

IDENTIFICATION AND EVALUATION OF REGULATORY AND INSTITUTIONAL UNCERTAINTIES IN 10 CFR PART 60 VOLUME 1 — EVALUATION

Prepared for

**Nuclear Regulatory Commission
Contract NRC-02-88-005**

Prepared by

**Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas**

February 1990

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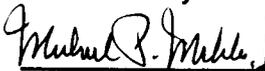
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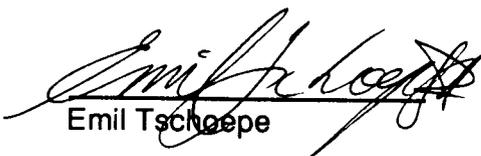
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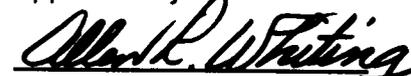
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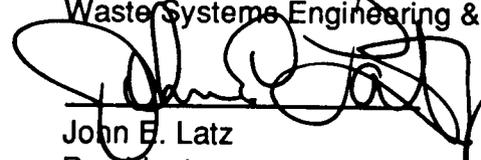
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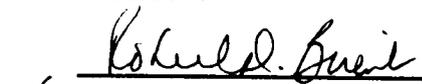

for Bruce Mabrito, Director
Quality Assurance

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IDENTIFICATION AND EVALUATION OF
REGULATORY AND INSTITUTIONAL UNCERTAINTIES IN 10 CFR PART 60

1. EXECUTIVE SUMMARY

1.1 BACKGROUND

In SECY-88-285 (Ref. 1), the Commission was advised of a general strategy for identifying and resolving Regulatory, Institutional, and Technical Uncertainties in 10 CFR Part 60. In addition, SECY-88-285 related the Regulatory Uncertainties developed by the Program Architecture (an integrated systems analysis of the statutory and regulatory framework for the high level waste program) to the NRC's ongoing and proposed rulemakings and technical positions. SECY-89-339 (Ref. 2) briefed the Commission on the general groups of Uncertainties which had been developed from the Program Architecture analysis of Subparts B and E of 10 CFR Part 60, and recommended to the Commission a broad-scale approach for addressing those Uncertainties. SECY-89-339 responded as well to the Commission's request for an explanation of the Regulatory Requirement related to each Uncertainty (COMJC-89-2, Ref. 3).

1.2 PURPOSE OF THE REPORT

The present document completes, with the exception of evaluation of regulatory sufficiency, the identification and classification of the Regulatory and Institutional Uncertainties developed by the Program Architecture analysis of 10 CFR Part 60. CNWRA 89-003, "Analysis and Evaluation of Regulatory Uncertainties in 10 CFR 60 Subparts B and E" (Ref. 4 completed in February 1989) is the predecessor to the present report, although its scope was narrower. However, the parallelism between CNWRA 89-003 and the present report does not extend beyond grouping of the Uncertainties. The present report groups the identified Uncertainties, categorizes them, and correlates them with ongoing and planned rulemakings and technical positions, but goes no further in their analysis. Section 3.3 of the report presents and discusses the entire process for addressing Regulatory and Institutional Uncertainties. This report includes only the first stage of that process, and does not prioritize the Uncertainties in any way, even to the extent of identifying those that may be intended to provide flexibility in the Regulation, and does not suggest the application of any Uncertainty Reduction Method.

The purpose of this report is to provide the Nuclear Regulatory Commission (NRC) staff with an information base useful for documenting and revising a regulatory strategy. The Program Architecture process developed by the Center for Nuclear Waste Regulatory Analyses (CNWRA) was used to independently analyze 10 CFR Part 60, and to identify the Regulatory Requirements and the Regulatory and Institutional Uncertainties therein.

After analysis, the Regulatory and Institutional Uncertainties in 10 CFR Part 60 are described and classified in two ways: in groups by regulatory topic (as was done in CNWRA 89-003) and in categories related to the general means or action which can be used to reduce the Uncertainty. The groups are those from CNWRA 89-003, with several additions. These classifications can form the basis for further analysis of the Uncertainties.

1.3 SYSTEMATIC ANALYSIS OF 10 CFR PART 60

10 CFR Part 60, including sections of other regulations which are incorporated by reference, was systematically analyzed by the Program Architecture method. In addition, regulations of other agencies dealing with high-level radioactive waste, analogous non-high-level waste NRC regulations, and enabling statutes were included in the analytical base during the analysis of Part 60.

1.3.1 IDENTIFICATION OF REGULATORY AND INSTITUTIONAL UNCERTAINTIES

Systematic analysis resulted in the identification of nearly 100 candidate Regulatory Requirements. Regulatory and Institutional Uncertainties resident in those Requirements were identified using the definitions in Reference 5, which are given in Section 3.2 of Volume 1 and Appendix A of Volume 2 of this report. A description of each Uncertainty is presented in Appendix B of this report. It should be noted that these descriptions state the Uncertainty positively, in accord with the NRC-approved Technical Operating Procedure (TOP).

As noted in Section 3.2, a Regulatory Uncertainty exists "...when there is lack of clarity in the quoted statement, when an essential requirement has been omitted, or when requirements which either detract from the regulatory program or do not contribute to the regulatory program are included in the regulation." This definition, together with the definition of Institutional Uncertainties, allows Uncertainties to be categorized so as to screen out Uncertainties which may result from language used to retain regulatory flexibility and assist the selection and implementation of Uncertainty reduction methods, if NRC wishes to reduce the Uncertainty. Categorization does not imply necessity or importance of uncertainty reduction, nor does it attempt to select a particular method.

1.3.2 THE PROCESS FOR ADDRESSING UNCERTAINTIES

As has been pointed out, there are three classes of potential Uncertainties: Regulatory, Institutional, and Technical. The classification and the identification of Uncertainties by the CNWRA is discussed in detail in Appendix A of Volume 2. Each Regulatory and Institutional Uncertainty found in the CNWRA analysis of 10 CFR Part 60 will eventually be addressed in one or more stages of a three-stage process. The three stages are identification of the Uncertainty, characterization of the Uncertainty, and reduction of the Uncertainty (Fig. 2).

All of the three types of Uncertainties are identified by the method of Appendix A. They can then be classified or grouped in accordance with various criteria. Criteria for classification are: uncertainty type (Regulatory, Institutional or Technical); the subject matter of the Uncertainty (topical title of the Regulation); and delineation of the reason for identifying the Uncertainty.

This report is entirely concerned with the first stage of a three-stage process comprising:

1. Identification of Regulatory and Institutional Uncertainties.

2. Uncertainty Characterization: identifying and screening out from further analysis the Uncertainties which result from language intentionally used to provide regulatory flexibility, and classifying the remainder for prioritization. The process of characterization is not addressed in this report.

3. Reduction of Uncertainties by selection of an appropriate Uncertainty Reduction Method and implementation of that method. The process of uncertainty reduction is not addressed in this report.

1.4 RESULTS OF THE ANALYSIS

1.4.1 SUMMARY OF RESULTS

The previous report on the subject, CNWRA 89-003, identified a total of 50 discrete Uncertainties, of which 18 have been excluded on further analysis. During the present analysis, 79 discrete, unique Regulatory and Institutional Uncertainties were identified; these Uncertainties include those identified in CNWRA 89-003. Thirty-six of these Uncertainties were excluded from the Regulatory and Institutional categories, leaving a total of 43 discrete Regulatory and Institutional Uncertainties for further characterization and consideration of Uncertainty reduction.

The report recognizes that a number of the Regulatory and Institutional Uncertainties may be present in the Regulation by deliberate intent of the NRC, and require no action. Where reduction of an Uncertainty is desired, the reduction may apply to one or more Uncertainties. As a result, far fewer than 43 regulatory actions (rulemakings, technical positions, prelicensing consultations, etc.) may be needed to address the identified Uncertainties.

Prioritization by importance, timeliness of reduction, and/or durability of the Uncertainties also was not part of this task, and was not addressed. Thus, no time frame is suggested for Uncertainty reduction. Furthermore, NRC may choose not to act on some Uncertainties because of resource constraints or to maintain regulatory flexibility, and may also choose to reduce a particular Uncertainty during the licensing hearing or at some other time during the licensing process.

1.4.2 GROUPS OF UNCERTAINTIES

The Uncertainties have been organized into twelve groups by subject matter, which corresponds in general to Sections and Subsections of the regulations (Table 1). This grouping is similar to that used in CNWRA 89-003. As discussed in Section 3, reduction of the Uncertainties may be facilitated by formation of these groups. The groups, with brief descriptions of the Uncertainties included in each, are given in Table 1 (a complete description of each Uncertainty is given in Appendix B of Volume 2). The particular relationship of the Regulatory Requirements and Uncertainties which bear on assessment of repository performance - Group I - is singled out for discussion in Section 1.4.3, below, because performance assessment is critical to compliance with 10 CFR Part 60.

The groups of Uncertainties identified are:

GROUP I: General Adequacy of Site Characterization

- GROUP II: Anticipated and Unanticipated Processes and Events
- GROUP III: Systems, Structures, and Components Important to Safety--Design Criteria and Design Bases
- GROUP IV: Engineered Barrier System Performance
- GROUP V: Radiological Safety Considerations
- GROUP VI: Retrievability Conditions
- GROUP VII: Conditions for Construction Authorization, License and License Amendment
- GROUP VIII: Regulation of Mining Safety and Nonradiological Safety Considerations
- GROUP IX: Conditions of Land Acquisition and Control
- GROUP X: Quality Assurance and Information Requirements
- GROUP XI: Compliance With the EPA Standard
- GROUP XII: Emergency Planning Criteria

1.4.3 THE RELATIONSHIP BETWEEN 10 CFR 60.112 AND 10 CFR 60.122

The Subsections of 10 CFR Part 60 which explicitly or implicitly address assessment of performance of the high-level waste repository (10 CFR 60.101, 10 CFR 60.112 and 10 CFR 60.113) exhibit a unique relationship to the subsection which addresses siting criteria (10 CFR 60.122). This relationship pervades the entire systematic analysis of these subsections, including consideration of Uncertainties. The relationship is also realized in that the repository must comply with both 10 CFR 60.112 and 10 CFR 60.122 in order to be potentially licensable, and is best understood by considering the relationship of the Regulatory Requirements first, followed by consideration of the relationship of the Uncertainties. Compliance with the Regulatory Requirements of 10 CFR 60.122 is in the context of compliance with the Performance Objectives of 10 CFR 60.112.

Regulatory Uncertainties have been identified in both 10 CFR 60.112 and 10 CFR 60.122. These Regulatory Uncertainties occur when either DOE or NRC does not know what (or how much) is needed to show that the site is in compliance with the Siting Criteria or Performance Objectives. They also occur in cases where either party does not know what is needed to support a finding of reasonable assurance that the repository will meet the Performance Objectives. The distinction between Group I, which comprises the Regulatory Uncertainties in the language of 10 CFR 60.122, and Group II, the Regulatory Uncertainties in 10 CFR 60.112, occurs because the Regulatory Requirements from which these Uncertainties arise are themselves separate. The Regulatory Uncertainties in 10 CFR 60.122 are ambiguities in the language which guides DOE's evaluation of the site and NRC's assessment of DOE's application of the Siting Criteria and require clarification separately from any Regulatory Uncertainties which may be present in 60.112.

