigning performance goals presented in Enclosure 4 are quite similar. It was further agreed that a working session should be convened to reach closure on a common logic diagram and set of terms. DOE will generate a strawman version by May 15, 1985 at which time a meeting date will be arranged.

2. Performance Goals for Preclosure

NRC disagreed with the position taken by DOE in Enclosure 3. NRC considered the position to be inconsistent with the need for system analyses needed to establish a safety classification system (Q-lists).

There was agreement that this subject will be deferred to later discussions between the agencies on the development of Q-lists for the site characterization plans. Charles Head (DOE) will work with James Kennedy (NRC) to establish a schedule within 30 days.

3. Level of Allocation of Performance Goals to the Repository/Waste Package Design.

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There was agreement that the level of allocation of performance goals to the repository/waste package design presented by DOE in Enclosure 4 is acceptable to both agencies. It was also agreed that tentative performance goals would be specified for those components in the SCP's.

4. Allocation of Performance to Site Characteristics

There was agreement that tentative goals for the performance of the site should be specified in the SCPs. It is recognized that these tentative goals will only be set for those site characteristics for which credit for performance will be taken by DOE. There was further agreement that these goals should be established conservatively (i.e. underestimating the performance of the site) and that the goals can be redefined as site characterization proceeds with an appropriate accompanying re-allocation of performance to other site parameters and components. It is recognized that this approach will not be used to bypass the multiple barrier concept.

It was agreed that an approach using appropriate analyses to define the relative importance of site parameters and prioritize the testing program toward the most important site parameters is appropriate.

5. Stages in SCP Process for Assignment/Revision of Performance Goals

There was agreement that DOE will discuss tentative performance goals in advance of the SCPs at technical workshops. DOE will discuss any revisions made after submittal of the SCP in technical meetings and will document these in semiannual progress reports on the Site Characterization Plans, and the license application design. DOE expects to complete its final performance allocation prior to submittal of the license application.

6. Specification of Confidence

NRC considers that as part of the statement of a performance goal, DOE should also state the desired level of confidence at which the goal would be achieved. NRC considered such a statement to be needed to establish the relative importance of a system component and is therefore needed to evaluate the test plans that DOE will present in its SCPs. NRC recognizes that there may be situations in which quantification of confidence may be impractical and in those instances would want to see a qualitative statement.

DOE believes that when sufficient site characterization, design and testing data have been developed and appropriate performance analyses have been conducted, the reliabilities in achieving the performance goals will be stated. DOE believes that it will not have sufficient data or models to defensibly attach reliability values or confidence levels to long term performance goals in the SCP. However, DOE will provide plans where appropriate, for establishing the level of reliability or confidence levels in the SCP. Further, DOE believes that the use of the terms reliability and confidence are not being used consistently and need to be rigorously defined and agreed upon.

DOE believes however, that it might be able to set tentative confidence levels (as mathematically defined) in the SCP for short term test goals. These may be expressed either as single values or as a range of values. Such confidence levels could be set only for tests that can be readily repeated. Therefore, large-scale tests would be excluded in most cases. For example, if a tentative design goal on corrosion rate is to keep the corrosion rate to less than .01 mm/yr a tentative confidence level of x% that the rate would not be exceeded could be pre-set. In terms of site characteristics, the following serves as an example: if a tentative lower bound for a Kd is set at 10, a tentative confidence level of x% that the Kd would be exceeded could be preset.

DOE considers that if, after gathering sufficient data, it is found that the target goal could not be achieved then consideration would be given to the revision of target goals, confidence goals, model refinement, recommending changes, switching credit to a different component or site characteristics or additional testing.

NRC and DOE agree that further dialogue is needed to establish a mutual understanding of what is an appropriate way to specify confidence with a performance goal, and when such specification will be made. Definitions of "confidence" and "reliability" will be included in the strawman that DOE will prepare under Item 1 above.

7. Transfer of Codes

DOE will identify to the NRC as early as practical, those codes or models that will be used to allocate performance in the SCPs. DOE will arrange if possible, to tranfer these codes to the NRC prior to issuance of the SCP.

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SUMMARY OF
NRC/DOE MEETING
ON
SUBSYSTEM PERFORMANCE ALLOCATION

DATE/LOCATION OF MEETING:

September 26-27, 1985
Willste Building, Rm. 106
Silver Spring, MD.

ATTENDEES/ORGANIZATIONAL AFFILIATION:

A list of attendees is attached as Enclosure 1.

BACKGROUND/FACTS:

The meeting was held to resolve follow-up items from an April 17, 1985 meeting on the same subject. A copy of the agenda is attached as Enclosure 2. Prior to the meeting NRC provided DOE with a copy of the talking paper attached as Enclosure 3 to serve as the basis for discussion.

The meeting started with a presentation (Enclosure 4) by NRC which summarized the examples provided in the talking paper. DOE presented its response (Enclosure 5). The DOE presentation included new viewgraphs mixed with some viewgraphs used by DOE during the April 17 meeting. During the meeting, this led to some confusion over what are DOE's current positions on certain key points. Accordingly, DOE marked up Enclosure 5 to distinguish the new viewgraphs from the older ones.

Subsequent discussion led to the observations, agreements, and open items stated below. State and Tribal representatives were present and participated throughout the meeting.

OBSERVATIONS/AGREEMENTS/OPEN ITEMS:

1. DOE and NRC agree that performance goals are not to be construed as performance criteria.

2. DOE and NRC agree that the initial performance goals and confidence levels are subject to change, indeed they are likely to change as more information is gathered throughout site characterization.

3. DOE and NRC agree that the initial estimates of performance goals and confidence levels, because of insufficient data, may be somewhat arbitrary; however, DOE will use its best efforts to establish these initial estimates based on sound technical/management judgment. The bases for goals and confidence levels, including relationships with overall system goals and with test programs, will be given. In both the initial allocation and in

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subsequent revisions, DOE will make every effort to quantify performance goals; however, the bases for numerical goals, when given, will involve both quantitative analysis and qualitative analysis based on technical judgments. Both performance goals and confidence level targets will be stated as precisely as practicable.

4. DOE and NRC agree that performance goals will be set for each performance measure to guide the testing program and that these goals will be presented in the SCP. The goals will consist of specified values for the performance measure and an indication of the desired level of confidence in this specified value. These indications of the level of confidence will be a specified numerical value where possible and appropriate; a range of values; or, as a fall-back, a qualitative statement (e.g., "high," "medium," or "low", where these terms are specifically defined).

5. DOE agrees with NRC that the rationale for every test or suite of tests will be provided in the SCP and that this rationale, where the tests relate to resolution of performance issues, will include the relationship of the tests to the set performance goals and confidence levels.

6. NRC and DOE both recognize that in the simple performance allocation example presented by DOE, the confidence levels developed by analyses may not be single values, but a range of values reflecting the uncertainties in the conceptual models and the existing data. Any confidence levels chosen on the basis of such calculations will necessarily involve technical judgments regarding the uncertainties in the analyses. The example does serve to illustrate an approach to carrying out the agreements of points 4 and 5 above.

7. DOE agrees that the NRC definitions of reliability taken from NUREG-0960, Vol. 1, page 9-5 and confidence level (attached in Enclosure 4) will be adopted for use in the development of the Site Characterization Plans.

8. DOE recognizes that the site characterization program logic diagram in NUREG-0960 as modified in Enclosure 4 will be used by the NRC in its review of the DOE site characterization plans; however, it was agreed that the step labeled "establish component requirements" would be replaced by "set performance goals" as given in Enclosure 6. DOE agrees with these steps as modified and the logic sequence in this schematic. Although the logic diagrams that will appear in the site characterization plans will be more detailed, they will be consistent with the NRC schematic.

9. NRC and DOE agree that prior to issuance of the SCPs, DOE staff will discuss tentative performance goals and confidence levels with NRC staff in the appropriate project-specific technical meetings (e.g., groundwater travel time in the hydrology meetings for each project). Also, performance allocation meetings will be held with each project prior to

SCP issuance to discuss the overall project specific performance allocations.