Consideration was given to the alternative interpretation that the Regulatory Uncertainties in 10 CFR 60.122 do not exist independently of Regulatory Uncertainties in 10 CFR 60.112 (and 10 CFR 60.101) because the terms are defined sufficiently in the context of the licensing action; i.e., in a finding of reasonable assurance that the Performance Objectives have been met. However, this alternative interpretation was not adopted by the CNWRA in these analyses. Rather, it is suggested that Regulatory Uncertainties in 10 CFR 60.122 should be reduced appropriately before a finding of reasonable assurance can be made.

1.4.4 CATEGORIES OF UNCERTAINTIES

Seven unique, mutually exclusive categories of Uncertainties may be drawn from the definitions of Regulatory and Institutional Uncertainties. These categories may also provide guidance for addressing the various Uncertainties. Twenty-four Uncertainties are in Category 1 - need for clarification - more than in any other category (Table 3). Fifteen Uncertainties are in Category 2 - omission, and two each are in Category 3 - inconsistency and Category 7 - questions of agency jurisdiction, respectively. There were no Uncertainties in either Category 4 - lack of necessity or Category 6 - exceeds authority. Category 5 - insufficiency - was not analyzed in this study.

1.4.5 EXCLUDED UNCERTAINTIES

A number of Uncertainties have been excluded as Regulatory or Institutional Uncertainties since the submission of CNWRA 89-003 and the draft version of this report. The excluded Uncertainties, with a brief rationale for each exclusion, are given in Table 2. A few Uncertainties have been reduced by rulemakings or publication of other relevant materials since publication of CNWRA 89-003, such as the rulemaking for 10 CFR Part 51 and recent revisions in 10 CFR Part 72. Seven Uncertainties were reclassified as Technical Uncertainties. A detailed rationale for each exclusion is given for each excluded Uncertainty in Appendix B of Volume 2.

1.4.6 CORRELATION OF UNCERTAINTIES WITH ONGOING STAFF ACTIONS

CNWRA 89-003 listed Uncertainties which are part of ongoing or planned NRC rulemakings and technical positions. These categories are expanded in Tables 4 and 5 to include additional Uncertainties. One of the Uncertainties in CNWRA 89-003, 51-UN3, was reduced by the rulemaking on 10 CFR Part 51 (Ref. 7). Numbers for rulemakings in Tables 4 and 5 are taken from SECY-89-339.

The ongoing rulemakings should result in reduction of the Uncertainties. In practice, however, the language of the proposed rule needs careful scrutiny to assure both that the existing Uncertainty is reduced and that no new Uncertainty is created. Program Architecture analysis of the proposed rules can effectively respond to these questions as well as assist in the analysis of comments which the proposed rulemakings may generate.

Relationships between ongoing and planned technical positions and the Uncertainties in 10 CFR Part 60 reflect primarily the similarity of topics between technical positions and Uncertainties (Table 5). Effective reduction of the Uncertainty will depend on the precise language of the technical

position. Since these technical positions have not been finalized, it is feasible to introduce appropriate language.

1.5 SUGGESTIONS FOR FURTHER ACTIONS

The individual Uncertainties and groups of Uncertainties not listed in Tables 4 and 5 are not clearly addressed by the ongoing NRC technical positions or rulemakings given in SECY-89-339. In some cases, the topic of some Uncertainties appears to be related to the topic of a proposed technical position, but it is not evident that the technical position in question will reduce the Uncertainty. Other Uncertainties are not addressed at all in the planned rulemakings or technical positions. It is recommended that NRC further evaluate the existing regulatory program in the context of the Uncertainties identified in Table 6. In many cases, means other than rulemakings and technical positions may be used to effectively reduce the Uncertainty.

As noted above and in Section 4.2, evaluation of regulatory sufficiency remains to be completed. This must await completion of the repository system functional analysis.

It is further recommended that the Uncertainties enumerated herein be further evaluated as to importance, need for timely reduction, and durability of reduction. Such an evaluation can be readily performed using an attribute analysis technique (Ref. 4). Both the most appropriate Uncertainty reduction methods and the priorities for accomplishment of the Uncertainty reductions will flow directly from the attribute analysis, providing a documented defensible basis for an overall regulatory strategy.

1.6 ORGANIZATION OF THE REPORT

Volume 1, the Evaluation of Regulatory and Institutional Uncertainties in 10 CFR Part 60, is divided into five sections. Section 1.0 is the Executive Summary, Section 2.0 is the introduction and summarizes the background and scope of the report, Section 3.0 describes the methods of identification and classification of the Uncertainties briefly, Section 4.0 is a discussion of the results and conclusions of the evaluation, and Section 5.0 lists the references used.

Volume 2, the Identification of Regulatory and Institutional Uncertainties in 10 CFR Part 60, consists of three Appendices. Appendix A contains the relevant sections of the Technical Operating Procedure used to identify the Regulatory and Institutional Uncertainties, Appendix B contains the description of each Uncertainty, together with its rationale and appropriate references, and Appendix C includes tables of the groups and categories of the Uncertainties.

2. INTRODUCTION

In SECY-88-285 (Ref. 1), the Commission was advised of a general strategy for identifying and resolving Regulatory, Institutional, and Technical Uncertainties in 10 CFR Part 60 (the NRC regulation governing licensing of a high-level radioactive waste repository). In addition, SECY-88-285 related the Regulatory Uncertainties developed by the Program Architecture (an integrated systems analysis of the statutory and regulatory framework for the high level waste program) to the NRC's ongoing and proposed rulemakings and technical positions. SECY-89-339 (Ref. 2) briefed the Commission on the general groups of Uncertainties which had been developed from the Program Architecture analysis of Subparts B and E of 10 CFR Part 60, as well as those previously identified in SECY-88-285, and recommended to the Commission a broad-scale approach for addressing those Uncertainties. SECY-89-339 responded as well to the Commission's request for an explanation of the Regulatory Requirement related to each Uncertainty (COMJC-89-2, Ref. 3).

The present document completes, with the exception of evaluation of regulatory sufficiency, the identification and classification of the Regulatory and Institutional Uncertainties developed by the Program Architecture analysis of 10 CFR Part 60, and thus provides a more complete information base for a regulatory strategy. The list of Uncertainties incorporated in the two SECY papers was published in CNWRA 89-003 (Ref. 4).

CNWRA 89-003, "Analysis and Evaluation of Regulatory Uncertainties in 10 CFR 60 Subparts B and E" (Ref. 4 completed in February 1989) is the predecessor to the present report, although its scope was narrower. Approximately eighty Regulatory Uncertainties in Subparts B and E of 10 CFR Part 60 were identified in the report. The Uncertainties were combined into nine groups by topics, on the premise that a group of Uncertainties might be reduced by one or two generic reduction methods. These groups have been retained in the present report, and a few groups have been added to accommodate subjects not covered in Reference 4. However, further evaluation of the groups indicates that a single generic Uncertainty Reduction Method is unlikely to reduce the entire group in all cases.

The parallelism between CNWRA 89-003 and the present report does not extend beyond grouping of the Uncertainties. The present report groups the identified Uncertainties, further categorizes them, and correlates them with ongoing and planned rulemakings and technical positions, but goes no further in their analysis. Section 3.3 of this report presents and discusses the entire process for addressing Regulatory and Institutional Uncertainties. This report includes only the first stage of that process, and does not prioritize the Uncertainties in any way, even to the extent of identifying those that may be intended to provide flexibility in the Regulation, and does not suggest the application of any particular Uncertainty Reduction Method.

In CNWRA 89-003, the Uncertainties were analyzed by attributes. The relative importance, need for timely reduction, and durability of reduction were assessed by ranking the Uncertainties against 26 attributes, which expressed various criteria for importance, timeliness of uncertainty reduction, and need for a durable reduction. CNWRA 89-003 is not recapitulated in detail here. The type of attribute analysis performed in CNWRA 89-003 was not done for this report, but could be readily accomplished

as a follow-on activity to support decision-making regarding the timing and nature of Uncertainty reduction.

3. METHODS OF IDENTIFICATION AND ANALYSIS

3.1 SYSTEMATIC ANALYSIS OF 10 CFR PART 60

The process diagram for the regulatory analysis presented herein is shown in Figure 1. An abbreviated overview of the pertinent parts of the analysis technique follows. The analysis is fully described in Reference 5, pertinent sections of which are reproduced in Appendix A of Volume 2.

1. Regulatory Requirements (RRs) were identified, each of which consisted of one or more subsections of 10 CFR Part 60. The relevant Subsections were organized to constitute a coherent requirement for which DOE must demonstrate compliance, and for which NRC must determine compliance.

2. The Regulatory Elements of Proof (REOPs) were drawn from the regulation. The regulatory language which delineates each of the interrelated parts of the regulatory requirement, together with the logical relationships among those parts, is identified as the REOP structure for that RR.

3. Potential Regulatory and Institutional Uncertainties were then identified based on evaluations of the regulatory text of 10 CFR Part 60, regulations governing similar facilities (such as Parts 50 and 72, where appropriate), and the enabling legislation.

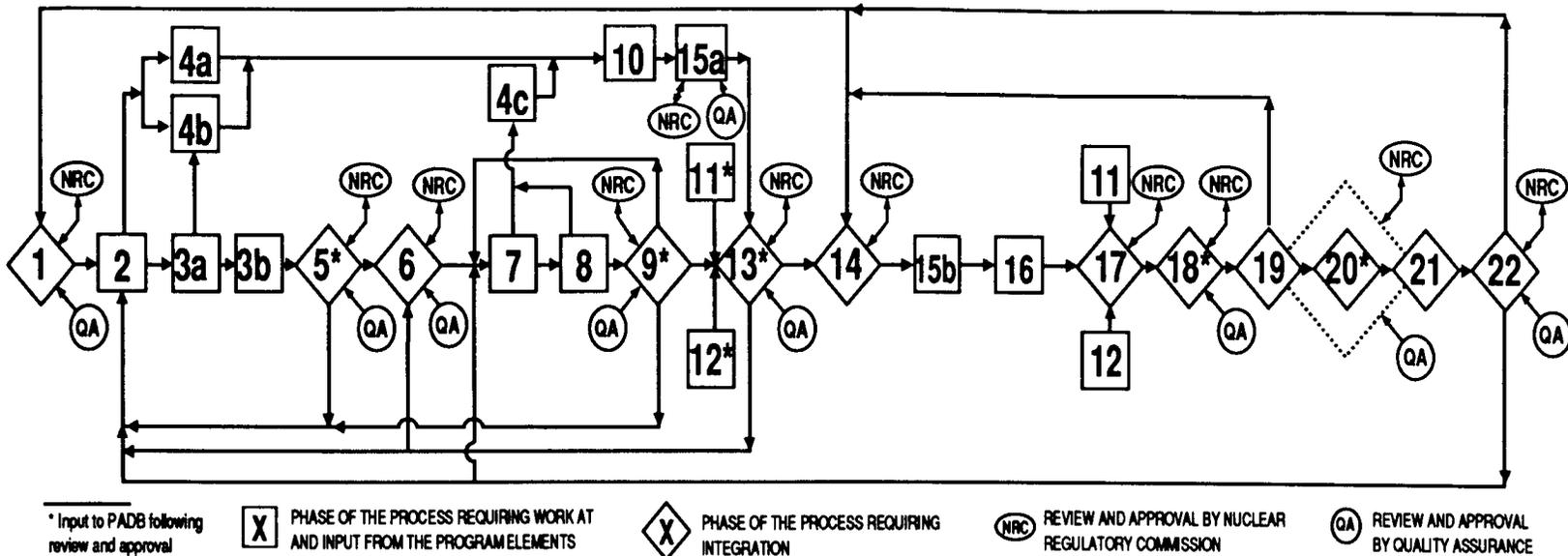
4. The potential Uncertainties were further analyzed and evaluated in the context of information contained in NUREG-0804, the Statements of Consideration, draft rulemakings and technical positions, etc.