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SUMMARY OF THE NRC/DOE MEETING ON SCP

ISSUES HIERARCHY/PERFORMANCE ALLOCATION

Date and Location of Meeting:

March 3-4, 1987
Room 6E-069
Forrestal Building
Washington, D.C.

List of Attendees:

See Attachment 1

Background and Summary:

The purpose of the meeting was for DOE to brief and solicit comments from the NRC, States and Tribes on their Generic Issues Hierarchy and Issue Resolution Strategy, including a description of the approach being used for performance allocation. By familiarizing the NRC, States and Tribes with the framework being used to organize, plan and conduct site characterization, DOE hopes to facilitate the understanding, review, and comment on the SCP when they become available. The DOE's approach to Generic Issues Hierarchy/Performance Allocation was described in advance materials provided by the DOE by letter dated February 13, 1987. (Attachment 2).

DOE and NRC made brief introductory remarks regarding the purpose and scope of the meeting. The NRC staff's opening remarks are provided as Attachment 3. Following the opening remarks, DOE provided its briefing (Attachment 4). Representatives from the States of Mississippi and Utah and from the Yakima Indian Tribe and CERT, representing the Nez Perce and Umatillas also participated in discussions on selected topics. The NRC staff presented and discussed their clarifying points on the advanced materials and the briefing. The more significant points raised by the NRC staff were:

1. The NRC commented to DOE on the lack of QA as an issue in their issues hierarchy. DOE responded that the issues hierarchy was based on Subpart E of 10 CFR 60, which does not contain the Part 60 QA Requirements. DOE stated that QA will be presented in Chapter 8.6 of the SCP.

2. The NRC commented that the hydrologic assumptions underlying the chart on page 46 of DOE's briefing package were too optimistic. The DOE stated that the chart, presented as an example, was only a small slice of what was being considered and that it was still under internal review.

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3. The NRC raised the issue of whether the Issue Resolution Strategy allowed for changes to the test programs in an iterative manner based on a comparison of test results to performance issues. The DOE stated that the Issue Resolution Strategy intends for such comparisons.

4. The NRC questioned how DOE was dealing with scenarios in its development of issue strategies. DOE indicated that this will be addressed under all the performance issues especially Issue 1.1.

5. NRC questioned how or where DOE was developing integrated testing programs that would not only focus on identified issues and information needs, but also a basic understanding of site and identification of unexpected findings and detrimental factors. DOE indicated this was covered in other sections of the SCP.

6. NRC questioned why there were no earth science Characterization issues under Issue 2. DOE indicated that these characterization needs for Issue 2 would be included in the Characterization Issues under Issue 1 and 4.

The NRC will follow-up on how these points are implemented in up coming pre-SCP meetings.

NRC Staff Observations:

The NRC staff had the following observation:

Based on its review of DOE's advance material and the additional information provided during the briefing, the NRC staff identified no fatal flaws in the Generic Issue Hierarchy, Issue Resolution Strategy and Performance Allocation at the broad level contained in those materials. The staff will need to see the specific implementation particularly with respect to the points raised above at the site level. Points of clarification, in addition to those discussed during the briefing, may be forthcoming upon re-review of the DOE materials in light of this briefing.

DOE-NRC Agreements and Action Items:

The DOE and NRC made the following agreements:

1. DOE reaffirmed its agreement from the September 26-27, 1985, Subsystems Performance Allocation Meeting to discuss tentative performance goals and confidence levels with the NRC staff in the appropriate project-specific technical meetings (e.g., groundwater travel time in the hydrology meeting for each project).

2. The DOE agreed to provide the Generic Issues Hierarchy briefing to each of the NRC project teams. States and Tribes will also be invited to participate.

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Attachments (4)

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Performance Allocation Guide

Introduction

The NRC and the DOE have agreed to carry out a process called "performance allocation" as a method for guiding the testing programs at potential repository sites. Because the written agreement describes the process only in general terms, the DOE has translated that agreement into specific procedures that each repository project can follow.

The Performance Allocation Process

In general, the performance allocation process includes the following steps which will be described in more detail later in the text:

- Describe the system and the conceptual models that are being considered for the resolution of the issue.
- Identify those system elements that will be relied upon to resolve the issue. Both primary barriers and "barriers held in reserve" should be identified.
- Identify performance measures for these system elements.
- Specify goals for these performance measures which, in terms of the conceptual models being considered, are consistent with resolving the issue. The goals are expressed as a value and an associated level of confidence. The confidence level may be quantitative or may be qualitative (e.g. "high", "medium", or "low") as long as some quantitative indication of the meaning of these terms is given. If more than one conceptual model is being considered for a specific element or process, multiple sets of performance measures and goals may need to be specified.
- Parameters needed to evaluate the performance measures are identified. Goals for these parameters are set consistent with the goals for the performance measures. Again, the goal is expressed as a value and an associated level of confidence needed for that value. Where possible, the existing level of confidence should also be provided.

The strategy that results from the performance and parameter goals is used to guide the testing program. As information is acquired from the tests and analyses, it can be used in system performance assessments to compare with the overlying performance and design issues. These comparisons may suggest that additional testing may be needed. In this case the performance allocation process will be reapplied and a new strategy developed with a new set of performance and parameter goals.

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For example, the performance allocation for a repository system will specify the following: For each of the performance and design issues from the OGR issues hierarchy

a. The systems (i.e., the barriers, subsystems and components, or elements) that the project expects to rely on.
b. Any systems that the project expects to use as secondary or redundant systems or to hold in reserve.
c. A level of performance (a "performance goals") that the project expects to achieve for each system.
d. A level of confidence that the project expects to achieve for each performance goal.

The performance goals need to be set only for the systems that a project expects to use in licensing; they need not be set for any potential systems that the project does not intend to use in showing that the performance or design issue can be resolved. In assigning goals it is important to keep in mind that the DOE will be permitted to change the goals without permission from other agencies. They are not criteria that must be met for licensing. It is expected, however, that changes will be discussed with the NRC and noted in the 6 month SCP progress reports.

The levels of confidence called for in the above list expresses, generally speaking, a quantitative assessment of how well the associated performance goals need to be met. It may be a statistically meaningful confidence level or confidence interval; it should, in fact, be statistically meaningful whenever such an indication is feasible. More often, however, it will not be statistically rigorous, and it will not even be stated in terms of statistical parameters. When no rigorous or semiquantitative statement is possible, it may be set by expert judgment. It may be stated as "high", "medium", or "low" provided that some effort is made to explain (quantitative indication) what these terms mean.

The approach to be used for performance allocation consists of a series of steps. As explained in this guidance, six steps are needed to provide the required information to produce a performance allocation for performance and design issues. The text below discusses these steps with respect to the postclosure performance objectives.

Steps of Performance Allocation for Postclosure Performance Objectives

This section explains, in sequence, the steps that produce a performance allocation for the four postclosure performance objectives. A simple way to visualize these steps is Table 1, which lists the steps as the headings of six columns. The performance-allocation process may be thought of as simply filling in the six columns.

Step 1: Performance objectives

In this column of the performance-allocation chart the four performance objectives are listed. For simplicity in the rest of this guidance these objectives are called

1. Containment time.
2. Release rate from EBS.
3. Ground-water travel time.
4. EPA standards.

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It is important to realize that objective 4 will contain three subobjectives covering the requirements for ground-water protection, individual protection, and releases to the accessible environment.

Step 2: System elements

In this step, for each performance objective listed in step 1, the barriers--the subsystems and components, or "system elements"--that are available to be relied on for meeting the performance objective are listed. These elements are taken from the complete list that the project's system-requirements document presents as a hierarchical framework. The containment-time objective will be met by relying on the elements within the waste package; the release-rate objective, by relying on those elements plus the other elements within the EBS boundary; the travel-time objective, by relying on the elements between the disturbed zone and the accessible environment; and the EPA-standards objective, by relying on elements in the entire postclosure waste-disposal system.

In step 2 no selections are made from these available elements. They are simply listed for selection in step 3.

Step 3: License approach

Step 3 defines the license approach for each performance objective: it consists of the decisions on the system elements and the processes that are expected to be used in showing compliance with the performance objectives. The license approach has three parts.