10 CFR Part 60, including sections of other regulations which are incorporated by reference, was analyzed by this method. In addition, regulations of other agencies dealing with high-level radioactive waste, analogous non-high-level waste NRC regulations, and enabling statutes were included in the analytical base.

Application of the Program Architecture process resulted in the identification of nearly 100 candidate Regulatory Requirements. The process was controlled by a technical operating procedure (Ref. 5) and the results of the analysis were evaluated by independent reviewers in accordance with the provisions of the Center Quality Assurance Manual (CQAM). This report was also reviewed in accordance with the CQAM. An additional review will be conducted as prescribed in the Program Architecture Review Committee (PARC) procedure (Ref. 6) at a later date. This approach is necessary because the resulting data must be prepared in a format different from that used in the present report for entry into the Program Architecture Relational Database.

3.2 IDENTIFICATION OF REGULATORY AND INSTITUTIONAL UNCERTAINTIES

In the course of the analysis described above, Regulatory Uncertainties were identified using the definition as follows:



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1. Identify Potentially Applicable Statutes and Regulations
2. Analyze and Identify Regulatory Requirements
- 3a. Identify Regulatory Elements of Proof and Define Logic Structure
- 3b. Identify Technical Review Components and Define Logic Structures
- 4a. Identify and Correlate Institutional Uncertainties
- 4b. Identify and Correlate Regulatory Uncertainties
- 4c. Identify and Correlate Technical Uncertainties
5. Review, Revise and Integrate Regulatory Requirements, Regulatory Elements of Proof, and Technical Review Components
6. Select Subset of Regulatory Requirements for Further Analysis Based on Time-Critical Nature
7. Identify Basic Approach for Compliance Determination Methods
8. Identify and Correlate Information Requirements for Compliance Determination

9. Review, Revise and Integrate Compliance Determination Methods and Associated Information Requirements
10. Define NRC Composite Uncertainties; Identify Uncertainty Components
11. Obtain DOE "Issues", Compliance Demonstration Methods, Information Needs, Uncertainties and Uncertainty Reduction Methods
12. Obtain State, Tribe, and Other Affected Parties "Issues", Compliance Evaluation Methods†, Information Needs, and Uncertainties
13. Identify and Correlate Information Requirements for Uncertainty Reduction; Rank NRC Composite Uncertainties
14. Define Composite Information Requirements; Make Initial Selection of Composite Information Requirements for NRC Action; Identify Other Action Agencies
- 15a. Analyze Alternative Uncertainty Reduction Methods, Draft the Postulated Uncertainty Reduction Language (PURL) for Recommended Rulemakings, and Submit to NRC for Review.

- 15b. Define Alternative NRC Programs for Each Composite Information Requirement, Uncertainty Reduction, and Compliance Determination
16. Develop Costs, Schedules, and Lead Times for Alternative NRC Programs
17. Analyze and Perform Tradeoffs of Alternative NRC Programs
18. Recommend Overall NRC Programs Including Overall Research Program Plan
19. Develop and Display the Network and Critical Path for Each Regulatory Requirement
20. Develop and Display Network for Total Program
21. Control and Document Program Structure and Changes
22. Conduct the NRC program

† It is assumed that at least one affected party will request information to perform an independent "compliance evaluation".

FIGURE 1. PROCESS DIAGRAM FOR DEVELOPING AND MAINTAINING THE PROGRAM ARCHITECTURE

A regulation is said to contain a Regulatory Uncertainty when there is lack of clarity in the quoted statement, when an essential requirement has been omitted, or when requirements which either detract from the regulatory program or do not contribute to the regulatory program are included in the regulation.

In general terms, a Regulatory Uncertainty is present when one or more of the following questions cannot be answered in the affirmative:

- o Are all functions of the site, engineered barriers, and repository adequately regulated (i.e. does the regulation meet the tests of necessity and sufficiency)?
- o Does DOE know what to do in order to comply with the regulation?
- o Does NRC know what to do to determine compliance with the regulation?

Identification of Institutional Uncertainties was based on the following definition:

A regulation is said to contain an Institutional Uncertainty when there is lack of certitude regarding the roles, missions, actions, and schedules of agencies which have Regulatory Requirements that affect the high-level waste Regulatory program, their impacts, or their integration with the NRC Regulatory program.

An Institutional Uncertainty generally arises when there is no clear identification of the Federal agency with jurisdiction or when there appears to be overlap in the jurisdictions assigned by Congress or assumed by the agencies.

The previous report on the subject (CNWRA 89-003) identified a total of 50 discrete Uncertainties in Subparts B and E, of which 18 have been excluded on further analysis. During the present analysis, 79 discrete, unique Regulatory and Institutional Uncertainties were identified in Subparts A through I; these Uncertainties include those identified in CNWRA 89-003. Thirty-six of these Uncertainties were excluded from the Regulatory and Institutional categories. A total of 43 discrete Regulatory and Institutional Uncertainties remain for further characterization and consideration for Uncertainty reduction. Seven of these (two from CNWRA 89-003 and five more from the present analysis) are Regulatory Uncertainties for all 24 potentially adverse conditions given in 10 CFR 60.122(c).

A number of the Regulatory and Institutional Uncertainties may be present in the Regulation by deliberate intent, and require no action. Where reduction of an Uncertainty is desired, the reduction may apply to one or more Uncertainties. As a result, far fewer than 43 regulatory actions (rulemakings, technical positions, regulatory guides, precicensing consultations, etc.) may be needed to address the identified Uncertainties.

A description of each Uncertainty is presented in Appendix B of Volume 2. It should be noted that these descriptions state the Uncertainty positively, in accord with the NRC-approved Technical Operating Procedure (TOP) (Ref. 5). The relevant section of the TOP-001-02 is given below (see also Page A-10):

"For each NRC UNCERTAINTY, a brief statement is to be provided that identifies what is uncertain... These are to be positive statements; i.e., what is needed, rather than what is not now available." (Ref. 5)

Even though the Uncertainty is described in terms of what is needed for its putative reduction, there is no implication whatsoever that any particular regulatory action is warranted or desirable. For example, when the discussion suggests that clarification is needed or that criteria should be provided to reduce the uncertainty, there is no intent to specify a particular means or action for doing so. The Uncertainty may be able to be appropriately reduced by regulatory action ranging from staff interactions during the precicensing process to formal rulemaking. Thus, this report goes no further than identification of Regulatory and Institutional Uncertainties, and does not imply any action with respect to Uncertainties at all.

Selection of a particular action to reduce the Uncertainty is accomplished in Stage 3 of this process, as discussed in Section 3.3.3. Figure 2 shows that separation of unintentional Regulatory and Institutional Uncertainties (which may be the subject of some future regulatory action) from intended Uncertainties that were deliberately included in 10 CFR Part 60 (which will presumably remain) is part of a further analysis which has not yet been undertaken.

A cursory examination suggests that the severity of the Uncertainties varies: some appear to be critical to implementation of the regulation, others appear to be less significant, and others may be of minor importance. Severity, importance, and similar factors will be definitively evaluated at a later date using attribute analyses similar to those presented in Reference 4.

In the following Section, the Uncertainties are grouped by both subject matter and Uncertainty type. Uncertainties are identified in this discussion by citation of the appropriate Subsection of 10 CFR Part 60 and an Uncertainty number. For example, '46-UN1' refers to Uncertainty 1 of 10 CFR 60.46.

3.3 THE PROCESS FOR ADDRESSING UNCERTAINTIES

As has been pointed out, there are three classes of potential Uncertainties: Regulatory, Institutional, and Technical. The classification and the identification of Uncertainties by CNWRA is discussed in detail in Appendix A of Volume 2. Each Regulatory and Institutional Uncertainty found in CNWRA's analysis of 10 CFR Part 60 will eventually be addressed in one or more stages of a three-stage process. The three stages are identification of the Uncertainty,

characterization of the Uncertainty and reduction of the Uncertainty (Figure 2).

3.3.1 UNCERTAINTY IDENTIFICATION

All of the three types of Uncertainties are identified by the method of Appendix A of Volume 2. They can then be classified or grouped in accordance with various criteria. The most obvious criterion for classification is uncertainty type: Regulatory, Institutional, or Technical.

A second characteristic by which Uncertainties were combined in groups is the subject matter of the Uncertainty which generally reflects the topical title of the Regulation or the appropriate section or subsection of the regulation. Combination in groups (as application of this criterion is referred to in this report) is done primarily to aid discussion. There is an additional benefit when reductions of the Uncertainties in a group are related so that a single uncertainty reduction may be applied either to similar uncertainties in different parts of the Regulation or to different uncertainties. Moreover, cognizance of the relationships between Uncertainties within a group can maximize the benefit and applicability of possible regulatory actions, and can minimize the probability of expanding one Uncertainty while reducing another in a collateral section of the Regulation.

Further delineation of the reason for identifying the Uncertainty provides a third characteristic for combining Uncertainties. Referred to in the present report as categorization, this approach to grouping examines:

- o Need for clarification;
- o Omission in the regulation;
- o Inconsistency in the regulation;
- o Lack of demonstrated necessity for the provision;
- o Insufficiency in the scope or coverage of the particular Regulatory Requirement;
- o Exceedence of statutory authority; or
- o Need for clarification of jurisdiction.

The principal reason for assigning categories is to differentiate among the causes of Regulatory and Institutional Uncertainties. Assignment to a particular category carries with it no implication regarding either the importance of an Uncertainty, or the need or desirability for its reduction. Such matters are addressed in Stage 2 of the process (see Figure 2). However, although selection of an Uncertainty Reduction Method is a Stage 3 action, the category can provide early insights into how the particular Uncertainty might be broadly addressed (Figure 2).