Part 1. For each performance objective, the subsystem and components that are expected to be relied on in licensing are listed. Some of these elements can be specified as redundant, or secondary barriers; or some of the elements can be specified as barriers to be held in reserve.

Part 2 For each of the elements selected in part 1, the functions that the element are expected to perform in meeting the performance objective are specified. All the processes that will occur in the element and that could be taken into account in deciding whether the element will satisfactorily perform the expected functions should be listed.

Part 3 From the processes specified in part 2, the processes that are expected to be relied on are selected.

The choices to be made in step 3 are highly important because they set up the remainder of performance allocation and of the overall licensing strategy. Although these choices can be changed as site characterization proceeds, they should be made as carefully as possible; they should reflect rigorous thinking about potential licensing strategy. If some of the available barriers can reasonably be omitted from the license approach, the testing program and the licensing strategy may be significantly simplified. But it would be unwise to omit, at this early stage, any barriers that are likely to be needed eventually; site characterization will not last so long that its testing program can be easily revised after it is well under way.

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For the EPA-standards performance objective, it is important that the choices reflect the systems not only for meeting the regulations under expected conditions, but also for meeting them under the unexpected, disruptive conditions that may occur in the future. Therefore, the analyst must think ahead to the scenario analysis that will be done as part of licensing. It will not, of course, be possible to do that analysis as part of performance allocation. But a prudent approach to step 3 will require decisions about what barriers are likely to be relied on for compliance under both expected and unexpected conditions.

At least one further criterion for choosing elements is important: the analyst must be careful not to omit any elements that could adversely affect the performance of a barrier. If it is decided not to include a barrier in the licensing approach, the omission must not mask a potential difficulty in meeting the performance objective.

The basis for making the choices in step 3 will probably be the studies reported in the environmental assessments and other bounding and sensitivity studies that the projects have already made. Additional studies will undoubtedly be necessary as revisions to the performance allocation are made, but the schedule for producing the first edition of the site characterization plans probably will not allow many new studies.

Step 4: Performance measures

With the completion of step 3, the licensing strategy part of performance allocation is in place, and the allocation can move toward assigning goals and levels of confidence. In step 4 the terms in which the performance goals will be expressed are chosen. In other words, "performance measures" are selected. This choice should be a physical quantity that indicates the level to which a function is performed. This physical quantity may be a measurable quantity or a dependent variable. Values for performance measures are not selected in step 4; they are discussed below as part of step 5.

Step 5: Performance goals and confidence

In step 5 a value for each performance measure selected in step 4 is selected. This value is the goal whose achievement is expected through the testing program and through analytic studies that use the results of testing. Additionally, the level of confidence for each performance measure goal is selected. The level of confidence is listed in quantitative terms, if possible, or in qualitative terms, if not.

In setting the goals, the analyst should also try to achieve a reasonable redundancy among the barriers it chose in step 3. The analyst should, however, limit the redundancy to what it thinks is necessary for showing reasonable assurance in the licensing process. Unnecessary redundancy increases the difficulty of getting a license, simply because it would require more testing and analysis than a properly designed licensing strategy would require.

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The goals should be as simple as possible, and they should be as simple to evaluate as possible. They should, for example, be chosen in such a way that a reasonable testing program can show whether they have been achieved. There is little usefulness in a goal that no test can measure with confidence, or in the time available for site characterization. Further consideration of whether the goals are reasonable will occur in a later step of performance allocation, when they are compared with the expectations for proposed tests, but step 5 is best done with some looking ahead to what real experiments can do.

The goals will probably be stated, at least in the early versions of performance allocation, in terms of bounds on performance measures. If X is a performance measure, for example, its goal is likely to be stated in a form like

X is greater than (some number)

where the "(some number)" is a value that the allocator thinks will contribute strongly to meeting the performance objective to which the performance measure is attached. One reason that bounding values are likely to be appropriate is that step 5, like step 3, will probably be based on available studies, which are largely bounding analyses. Another reason is that, in providing for unexpected disruptive events, at this early stage, little quantative detailed scenario studies have been completed; however, the analyst may be able to decide that a barrier will protect against particular potential disruptions if its performance is better than some conservatively chosen bound.