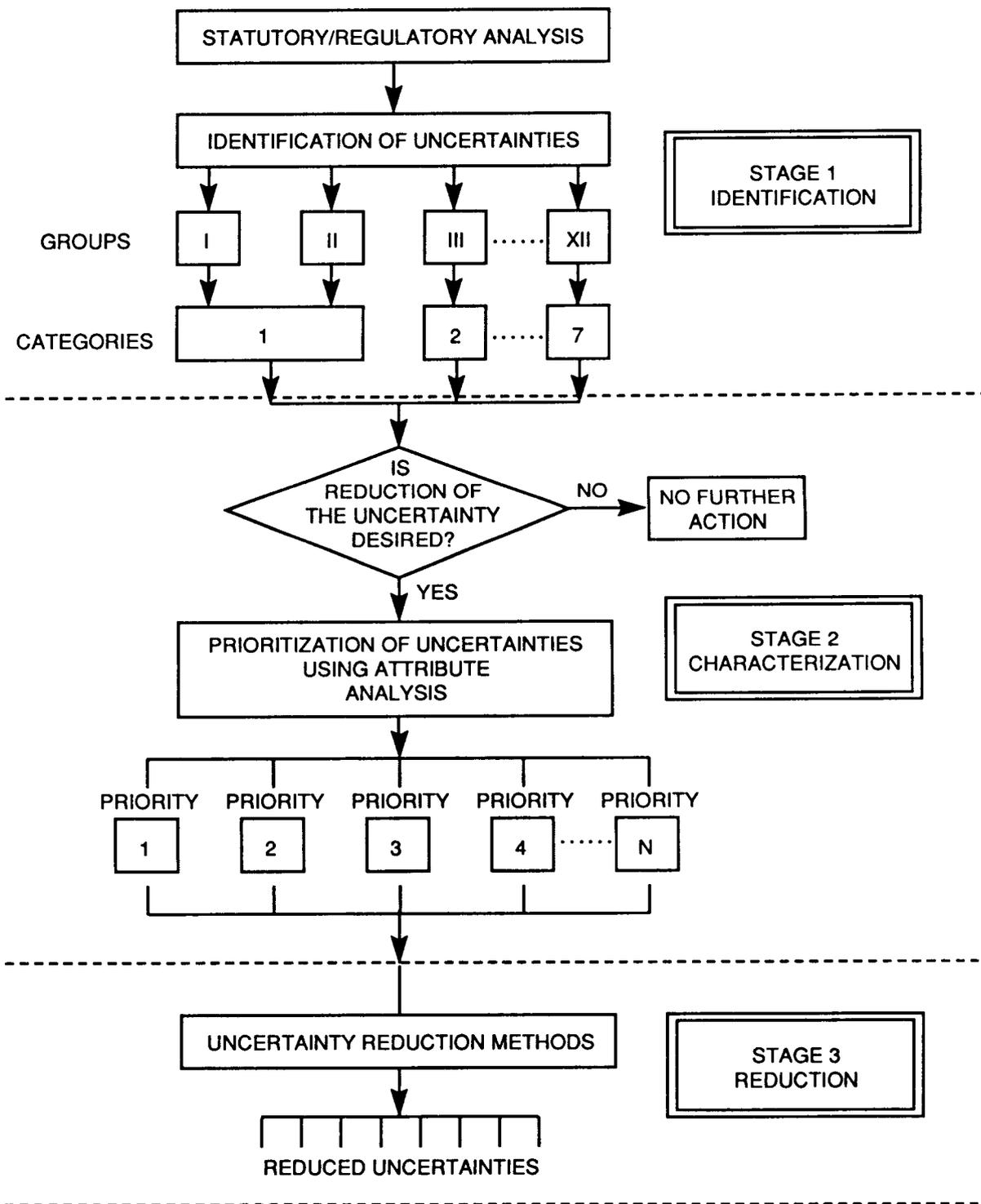


FIGURE 2. DIAGRAM OF THE THREE-STAGE PROCESS OF UNCERTAINTY IDENTIFICATION, CHARACTERIZATION, AND REDUCTION

This report is entirely concerned with the first stage - identification - of Regulatory and Institutional Uncertainties. The CNWRA has also been asked to correlate the identified Regulatory and Institutional Uncertainties with ongoing NRC staff actions, such as proposed rulemakings and preparation of draft technical positions. This correlation, which is part of uncertainty identification, is included in this report.

The second and third stages in this three stage process - uncertainty characterization and uncertainty reduction - are described below for the sake of completeness, but are not addressed in this report.

3.3.2 UNCERTAINTY CHARACTERIZATION

Once Uncertainties have been identified, their disposition must be agreed upon. All Uncertainties in a regulation need not be reduced; some may result from language intentionally used to provide regulatory flexibility, and should remain. Some Uncertainties are more important than others, the consideration of some should take priority over the consideration of others, and some will be reduced automatically with the reduction of others. Characterization of Uncertainties is the process of evaluating the Uncertainties systematically according to such measures as the importance, timeliness, and durability of their reduction. Characterization proceeds in a series of steps to the selection of Uncertainty Reduction Methods, and ultimately to reduction where desired. The steps in characterization are:

1. Identification of Uncertainties for which reduction is not desired or needed. These Uncertainties, which result from language intentionally used to provide regulatory flexibility, will not be considered further.
2. Characterization of the unintentional Uncertainties - the remainder - according to their importance, priority of their reduction, durability of the reduction, and other factors determined by the decision maker to be appropriate. This sort of characterization may require an analysis like that used in Reference 4 and diagrammed in Figure 3.

A complete set of attributes which was used for a previous decision is given in Reference 4. Although these may be applicable to further analysis of the Uncertainties described here, it must be recognized that attributes are not generic, but are specific to the decision at hand. Therefore, development and application of a different set of attributes may be necessary.

Examples of attributes related to the **importance** of reducing Uncertainties are:

- o Affecting the overall repository performance;
- o The potential for radioactive contamination during the operational phase;
- o Possible disqualification of the site.

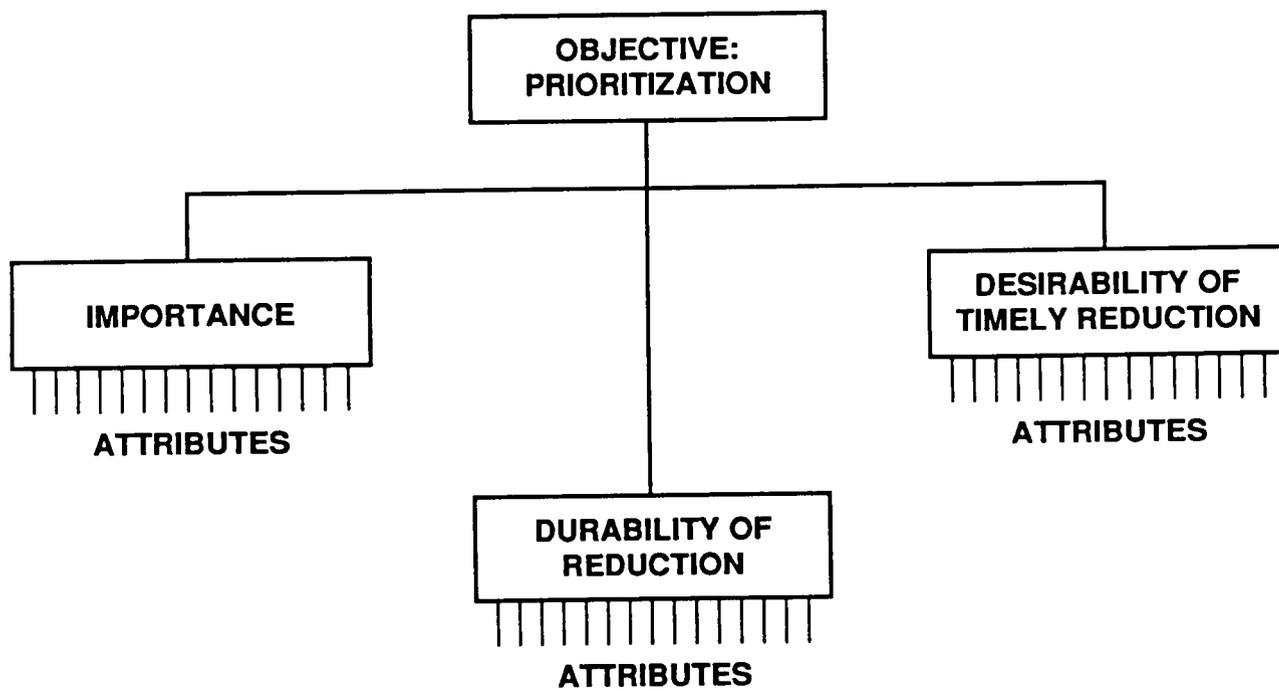


FIGURE 3. EXAMPLE HIERARCHY FOR PRIORITIZATION OF UNCERTAINTIES USING AN ATTRIBUTE ANALYSIS

Examples of attributes related to the **desirability of a timely reduction** are:

- o Expediting the licensing process;
- o Affecting DOE site characterization activities.

It should be noted that the present report does not characterize the Uncertainties at all, even to the extent of identifying intentional Uncertainties.

3.3.3 UNCERTAINTY REDUCTION

The final stage of the process diagrammed in Figure 2 is selection of an appropriate Uncertainty Reduction Method and implementation of that method. The second and penultimate stage of the process is particularly important for this final stage because characterization of the Uncertainties screened out those Uncertainties whose inclusion in the regulation was intentional, and which will therefore remain part of the regulation. The unintentional Uncertainties - the remainder whose reduction is desired, and which were prioritized as part of characterization - then become the targets of uncertainty reduction.

Attributes such as desired durability of reduction, risk of litigation, effect on site characterization, etc., may be used to guide selection of an appropriate Uncertainty Reduction Method. Unless appropriate attributes were included in the characterization stage, a separate attribute analysis may be needed to guide and document this decision-making process in Stage 3.

The process of uncertainty reduction is not addressed further in this report.

4. RESULTS AND CONCLUSIONS

A preliminary analysis of the Regulatory and Institutional Uncertainties is discussed in this section, including how Uncertainties were grouped and categorized, previously identified Uncertainties which were excluded, and reclassification of some Regulatory and Institutional Uncertainties as Technical Uncertainties. A brief overview is given of each group in Section 4.2. The particular relationship of the Regulatory Requirements and Uncertainties which bear on assessment of repository performance - Group I - is singled out for discussion in Section 4.2.1, because performance assessment is critical to compliance with 10 CFR Part 60.

4.1 GROUPING OF UNCERTAINTIES

The Uncertainties have been organized into twelve groups by subject matter, which corresponds in general to Sections and Subsections of the regulations (Table 1). This grouping is similar to that used in CNWRA 89-003. As discussed in Section 3, above, reduction of the Uncertainties may be facilitated by formation of these groups. The groups, with brief descriptions of the Uncertainties included in each, are given in Table 1 (a complete description of each Uncertainty is given in Appendix B of Volume 2).