Deciding on a meaningful way to establish levels of confidence will require careful thinking. No single way will be appropriate for all the performance goals. The levels of confidence should be based on quantitative analysis if they exist, or as necessary qualitative analysis. They may simply reflect a consensus of professional judgment. They may be based on a conservative bounding analysis intended to ensure that the goals will satisfactorily demonstrate that the performance objectives will be met. Whenever it is possible to base the indications on statistical evaluations, well-defined confidence intervals or confidence levels and standard statistical parameters should be used.

A performance goal for a given barrier may take different forms depending on the confidence that the allocator desires to achieve for it. If, for example, the performance measure for a particular geohydrologic unit is travel time T, an analyst might choose to set goals and indications of confidence like the following:

T greater than 1,000 years with very high confidence.
T greater than 5,000 years with high confidence.
T greater than 10,000 years with medium confidence.

Such an allocation might be appropriate for relying primarily on ground-water travel for isolation during the first 5,000 years after closure and only partially on ground-water travel at later times.

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As mentioned in the introduction to this guidance, qualitative indications of confidence, like those used in this example, must be explained (using quantative forms if possible). Ground-water travel time, because it is a derived quantity rather than a directly measured quantity, will be difficult to associate with a statistically rigorous level of confidence. In this example, the analyst could choose to use as the indication of confidence the times associated with different percentiles on a cumulative frequency distribution of travel times. For example, the analyst might choose to associate the term "very high confidence" with the 5th percentile of the distribution—to require, in other words, that 95 percent of the ground-water travel times be greater than 1000 years. It might associate "high confidence" with the 20th percentile and "medium confidence" with the 50th percentile. In making such a choice, the analyst will not, of course, be using the word "confidence" in the sense that standard statistical textbooks use it. But allocations like these can serve to communicate the project's intentions about the importance of ground-water travel time to the NRC and, in later steps of performance allocation, to the testers who will measure it.

Table 1 shows, in the column for step 5, separate columns for the two products of the step: a statement of a goal for each performance measure listed in step 4 and a statement of desired confidence (labeled "C_D") for each goal.

Step 6: Parameter needs

Most of the performance measures treated in steps 4 and 5 will not be directly measurable quantities. They can be expressed by an expression like

$$\text{Performance measure} = f(P_1, P_2, \ldots, P_n)$$

where the P_i are parameters. In step 6 the analyst translates each performance measure into the parameters on which it depends. To do so, the analyst lists two things: the physical parameters, possibly including the ranges that it expects those parameters to take, and an indication of the level of confidence with which each parameter must be known. Table 1 shows, in the column for step 6, a separate column for these two items. Any listed ranges must be chosen in such a way that they will produce a satisfactory value for the performance measure—a value that meets the goal established in step 5. The levels of confidence must be chosen so that meeting them will produce the confidence desired for the performance goal. The choice of ranges and indications of confidence may be based on professional judgment, sensitivity analyses, or statistical analyses.

Difficulties in Implementing the Performance Allocation Process

It is admittedly difficult to apply the performance allocation approach to the development of the site characterization program in the face of the large uncertainties that presently exist regarding conceptual models for system elements and processes. Nevertheless, the Department of Energy is committed to providing the rationale for its site characterization program in terms of the performance and parameter goals described above and the logical linkages among them. Therefore, it is important to address and resolve the difficulties in an appropriate and timely way.

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One difficulty is the lack of clear evidence to define all the conceptual models that might be needed for some step in the performance allocation. However, there is an urgent need to focus the testing program on those elements of the system that may be important in resolving the issues. In this case the relationships between the elements and the performance and design issues must be considered and these relationships are generally adequate for the respective allocations. It is believed that it will be possible to resolve all issues without relying on every favorable feature of the sites, but by focusing on only those few favorable characteristics for which preliminary conceptual models have already been developed.

It is believed that these preliminary models provide a basis for the characterization program and, as long as the studies include efforts to validate or improve the conceptual models, it is believed that the performance allocation approach will be useful. In some areas conceptual models are indeed too primitive to be helpful and only subjective judgment can be used to set the goals, but it is believed that for the most part the goals can be set on the basis of some conceptual models. It is recommended that wherever practical to do so, the performance allocation should rely upon the models described and utilized in the Environmental Assessment reports. The descriptions of these models, including the underlying assumptions, to the extent they are considered to still be applicable can simply be referenced in the SCP, reducing the burden of the first required step in the performance allocation process.

A second and related difficulty is the concern of premature commitment to conceptual models. There is concern, for example, that the goals may become criteria for the program that DOE must meet to select a site, obtain construction authorization, or emplace waste. This concern is legitimate. There has been a tendency on the part of parties both inside and outside the program to look at goals set as somehow binding. It must be constantly stressed that the purpose of the performance goals is purely to help formulate the testing program and that results of characterization need only be compared with the true criteria such as the performance objectives of 10 CFR 60. In particular, logic diagrams for the site characterization program should only mention performance goals in the context of development of plans for site characterization; any comparisons of test results or analyses should always be made with true criteria such as the performance objections of 10 CFR 60, never with the performance goals.

Furthermore, there is concern that commitment to a particular conceptual model may result in a characterization program that overlooks some aspect of the system, particularly those portions of the system for which a clear relationship to performance or design issues cannot presently be established. Again, this is a valid concern. There is a need to insure that potentially important areas are not overlooked. However, experience has shown that when a particular area is proposed for testing and analysis, it is possible to do the performance allocations. That is, if a particular variable is thought to be important enough to be considered in the testing program, a relationship

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between this variable and the various performance or design issues already tacitly exists and this relationship, however ambiguous, can be used to set goals. It goes without saying that variables that do not impact performance or design issues should not play a critical role in the testing program and should have low priority in the SCP.

A third difficulty is the specification of quantitative goals where in many cases quantitative methods are even less well defined than the conceptual models. This too is a valid concern. It is clear that specific values for a performance measure obtained from the characterization program will have a direct impact on the decisions and the demonstration in the future. However, experience has shown that the testing program itself is not particularly sensitive to the specific goals. While there may be some dependence, different allocations performed for the same system usually result in testing programs which are not significantly different. Therefore, while care must be chosen in specifying the values used for criteria, the values for goals would not have as strong an impact. Furthermore, in the development of studies, the program must have some idea of needed parameter values in order to orient the testing program. Prudence should dictate that the setting of numerical goals for parameters would take into account this need.

An associated problem is the specification of a needed confidence level in the performance goal value. This step in the performance allocation process is needed because there is large uncertainty in the parameters of the system due to heterogeneity in the system, incomplete knowledge, measurement inaccuracy, and other factors. It simply is not meaningful to set a goal in terms of a single point value for a parameter without regard for this uncertainty. Whenever possible, the existing confidence level for the parameter value should be specified. If the existing confidence in that value is higher than the needed confidence, then there may be few requirements on the testing program; while, if the needed confidence is higher than the existing confidence, there may be greater demands on the characterization program. Thus, the confidence levels play an extremely important role in prioritizing the testing and analysis activities in this program.

Likewise, it is important to realize that the notions of what factors contribute to the uncertainty and the confidence level will influence the testing program. If the uncertainty is due to heterogeneity, then a certain kind of testing program is dictated; if the uncertainties are associated with the conceptual model itself, then the characterization program will have to address these in a particular way. While this presents difficulties for the development of the characterization program, the performance allocation process is not the source of these difficulties. On the contrary, performance allocation is an orderly way to present the case to address this difficulty.

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TABLE-1

PARTS OF LICENSING STRATEGY	PERFORMANCE ALLOCATION				
STEP 1 Regulations: Postclosure Performance Objectives	STEP 2 System Elements	STEP 3 License Approach	STEP 4 Performance Measures	STEP 5 Performance Goals and Confidence	STEP 6 Parameter Needs for each performance goal
				Goal C_D	Parameter C_D Goal
1. Containment Time					
2. Release Rates					
3. Groundwater Travel Time					
4. Releases to Accessible Environment					

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3. ISSUES HIERARCHY

KEY ISSUE 1: Will the mined geologic disposal system at [site name] isolate the radioactive waste from the accessible environment after closure in accordance with the requirements set forth in 40 CFR Part 191, 10 CFR Part 60, and 10 CFR Part 960?