Uncertainties were combined in a group when they met one or more of the following criteria:

- o The Uncertainties and the parent Regulatory Requirements dealt with a single topic or related topics;
- o The reductions of the Uncertainties in the group are related, affording the opportunity for generic uncertainty reduction or resulting in automatic reduction of some Uncertainties in a group when others are reduced;
- o Action on one Uncertainty in a group will affect other Uncertainties in the same group; the Uncertainties in the group are not completely independent of each other.

4.2 CATEGORIZATION OF UNCERTAINTIES

As noted in Section 3.2, a Regulatory Uncertainty exists "when there is lack of clarity in the quoted statement, when an essential requirement has been omitted, or when requirements which either detract from the regulatory program or do not contribute to the regulatory program are included in the regulation." This definition, together with the definition of Institutional Uncertainties, allows Uncertainties to be categorized as to their character which, in turn, gives insight into the general means or actions required to reduce the Uncertainty. Such a categorization will ultimately aid the selection and implementation of Uncertainty Reduction Methods, if NRC wishes to reduce the Uncertainty. Categorization does not imply necessity or importance of uncertainty reduction, nor does it attempt to select a particular method.

Seven unique, mutually exclusive categories of Uncertainties may be drawn from the definitions of Regulatory and Institutional Uncertainties. As discussed in Section 3.2, although the Uncertainties and associated categories may state a general action that is perceived to be necessary to reduce the

Uncertainty, there is no intent to specify a particular regulatory action for achieving the reduction.

1. Need for Clarification. The meaning of a word or phrase in the regulation is unclear. Reducing the Uncertainty requires a clarification of the word or phrase in question.
2. Omission. One or more functions that are addressed in a Regulatory Requirement are incompletely regulated. One or more additional requirements are essential to reduction of the Uncertainty. Omission carries the sense of incompleteness of regulatory coverage of a function, as distinct from insufficiency (see below) which implies that a function is not regulated at all.
3. Inconsistency. Functions are addressed differently in 10 CFR Part 60 than in regulations which cover similar or analogous facilities, or a given function is addressed differently and inconsistently within different sections of 10 CFR Part 60. Reduction of the Uncertainty requires clarification or removal of the inconsistency.
4. Lack of Necessity. The regulation contains a requirement which is unnecessary, or a requirement which detracts from the regulatory program. Reduction of the Uncertainty requires deletion of the particular requirement.
5. Insufficiency. A function of the site, the engineered barrier system, or the repository which should be regulated is not regulated. Note that this category cannot be evaluated until a functional analysis of the site, engineered barrier system, and repository has been performed. Therefore, it is not considered in this report.
6. Exceedence of Statutory Authority. The Regulatory Requirement exceeds the statutory authority of the NRC.
7. Need for Clarification of Jurisdiction. There is confusion about agency jurisdiction for implementation and/or evaluation of compliance with a Regulatory Requirement. This category comprises all Institutional Uncertainties.

The tables in Appendix C of Volume 2 list all of the Regulatory and Institutional Uncertainties by both group and category. Table 3 summarizes the Regulatory and Institutional Uncertainties by category. Note that Category 5 is omitted from the table because it is not considered in this report. Furthermore, there appeared to be no Regulatory or Institutional Uncertainties in Categories 4 and 6.

Table 3 reflects that by far the largest numbers of Regulatory Uncertainties are due either to a lack of adequate clarity of a term in the regulation or to the omission of an essential requirement from the regulation in question. In addition, there are two Regulatory Uncertainties stemming from inconsistencies either within 10 CFR Part 60 or between Part 60 and other Parts of Title 10, and two Institutional (or jurisdictional) Uncertainties.

4.3 DISCUSSION OF THE UNCERTAINTY GROUPS AND CATEGORIES

4.3.1 GROUP I: GENERAL ADEQUACY OF SITE CHARACTERIZATION

The Subsections of 10 CFR Part 60 which explicitly or implicitly address assessment of performance of the high-level waste repository (10 CFR 60.101, 10 CFR 60.112 and 10 CFR 60.113) exhibit a unique relationship to the subsection which addresses siting criteria (10 CFR 60.122). This relationship pervades the entire systematic analysis of these subsections, including consideration of Uncertainties. This particular discussion focuses on postclosure repository performance and the requirements of 10 CFR 60.112, but 10 CFR 60.113, which regulates postclosure performance of particular barriers in the repository, bears a similar relationship to 10 CFR 60.122 as does 10 CFR 60.112. For brevity, this discussion will refer only to 10 CFR 60.112. An analogous relationship may exist between 10 CFR 60.111 and parts of 10 CFR 60.130 through 60.133, but it has not been explored at this time.

A review of the provisions of 10 CFR 60.101, 10 CFR 60.112 and 10 CFR 60.122 gives an insight into this pervasive relationship. 10 CFR 60.101 states the purpose of the subpart of the regulation: "...to set out performance objectives and site and design criteria which will support ... a finding of no unreasonable risk..." to the public health and safety. The siting criteria listed in 10 CFR 60.122 are characteristics of a site which would favor location of a repository there (10 CFR 60.122(b)) and potentially adverse conditions (10 CFR 60.122(c)). Thus, the siting criteria are crucial to licensing, and are related to performance assessment through 10 CFR 60.101 and 10 CFR 60.112, which require both demonstration to an Atomic Safety Licensing Board that the repository will perform adequately, and provision of reasonable assurance of such a demonstration. Implementation of 10 CFR 60.112 requires performance assessment, projected through 10,000 years, under a wide variety of conditions.

As 10 CFR 60.101(a)(2) states, repository performance is appropriately assessed by predictive modeling. Modeling includes repository response to a series of credible, hypothetical, potentially disruptive events. The siting criteria of 10 CFR 60.122 express the geologic framework of the repository's environment and the threats to its adequacy, and are a logical basis for this modeling, and thus for the implementation of 10 CFR 60.112.

While the Siting Criteria may not include all possible potentially adverse conditions, all of the Siting Criteria will be considered in assessing repository performance. Some may be considered only to the extent that they are eliminated as not being characteristic of the site; such elimination does not detract from the relationship between 10 CFR 60.112 and 10 CFR 60.122. The relationship is also realized in that the repository must comply with both 10 CFR 60.112 and 10 CFR 60.122 in order to be potentially licensable, and is best understood by considering the relationship of the Regulatory Requirements first, followed by consideration of the relationship of the Uncertainties.

4.3.1.1 Relationship of the Regulatory Requirements of 10 CFR 60.112 to the Regulatory Requirements of 10 CFR 60.122

The subsections of 60.122 comprise Regulatory Requirements, in and of themselves. While these Regulatory Requirements are distinct from those in 60.112, the associated compliance determinations are not independent. Indeed,

compliance with the Regulatory Requirements of 10 CFR 60.122 is in the context of compliance with the Performance Objectives of 10 CFR 60.112. The three-fold rationale for the relationship between the Regulatory Requirements is outlined below.

1. The Regulatory Requirements are distinct because the high-level structure of 10 CFR 60.122 is different from that of 10 CFR 60.112. The Regulatory Requirements of 10 CFR 60.122 are identified in the Regulation as Siting Criteria whereas those of 10 CFR 60.112 are Performance Objectives.

2. The text of 10 CFR 60.101 explicitly requires evaluations of compliance with regard to both the "objectives" and the "criteria" of 10 CFR Part 60 Subpart E. A discrete assessment of compliance with each siting criterion is also required by the language of 10 CFR 60.122.

3. Although the language and structure of 10 CFR 60.122(b) and 60.122(c) indicate that these requirements are separate from 60.112, they display a logical relationship to it. Compliance with the Performance Objectives of 10 CFR 60.112 requires an appropriate combination of favorable conditions (10 CFR 60.122(a)(1)), and may also require a combination of favorable conditions to offset a potentially adverse condition (10 CFR 60.122(b)(iii)(B)).

4.3.1.2 Relationships Between Regulatory Uncertainties in 10 CFR 60.112 and 10 CFR 60.122

Regulatory Uncertainties have been identified in both 10 CFR 60.112 and 10 CFR 60.122. These Regulatory Uncertainties occur when either DOE or NRC does not know what (or how much) is needed to show that the site is in compliance with the Siting Criteria and Performance Objectives. They also occur in cases where either party does not know what is needed to support a finding of reasonable assurance that the repository will meet the Performance Objectives. By comparison, Technical Uncertainties, which are not included in this report, arise when there are questions concerning methods, e.g. how one would conduct an investigation, perform an evaluation, obtain data, etc. Descriptions and rationales of the Regulatory and Institutional Uncertainties are provided in Appendix B of Volume 2.

Group I comprises the Regulatory Uncertainties in the language of 10 CFR 60.122, which are distinct from those of Group II, the Regulatory Uncertainties in 10 CFR 60.112. This distinction occurs because the Regulatory Requirements from which these Uncertainties arise are themselves separate, as discussed above. The Regulatory Uncertainties in 10 CFR 60.122 are ambiguities in the language which guides DOE's evaluation of the site and NRC's assessment of DOE's application of the Siting Criteria. These Uncertainties occur in the following phrases in 10 CFR 60.122(a) which apply to all of the potentially adverse conditions of 10 CFR 60.122(c):

- o "taking into account the degree of resolution" of the investigations;
- o "not to affect significantly" repository performance;

- o "not to underestimate the effect" of the condition;
- o "adequately investigated;"
- o "adequately evaluated;"
- o "geologic setting."

The inconsistent treatment of combinations of favorable and potentially adverse conditions is also a Regulatory Uncertainty: the language of 10 CFR 60.122(a)(2)(iii)(B) allows for compensation for the effect of any individual potentially adverse condition by a combination of favorable conditions, but is silent regarding circumstances under which potentially adverse conditions must be considered in combination. These expressions require clarification separately from any Regulatory Uncertainties which may be present in 10 CFR 60.112.

Consideration was given to the alternative interpretation that the Regulatory Uncertainties in 10 CFR 60.122 do not exist independently of Regulatory Uncertainties in 10 CFR 60.112 (and 10 CFR 60.101) because the terms are defined sufficiently in the context of the licensing action; i.e., in a finding of reasonable assurance that the Performance Objectives have been met. The main points of this alternative interpretation are given below.

1. If findings of "reasonable assurance...that the objectives and criteria will be met" (10 CFR 60.101(a)(2) and "assur[ance] that releases of radioactive materials...conform...to generally applicable environmental standards" (10 CFR 60.112) are made, then:

- o the "degree of resolution" was appropriately "taken into account;"
- o the "significance" of the effect on repository performance was assessed correctly;
- o the effect of the potentially adverse condition was not "underestimated;"
- o the investigation and evaluation must have been done "adequately;"
- o the extent of the "geologic setting" was delineated adequately; and
- o there was no inconsistency in combining favorable and potentially adverse conditions.

2. The Commission cannot be reasonably assured that the Performance Objectives are satisfied unless there has been, for example, an adequate investigation, adequate evaluation, and so on.

3. DOE knows what to do to characterize a site simply by virtue of knowing that the Performance Objectives must be satisfied. Hence, DOE knows what the various terms such as "adequately evaluated" mean, and will do what it knows could and should be done for site characterization.

The position that the Uncertainties listed above do not exist distinct from 10 CFR 60.112 (and 10 CFR 60.101) was not adopted in the CNWRA analysis for the following reasons.

1. The Performance Objectives can appear to be met or be judged to be satisfied, but the adequacy of the investigation or evaluation that supported that judgment can still be questioned. A judgment of adequacy of an investigation is separate from and a precursor to a judgment of reasonable assurance.

2. If a decision of reasonable assurance is predicated on judgment of such matters as the adequacy of the investigation or evaluation, any judgment of adequacy would come very late in the licensing review process, and would almost certainly lead to delays. Delays could result from litigating the meaning of such terms or from taking remedial actions to achieve adequacy of investigation, evaluation, etc. Even taking the important concept of iterative performance assessment into account, reaching closure on such matters as the adequacy of investigation could be protracted, because the finding of reasonable assurance comes at the end of the process. Such an approach appears to be contrary to the goal of streamlining the licensing process.

3. Technical exchanges between NRC and DOE, and the Site Characterization Analysis done by NRC, suggest that DOE does not in every case have a clear understanding of what constitutes, for example, an adequate investigation. On the other hand, DOE's understanding of assessment of repository performance is much the same as NRC's understanding. It appears, then, that simply knowing that the Performance Objectives must be met does not provide sufficient criteria for determining the operational clarification of the Regulatory Uncertainties in 10 CFR 60.122. An effective prelicensing consultative process may be an appropriate way to provide additional criteria and guidance for reducing these Uncertainties.

4. Finally, 10 CFR 60.101 relates the data from site characterization and the predictive models built from that data to considerations in making a finding of reasonable assurance. The existence of this relationship establishes proper treatment of the Uncertainties in 10 CFR 60.122 as a logical precursor to a finding of reasonable assurance. Such a finding would be affected by data reliability (which can result only from an adequate investigation), sufficiency and accuracy of the evaluation of performance (which results only from adequate evaluation), etc.

Therefore, the alternative interpretation that all of the common Regulatory Uncertainties which arise because of language in 10 CFR 60.122 accrue to, and are not distinct from, the concept of reasonable assurance in 10 CFR 60.112 was not adopted by the CNWRA in these analyses. Rather, an approach was taken which suggests that Regulatory Uncertainties in 10 CFR 60.122 be appropriately reduced before a finding of reasonable assurance can be made.

4.3.1.3 Categories of Group I Uncertainties

The actual statements of UN1 through UN5 occur in 10 CFR 60.122(a)(2), the statement of UN12 in 10 CFR 60.122(b), and the statement of UN17 in 10 CFR 60.21(c)(1)(ii)(C). However, they all apply to 10 CFR 60.122(c)(1) through (c)(24). Consequently, they are referred to by the latter citation.

The Uncertainties UN1, UN2, UN4 and UN12 of 10 CFR 60.122(c)(1) through (c)(24) are all in Category 1: clarification, as is UN3 of 10 CFR 60.122(b)(1). That is, the terms "extent of the geologic setting," "taking into account the degree of resolution," "not to underestimate [the] effect" and "not to affect significantly" all require clarification. The Uncertainties UN3 and UN5 of 10 CFR 60.122(c)(1) through (c)(24) are all in the Category 2: omission, in that benchmarks, and some detail, are needed to characterize adequate investigation and adequate evaluation properly. As has been pointed out, UN17 of 10 CFR 60.122(c)(1) through (c)(24) is in Category 3: inconsistency. UN18 of 10 CFR 60.122(c)(3) and (c)(4) and UN19 of 10 CFR 60.122(c)(16) are also in Category 1: need for clarification, because the meanings of "regional groundwater flow system" and "extreme erosion" are not clear. UN18 of 10 CFR 60.122(c)(8) and (c)(24) are in Category 2: omission - "sorption" describes one restricted type of geochemical behavior, and "air filled pore spaces" refers to only one gas mixture - air.

4.3.2 GROUP II: ANTICIPATED AND UNANTICIPATED PROCESSES AND EVENTS

In 10 CFR 60.112, UN1, and 10 CFR 60.113(a)(2), UN3 and UN4, the terms "anticipated processes and events," "unanticipated processes and events," and "anticipated and unanticipated processes and events" are used in several contexts. Literature references cite a variety of interpretations for these terms (see Appendix B, page B-39, et seq.), with consequent confusion as to their meaning. Since "anticipated processes and events" provide the design bases (10 CFR 60.113(a)), and "unanticipated processes and events" includes by inference all processes and events that are not "anticipated," implementation of the regulation requires consistent definition of these terms. These Uncertainties are thus in Category 1: need for clarification.

4.3.3 GROUP III: SYSTEMS, STRUCTURES, AND COMPONENTS IMPORTANT TO SAFETY--DESIGN CRITERIA AND DESIGN BASES

The Regulatory Uncertainties in 10 CFR 60.131(b)(5), UN1, (b)(6), UN1, and (b)(10), UN1, arise because certain design and performance criteria for systems, structures and components important to safety may need additional explanation. Those in 10 CFR 60.72(b)(6), UN2, and (b)(7), UN3, and 10 CFR 60.73(a), UN1, and 10 CFR 60.73(b), UN2, inadequately characterize certain features of design criteria and design bases, and thus provide inadequate guidance. The Uncertainties in 10 CFR 60.131(b)(5), UN1, (b)(6), UN1, and (b)(10), UN1, are in Category 2: omission. In these Uncertainties, guidance is needed for better characterizing utility service testing, non-periodic inspection and maintenance of systems, structures, and components important to safety, and the design of waste conveyances. The Uncertainties in 10 CFR 60.72(b)(6), UN2, and (b)(7), UN3, and 10 CFR 60.73(a), UN1, and 10 CFR 60.73(b), UN2, are all in Category 1: need for clarification. The terms in these Uncertainties which require clarification are "construction problems," "anomalous conditions," and "substantial safety hazard."

4.3.4 GROUP IV: ENGINEERED BARRIER SYSTEM PERFORMANCE

The Regulatory Uncertainty UN1 in 10 CFR 60.113(a)(1)(i)(A) is ambiguity in the definition of "substantially complete containment" and it is thus in Category 1: need for clarification. Uncertainty UN2 in 10 CFR 60.135(c)(1) is in the regulation of non-solid constituents of the waste form. It is in Category 2: omission, because the Regulation as written does not explicitly consider the gases generated in spent fuel. These two Uncertainties are in the same group because they are part of the same subsection of the regulation, and are the only two Uncertainties which deal with the engineered barrier system.

4.3.5 GROUP V: RADIOLOGICAL SAFETY CONSIDERATIONS

UN5 in 10 CFR 60.111(a) is concerned with the design basis accident dose: the citation of Part 20 and generally applicable environmental standards implies a considerable range of possible design basis accident doses. It is in Category 1: clarification. The other Regulatory Uncertainty in 10 CFR 60.111(b), UN3, is lack of specificity in the extent and degree to which other regulations should be referenced or cited. It is in Category 2: omission.

4.3.6 GROUP VI: RETRIEVABILITY CONDITIONS

The Regulatory Uncertainty UN1 in 10 CFR 60.111(b)(1) is in the statement "option of retrievability" - whether this means designing for retrievability or not precluding it. Uncertainty UN1 10 CFR 60.46(a)(1) - the reference to "difficulty of retrieval" - could be reduced with reduction of the Regulatory Uncertainty in 10 CFR 60.111(b)(1), UN1. These Uncertainties are thus both in Category 1: need for clarification.

4.3.7 GROUP VII: CONDITIONS FOR CONSTRUCTION AUTHORIZATION, LICENSE AND LICENSE AMENDMENT

The Regulatory Uncertainties in 10 CFR 60.31, UN1, and 10 CFR 60.51(a)(2)(ii), UN1, are, respectively, omissions and lack of clarity in the regulations dealing with application and qualification for construction authorization, license application and license amendment. Although a variety of Regulatory Uncertainties, with a probable variety of reductions, is included in this group, they all relate to the mechanics or logistics of application for construction authorization or license amendment, or the license application itself. The Regulatory Uncertainty UN1 in 10 CFR 60.31 is the omission of NRC consideration of performance confirmation for construction authorization, and is thus in Category 2. UN1 in 10 CFR 60.51(a)(2)(ii) is the need for clarification of what is meant by "likely to be consulted by potential human intruders," and is in Category 1. Regulatory Uncertainty UN1 in 10 CFR 60.23 is an inconsistency in the Regulation in the use of the terms "environmental report, environmental impact statement, site characterization report, site characterization plan" and is thus in Category 3.

4.3.8 GROUP VIII: REGULATION OF MINING SAFETY AND NONRADIOLOGICAL SAFETY CONSIDERATIONS

Uncertainty UN1 in 10 CFR 60.131(b)(9) reflects lack of clarity in how the NRC will determine compliance with mining (nonradiological) safety requirements and is in Category 7: questions of agency jurisdiction. Uncertainty UN1 in 10 CFR 60.133(e) is in the lack of clarity in addressing

other non-radiological safety considerations and is in Category 1: need for clarification. These are the only Institutional Uncertainties identified in 10 CFR Part 60.

4.3.9 GROUP IX: CONDITIONS OF LAND ACQUISITION AND CONTROL

Regulatory Uncertainty UN1 in 10 CFR 60.121(a) concerns when and how DOE will 'guarantee' appropriate land control. The regulation implies that DOE need not demonstrate land use control at a site until construction authorization has been granted, and thus control would be in question during site characterization. This Uncertainty is in Category 2: omission.

4.3.10 GROUP X: QUALITY ASSURANCE AND INFORMATION REQUIREMENTS

The Regulatory Uncertainties designated UN1 in 10 CFR 60.10(b), 10 CFR 60.21, and 10 CFR 60.152 constitute inadequate clarity in the prescription of quality assurance activities, in record keeping and record disposition requirements, and are in Category 1: need for clarification. Uncertainty UN3 in 10 CFR 60.22(d) is in responsibility for putting documents in the NRC Public Document Room, and is in Category 7: questions of agency jurisdiction. Uncertainty UN2 in 10 CFR 60.24(a) concerns omissions in criteria for docketing, and is in Category 2.

4.3.11 GROUP XI: COMPLIANCE WITH THE EPA STANDARD

The Regulatory Uncertainty UN2 in 10 CFR 60.112, which deals with overall repository system performance, arises because the regulations cannot conform to the EPA standard until the EPA standard is finalized. This Uncertainty is thus in Category 2. CNWRA 89-003 (Reference 4) had identified the lack of an implementation method for the EPA standard as a Regulatory Uncertainty also, but it has since been reclassified as a Technical Uncertainty because it deals with methods (i.e., how compliance will be shown).

4.3.12 GROUP XII: EMERGENCY PLANNING CRITERIA

A Regulatory Uncertainty occurs in 10 CFR 60.31(a)(5), UN2, because 10 CFR Part 60 Subpart I, which will delineate the criteria for emergency planning, has not yet been promulgated. Since it includes no regulation at present, Subpart I, UN1, also comprises a Regulatory Uncertainty and is in Category 2: omissions.