PERFORMANCE ISSUES

ISSUE 1.1: Will the mined geologic disposal system meet the system performance objective for limiting radionuclide releases to the accessible environment as required by 10 CFR 60.112 and 40 CFR 191.13?

ISSUE 1.2: Will the mined geologic disposal system meet the requirements for limiting individual doses in the accessible environment as required by 40 CFR 191.15?

ISSUE 1.3: Will the mined geologic disposal system meet the requirements for the protection of special sources of ground water as required by 40 CFR 191.16?

ISSUE 1.4: Will the waste package meet the performance objective for containment as required by 10 CFR 60.113?

ISSUE 1.5: Will the waste package and repository engineered barrier systems meet the performance objective for radionuclide release rates as required by 10 CFR 60.113?

ISSUE 1.6: Will the site meet the performance objective for pre-waste-emplacement ground-water travel time as required by 10 CFR 60.113?

ISSUE 1.7: Will the performance-confirmation program meet the requirements of 10 CFR 60.137?

ISSUE 1.8: Can the demonstrations for favorable and potentially adverse conditions be made as required by 10 CFR 60.122?

ISSUE 1.9: (a) Can the higher-level findings required by 10 CFR Part 960 be made for the qualifying condition of the postclosure system guideline and the disqualifying and qualifying conditions of the technical guidelines for geohydrology, geochemistry, rock characteristics, climate changes, erosion, dissolution, tectonics, and human interference; and (b) can the comparative evaluations required by 10 CFR 960.3-1-5 be made?

KEY ISSUE 2: Will the projected releases of radioactive materials to restricted and unrestricted areas and the resulting radiation exposures of the general public and workers during repository operation, closure and decommissioning at [site name], meet applicable safety requirements set forth in 10 CFR Part 20, 10 CFR Part 60, 10 CFR Part 960, and 40 CFR Part 191?

PERFORMANCE ISSUES

ISSUE 2.1: During repository operation, closure, and decommissioning (a) will the expected average radiation dose received by members of the public within any highly populated area be less than a small fraction of the allowable limits and (b) will the expected radiation dose received by any member of the public in an unrestricted area be less than the allowable limits as required by 10 CFR 60.111, 40 CFR 191 Part A, and 10 CFR Part 20?

ISSUE 2.2: Can the repository be designed, constructed, operated, closed, and decommissioned in a manner that ensures the radiological safety of workers under normal operations as required by 10 CFR 60.111 and CFR Part 20?

ISSUE 2.3: Can the repository be designed, constructed, operated, closed, and decommissioned in such a way that credible accidents do not result in projected radiological exposures of the general public at the nearest boundary of the unrestricted area, or workers in the restricted area, in excess of applicable limiting values?

ISSUE 2.4: Can the repository be designed, constructed, operated, closed, and decommissioned so that the option of waste retrieval will be preserved as required by 10 CFR 60.111?

ISSUE 2.5: Can the higher level findings required by 10 CFR Part 960 be made for the qualifying condition of the preclosure system guideline and the disqualifying and qualifying conditions of the technical guidelines for population density and distribution, site ownership and control, meteorology, and offsite installations and operations?

DESIGN ISSUES

ISSUE 2.6: Have the characteristics and configurations of the waste packages been adequately established to (a) show compliance with the preclosure design criteria of 10 CFR 60.135 and (b) provide information for the resolution of the performance issues?

ISSUE 2.7: Have the characteristics and configurations of the repository been adequately established to (a) show compliance with the preclosure design criteria of 10 CFR 60.130 through 60.133 and (b) provide information for the resolution of the performance issues?

KEY ISSUE 3: Can the mined geologic disposal system at [site name] be sited, constructed, operated, closed, and decommissioned, and can the associated transportation system be sited, constructed, and operated so that the quality of the environment will be protected and waste-transportation operations can be conducted without causing unacceptable risks to public health or safety?

Note: The issues under Key Issue 3 will be identified after the EIS scoping hearings. The issues hierarchy will be amended at that time.