4.4 EXCLUDED UNCERTAINTIES

The analysis of CNWRA 89-003 made a preliminary identification of a number of Uncertainties which have been excluded based on subsequent analysis. CNWRA 89-003 had been presented as a preliminary analysis of the Regulatory and Institutional Uncertainties occurring in Subparts B and E of Part 60, in which the analyses had been 'frozen' as of February 1989. The present analysis is complete with respect to Part 60, with the exception of a pending evaluation of regulatory sufficiency (see Section 4.2, item 5).

The Uncertainties which have been excluded as Regulatory or Institutional Uncertainties, with a brief rationale for each exclusion, are given in Table 2. A few Uncertainties have been reduced by rulemakings or publication of other relevant materials since publication of CNWRA 89-003,

such as the rulemaking for 10 CFR Part 51 and recent revisions in 10 CFR Part 72. Seven Uncertainties were reclassified as Technical Uncertainties. A few Uncertainties have been excluded because they have been combined with other Uncertainties. A detailed rationale for each exclusion is given for each excluded Uncertainty in Appendix B of Volume 2.

4.5 CORRELATION OF UNCERTAINTIES WITH ONGOING STAFF ACTIONS

CNWRA 89-003 listed Uncertainties which were part of ongoing or planned NRC rulemakings and technical positions. These are expanded in Tables 4 and 5 of this report to include additional Uncertainties. Note that one of the Uncertainties in CNWRA 89-003, 51-UN3, was reduced by the rulemaking on 10 CFR Part 51 (Ref. 7). Numbers for rulemakings and technical positions in Tables 4 and 5 are taken from SECY-89-339.

The ongoing rulemakings should result in reduction of the Uncertainties. In practice, however, the language of the proposed rule needs careful scrutiny to assure both that the existing Uncertainty is reduced and that no new Uncertainty is created. Program Architecture analysis of the proposed rules can effectively respond to these questions as well as assist in the analysis of comments which the proposed rulemakings may generate.

Relationships between ongoing and planned technical positions and the Uncertainties in 10 CFR Part 60 reflect primarily the similarity of topics between technical positions and Uncertainties (Table 5). Effective reduction of the Uncertainty will depend on the precise language of the technical position. Since these technical positions have not been finalized, it is feasible to introduce appropriate language.

The Technical Positions (TPs) listed in Table 5 for Group XI are closely related to Rulemakings 1 and 2, which deal with the EPA high-level radioactive waste standard, though their language may not be so directly related to reduction of the indicated Uncertainties.

4.6 SUGGESTIONS FOR FURTHER ACTIONS

The individual Uncertainties and groups of Uncertainties not listed in Tables 4 and 5 are not clearly addressed by the ongoing NRC technical positions or rulemakings given in SECY-89-339. In some cases, the topic of some Uncertainties appears to be related to the topic of a proposed technical position, but it is not evident that the technical position in question will appropriately reduce the Uncertainty. Some examples are:

- o TP 10 - Preclosure Earthquake Hazard Evaluation Methods - apparently does not address UN1 through UN5 of 122(c)(12), 122(c)(13) and 122(c)(14), though conceivably the application of TP2 - Extrapolation of Short-term Data to Long-Term Results - could afford some applicability.
- o It is not apparent that TP 6 - Scope for Waste Package-Engineered Barrier Testing - and TP 7 - Waste Package Reliability Analysis address the remaining EBS-related Uncertainty, UN3 of 113(a)(1)(i)(B).

- o TP 15 - Geologic Mapping of Shafts and Drifts - needs expansion and apparently some redirection to address UN12 of 122(c) adequately.

Other Uncertainties are not addressed in the planned rulemakings or technical positions. It is recommended that NRC further evaluate the existing regulatory program in the context of the Uncertainties, as identified in Table 6. In many cases, means other than rulemakings or technical positions may be used to effectively reduce the Uncertainty.

As noted above and in Section 4.2, evaluation of regulatory sufficiency remains to be completed. This must await completion of the repository system functional analysis.

It is further recommended that the Uncertainties resulting from this analysis be evaluated as to importance, need for timely reduction, durability of reduction, and other factors, as appropriate. Such an evaluation can be readily performed using an attribute analysis technique (Ref. 4). Both the most appropriate Uncertainty reduction methods and the priorities for accomplishment of the Uncertainty reductions would flow directly from such an attribute analysis, providing a documented defensible basis for an overall regulatory strategy.

5.0 REFERENCES

1. "Regulatory Strategies and Schedules for the High-Level Waste Repository Program", SECY-88-285, U.S. Nuclear Regulatory Commission, Washington, D.C., 1988.
2. "Regulatory Strategy for the High-Level Waste Repository Program: Description of Uncertainties Being Addressed by the U.S. Nuclear Regulatory Commission Staff", SECY-89-339, U.S. Nuclear Regulatory Commission, Washington, D.C., October 1989.
3. "COMJC-89-2 - Identification and Resolution of Uncertainties - High-Level Waste Program", Memorandum from Samuel J. Chilk to Victor Stello, Jr., 27 February 1989, p. 1.
4. "Analysis and Evaluation of Regulatory Uncertainties in 10CFR60 Subparts B and E", CNWRA 89-003, R.F. Weiner and W.C. Patrick, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, San Antonio, TX, May 1989.
5. "Program Architecture Relational Database Content and Development", TOP-001-02, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, San Antonio, TX, September 1989.
6. "Submission and Verification of Program Architecture Database Entries", TOP-001-03, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, San Antonio, TX, August 1988.
7. Notice of rulemaking on 10 CFR Part 51.

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This report is an independent product of the CNWRA. It has not been fully reviewed by the NRC staff and does not necessarily reflect the views or regulatory position of the NRC. Nonetheless, it is appropriate to acknowledge the very valuable insights gained by interactions with the NRC staff and management throughout the course of the analyses and development of this report. Contributions were made both through their review and comment on an earlier draft, and through vigorous collegial discussion of differing points of view regarding the identification and classification of uncertainties.

Table 1. Grouping of Regulatory and Institutional Uncertainties.

GROUP	REGULATORY AND INSTITUTIONAL UNCERTAINTIES IN THE GROUP
GROUP I: Criteria for General Adequacy of Site Characterization	<p>121(b)(1)-UN3; 122(a), 122(c)(1) through 122(c)(24)-UN1 through UN5; 122(b), 122(c)(1) through 122(c)(24)-UN12; 21(c)(1)(ii)(C), 122(c)(1) through 122(c)(24)-UN17; 122(c)(3) and 122(c)(4)-UN18; 122(c)(8)-UN18; 122(c)(16)-UN19; 122(c)(24)-UN18.</p> <p>There are seven Uncertainties which apply to all potentially adverse conditions. The relationship of these Uncertainties to performance assessment and compliance with 10 CFR 60.101, 60.112 and 10 CFR 60.113 is discussed in some detail in Section 4.3.1. Reduction of these Uncertainties would provide clearer benchmarks against which to judge the general adequacy of site characterization. These benchmarks could provide a basis for "reasonable assurance" that the repository will perform as anticipated. Reduction of the Uncertainties will assist in refining the intended relationship between favorable and potentially adverse conditions.</p> <p>The Uncertainties include clarifications of the following terms:</p> <ul style="list-style-type: none">o "extent of the geologic setting" (UN3 in 122(b)(1) - the favorable conditions - as well as in 122(c), UN12);o "taking into account the degree of resolution" of the investigation, UN1;o "not to underestimate [the] effect" of the potentially adverse condition, UN4;o "not to affect significantly" the performance of the repository, UN2. <p>Two additional Uncertainties are found in the absence of criteria for "adequately investigated" (UN5) and for "adequately evaluated" (UN3).</p> <p>An Uncertainty also resides in the inconsistency with which combinations of potentially adverse conditions are treated in the regulation (UN17). Although combinations of favorable conditions may offset a single potentially adverse condition, the regulation is silent regarding consideration of combination or synergistic action of potentially adverse conditions.</p>

Table 1. Grouping of Regulatory and Institutional Uncertainties (Cont'd).

GROUP	REGULATORY AND INSTITUTIONAL UNCERTAINTIES IN THE GROUP
GROUP I: (Cont'd)	<p>Criteria for General Adequacy of Site Characterization</p> <p>Instances where the language of individual potentially adverse conditions is insufficiently clear are:</p> <ul style="list-style-type: none">o 122(c)(3) and (c)(4)-UN18: "regional groundwater flow system,"o 122(c)(8)-UN18: "sorption" may be too restrictive,o 122(c)(16)-UN19: "extreme erosion,"o 122(c)(24)-UN18: "air-filled pore spaces."
GROUP II:	<p>Anticipated and Unanticipated Processes and Events</p> <p>112-UN1 and 113(a)(2)-UN3 and UN4. These Uncertainties are in the meanings of "anticipated processes and events," "unanticipated processes and events," and "anticipated and unanticipated processes and events".</p>
GROUP III:	<p>Systems, Structures, and Components Important to Safety--Design Criteria and Design Bases</p> <p>131(b)(5)-UN1, 131(b)(6)-UN1, 131(b)(10)-UN1, 72(b)(6)-UN2, 72(b)(7)-UN3, 73(a)-UN1 and 73(b)-UN2. These Uncertainties relate to design criteria and design bases, including those for systems, structures and components important to safety. The Uncertainties include inadequate clarifications of certain design and performance criteria.</p>
GROUP IV:	<p>Engineered Barrier System Performance</p> <p>113(a)(1)(i)(A)-UN1 and 135(c)(1)-UN3. These Uncertainties relate to engineered barrier system performance. They include the Uncertainty in the definition of "substantially complete containment" and the regulation of non-solid constituents of the waste form and waste package.</p>

Table 1. Grouping of Regulatory and Institutional Uncertainties (Cont'd).

GROUP	REGULATORY AND INSTITUTIONAL UNCERTAINTIES IN THE GROUP
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GROUP V:	<p>Radiological Safety Considerations</p> <p>111(b)-UN3 and 111(a)-UN5. These are Uncertainties in the statements of radiological safety considerations in the regulation. UN3 is an Uncertainty in the extent and degree to which other regulations should be referenced or cited. UN5 is an Uncertainty in the design basis accident dose: the citation of Part 20 implies a considerable range of possible design basis accident doses.</p>
GROUP VI:	<p>Retrievability Conditions</p> <p>46(a)(1)-UN1 and 111(b)(1)-UN1. The Uncertainty in 111(b)(1) is in the statement "option of retrievability" - whether this means designing for retrievability or not precluding it. The Uncertainty 46(a)(1)-UN1 - the reference to "difficulty of retrieval" - could be reduced with reduction of the Uncertainty in 111(b)(1).</p>
GROUP VII:	<p>Conditions for Construction Authorization, License and License Amendment</p> <p>23-UN1, 31-UN1 and 51(a)(2)(ii)-UN1. These are Uncertainties and omissions in the regulations dealing with application and qualification for construction authorization, license application and license amendment.</p>
GROUP VIII:	<p>Regulation of Mining Safety and Nonradiological Safety Considerations</p> <p>131(b)(9)-UN1 and 133(e)-UN1. These reflect Institutional Uncertainty and need for clarification in the regulation of mining safety and other non-radiological safety considerations, respectively.</p>

Table 1. Grouping of Regulatory and Institutional Uncertainties (Cont'd).

GROUP	REGULATORY AND INSTITUTIONAL UNCERTAINTIES IN THE GROUP
GROUP IX:	Conditions of Land Acquisition and Control 121(a)(1)-UN1. This is an Uncertainty as to when and how DOE will 'guarantee' appropriate land control.
GROUP X:	Quality Assurance and Information Requirements 10(b)-UN1, 21-UN1, 22(d)-UN3, 24(a)-UN2 and 152-UN1. These are Uncertainties in the definitions of quality assurance activities, and in record keeping and record disposition requirements.
GROUP XI:	Compliance With the EPA Standard 112-UN2. The Uncertainty in 10 CFR 60.112, which deals with overall repository system performance, arises because the regulations cannot conform to the EPA standard until the EPA standard is finalized.
GROUP XII:	Emergency Planning Criteria 31(a)(5)-UN2 and Subpart I-UN1. Subpart I, which will delineate the criteria for emergency planning, has not yet been promulgated.

Table 2. Exclusions of Regulatory and Institutional Uncertainties Since Publication of CNWRA 89-003.

10 CFR PART 60 CITATION	REASON FOR EXCLUSION FROM REGULATORY AND INSTITUTIONAL UNCERTAINTIES
15-UN2	The presence in the statute of restrictions on the use of radioactive material is deemed sufficient for adequate regulation.
17-UN2	The Commission will have an opportunity to review use of radioactive material and assure its retrievability. "Tracers" were included in the regulation to remind DOE that all radioactive material is included in the retrievability requirement.
31(c)-UN3	The rulemaking on 10 CFR Part 51 (Ref. 7) reduced the Uncertainty.
32(a)-UN1	The Commission can include any condition it desires to include in the construction authorization, as long as it protects health and safety of the public, common defense and security, or common values.
32(a)-UN2	Additional conditions specific to the license application cannot be determined <u>a priori</u> .
51(a)(2)(i)-UN2	The term "as permanent as practicable" is deemed to be sufficiently clear to the engineers involved.
51(b)-UN3	The rulemaking on 10 CFR 51 (Ref. 7) reduced the Uncertainty.
52-UN1	Closer analysis of 10 CFR 60.52(c)(3) suggests that the Commission may determine whether termination is adequately authorized.
111(a)-UN1	ALARA is implied to apply to pre-closure, and NUREG-0804 testifies to its deliberate exclusion postclosure.
111(a)-UN2	Documentation indicates that release limits were intended to apply to both normal and off-normal operating conditions.
112-UN3	This is a Technical Uncertainty, not a Regulatory Uncertainty.
113(a)(2) and 122(b)(7)-UN1	This is a Technical Uncertainty, not a Regulatory Uncertainty.

Table 2. Exclusions of Regulatory and Institutional Uncertainties Since Publication of CNWRA 89-003 (Cont'd).

10 CFR PART 60 CITATION	REASON FOR EXCLUSION FROM REGULATORY AND INSTITUTIONAL UNCERTAINTIES
113(a)(2)and 122(b)(7)-UN2	This is a Technical Uncertainty, not a Regulatory Uncertainty.
122(b)(1)-UN1	Clarification of "Quaternary Period" is provided in NUREG-0804.
122(b)(7)-UN2	This is a Technical Uncertainty, not a Regulatory Uncertainty.
122(b)(7)-UN4	This is a Technical Uncertainty, not a Regulatory Uncertainty.
122(b)(7) and 122(c)(1) through (c)(24)-UN14	This is a Technical Uncertainty, not a Regulatory Uncertainty.
122(b)(7) and 122(c)(1) through (c)(24)-UN15	This is a Technical Uncertainty, not a Regulatory Uncertainty.
122(c)(10)-UN18	The language of 10 CFR 60.122(a)(2) provides a proper context.
122(c)(14)-UN18	The phrase "typical of the area in which the geologic setting is located" will be clarified when the Uncertainty in "geologic setting" is reduced.
122(c)(15)-UN18	The language of 10 CFR 60.122(a)(2) provides a proper context.
122(c)(16)-UN18	The language of 10 CFR 60.122(a)(2) provides a proper context.
122(c)(18)-UN18	The language of 10 CFR 60.122(a)(2) provides a proper context.
122(c)(19)-UN18	The language of 10 CFR 60.122(a)(2) provides a proper context.
131(b)(1)-UN1	The meaning of "anticipated processes and events" with respect to the GROA is clear.
131(b)(3)(i)-UN1	Text is clear regarding design criteria.
131(b)(3)(iv)-UN2	Explosion suppression systems are not appropriate for the facility.

Table 2. Exclusions of Regulatory and Institutional Uncertainties Since Publication of CNWRA 89-003 (Cont'd).

10 CFR PART 60 CITATION	REASON FOR EXCLUSION FROM REGULATORY AND INSTITUTIONAL UNCERTAINTIES
131(b)(3)(iv)-UN3	Text of regulation is adequate with respect to appropriate design criteria. Further detail requirements may be met by careful development of Technical Review Components.
131(b)(4)(ii)-UN3	Location virtually requires primary response to emergency situations to be onsite rather than offsite, and the regulation appears explicit in this respect.
131(b)(7)-UN1	Recent revisions to 10 CFR 72.73(a) have made the text consistent with the 10 CFR Part 60 text.
131(b)(7)-UN2	The 10 CFR Part 60 text is more stringent than 10 CFR 72.73(a).
131(b)(7)-UN3	Recent revisions to 10 CFR 72.73(a) (now 10 CFR 72.124) have made the text consistent with the 10 CFR Part 60 text.
131(b)(8)-UN1	Careful comparison with 10 CFR 60.21 resulted in a decision that there was no Uncertainty.
131(b)(9)-UN2	Embedded regulations are adequate to remove the Uncertainty.
131(b)(9)-UN3	"Design" adequately implies "procedures."
133(i)-UN2	The Uncertainty is an apparent typographical error, and the meaning of the regulation is clear.

Table 3. Categorization of Regulatory and Institutional Uncertainties.

CATEGORY			
1	2	3	7
Need for Clarification	Omission	Inconsistency	Need for Clarification of Jurisdiction
10(b)-UN1	24(a)-UN2	23-UN1	22(d)-UN3
21-UN1	31-UN1	122(c)-UN17	131(b)(9)-UN1
46(a)(1)-UN1	31(a)(5)-UN2		
51(a)(2)(ii)-UN1	111(b)-UN3		
72(b)(6)-UN2	112-UN2		
72(b)(7)-UN3	121(a)-UN1		
73(a)-UN1	122(c)-UN3, UN5		
73(b)-UN2	122(c)(8)-UN18		
111(a)-UN5	122(c)(24)-UN18		
111(b)(1)-UN1	131(b)(5)-UN1		
112-UN1	131(b)(6)-UN1		
113(a)(1)(i)(A)-UN1	131(b)(10)-UN1		
113(a)(2)-UN3, UN4	135(c)(1)-UN2		
122(b)(1)-UN3	Subpart I-UN1		
122(c)-UN1, UN2			
122(c)-UN4, UN12			
122(c)(3)-UN18			
122(c)(4)-UN18			
122(c)(16)-UN19			
133(e)(1)-UN1			
152-UN1			

Notes: Category 7 comprises Institutional Uncertainties.

Table 4. Correlation of Regulatory and Institutional Uncertainties with Ongoing/Planned Rulemakings.

REGULATORY AND INSTITUTIONAL UNCERTAINTIES WHICH ARE PART OF ONGOING/PLANNED RULEMAKINGS	
UN/UN GROUP	Rulemaking Number and Subject
GROUP II	3. Amplification of the Phrase "Anticipated and Unanticipated Processes and Events"
GROUP IV: 113(a)(1)(i)(A)-UN1	5. Amplification of the Phrase "Substantially Complete Containment"
GROUP V: 111(a)-UN5	8. Definition of "Radiation Dose Criteria for Accidents"
GROUP XI	1. Conforming Part 60 to the EPA HLW Standard
GROUP XII	9. Establishment of Emergency Planning Criteria

Note: Numbers for these rulemakings are taken from SECY-89-339.

Table 5. Correlation of Regulatory and Institutional Uncertainties with Ongoing/Planned Technical Positions.

REGULATORY AND INSTITUTIONAL UNCERTAINTIES WHICH ARE RELATED TO ONGOING/PLANNED TECHNICAL POSITIONS	
UN/UN GROUP	Technical Position Number and Subject
GROUP I	19. Data and Parameter Uncertainty
	20. Formal Use of Expert Judgment
GROUP III	5. Repository Design (including appropriate regulatory guides)
	10. Preclosure Earthquake Hazard Evaluation Methods
GROUP VI	3. Waste Retrievability
	4. Retrieval Demonstration During Site Characterization
GROUP XI	17. Scenario Identification and Screening
	18. Verification and Validation of Performance Assessment Models
	19. Data and Parameter Uncertainty
	20. Formal Use of Expert Judgment
122(c)(11)-(c)(14) UN1-UN5, UN12	13. Tectonic Models Under 10 CFR Part 60
122(c)(2)-(c)(10) 122(c)(22)-(c)(24) UN1-UN5	8. Radionuclide Transport
122(c)(15) UN1 - UN5	12. Volcanic Hazard Analysis
122(c)(11)-(c)(14) UN1 - UN5	11. Probabilistic Seismic Hazard Analysis
122(c)(7)-(c)(9) UN1 - UN5	9. Chemical Interactions in Fractured Unsaturated Rock
122(c)(17)-(c)(19) UN1 - UN5	14. Natural Resource Assessment Methods
122(c)-UN12 122(c)(16)-UN19	16. Geomorphic Analysis

Notes: Numbers for these technical positions are taken from SECY-89-339.

Table 6. Regulatory and Institutional Uncertainties which are not Correlated with Ongoing/Planned Rulemaking or Technical Positions.

REGULATORY AND INSTITUTIONAL UNCERTAINTIES WHICH ARE NOT PART OF ONGOING/PLANNED RULEMAKINGS OR TECHNICAL POSITIONS

10 CFR Part 60 Citation	UN GROUP	Topical Area
135(c)(1)-UN3	GROUP IV	EBS performance
111(b)-UN3	GROUP V	Radiological safety considerations
31-UN1 23-UN1 51(a)(2)(ii)-UN1	GROUP VII	Conditions for construction authorization, license and license amendment
131(b)(9)-UN1 133(e)(1)-UN1	GROUP VIII	Regulation of mining safety and nonradiological safety considerations
10(b)-UN1 21-UN1 22(d)-UN3 24(a)-UN2 152-UN1	GROUP X	Quality assurance and information requirements
121(a)(1)-UN1	GROUP IX	Conditions of land ownership and control