CNWRA 89-003

ANALYSIS AND EVALUATION OF REGULATORY UNCERTAINTIES IN 10CFR60 SUBPARTS B AND E

Prepared for

Nuclear Regulatory Commission
Contract NRC-02-88-005

Prepared by

Center for Nuclear Waste Regulatory Analyses

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Analysis and Evaluation of
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10CFR60 Subparts B and E

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May 1989

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ANALYSIS AND EVALUATION OF REGULATORY UNCERTAINTIES IN 10CFR60 SUBPARTS B AND E

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1.0 EXECUTIVE SUMMARY

1.1 Purpose of the Analysis

The Center for Nuclear Waste Regulatory Analyses (CNWRA) has conducted a preliminary regulatory analysis of Subparts B and E of 10CFR60. The method used to analyze the regulations and identify the regulatory uncertainties, called the Program Architecture, is diagrammed in Fig. 2 and outlined in Appendix A, the uncertainties themselves are described in Appendix B, and 10CFR60 constitutes Appendix D.

As a result of this regulatory analysis, approximately eighty regulatory uncertainties were identified. The severity of these uncertainties varies: some are critical to implementation of the regulation, others are less significant, and some are of minor importance. Resolution of some uncertainties is complex and will take considerable time; others can easily be reduced, although their resolution is not critical. Moreover, it is important to reduce some uncertainties in a timely fashion, or at least to begin their reduction soon. Finally, the reduction or resolution of some uncertainties should be permanent in the sense that it should withstand the test of time and legal challenges; other uncertainties can be reduced with a temporary expedient.

The acceleration of the Program Architecture analysis resulted in a modified analytical strategy. This report is thus based on a preliminary examination of 10 CFR60; what could be considered as an analytical "first cut", and should be read with this in mind. Only Subparts B and E were included, no regulation was addressed in depth except 10CFR60, and the results were "frozen" as of 15 February 1989. Thus, all of the uncertainties were not reviewed completely by the Program Architecture Review Committee (PARC) process; technical uncertainties and, more crucially, elements of proof have not been considered.

The present analysis identifies the uncertainties in several categories, and prioritizes their reduction with respect to these categories. The categories include the criteria of importance, desired timing of resolution and durability. The combination of importance, desired timing and durability of the resolution of a given uncertainty is intended to serve as a guide to the choice of uncertainty reduction method (rulemaking, technical position, etc.). Weighting of the attributes by the decision maker, which was not within the scope of this study, may produce somewhat different priorities. The present study does not suggest any reduction method or alternative methods for any uncertainty, but provides input for such a selection to be made by the NRC.

1.2 Summary of the Report

Section 1 of the report is an executive summary: the purpose of the study is reviewed, the sections of the report are summarized, and the results of the analysis and the recommendations suggested by these results are reported.

Section 2 briefly describes the identification or elucidation of the uncertainties and discusses them. Section 3 discusses the selection and wording of the attributes against which the uncertainties are ranked, and the method used in ranking them. The attributes are given in Appendix C, and the full statement of each attribute is given at the beginning of the subsection of Section 3 in which that attribute is discussed.

Section 4 discusses the regulatory uncertainties in their relationship to individual attributes, and to groups of two to four attributes. The groups are designed to highlight time priority for resolution, importance to waste confidence and licensing, involvement of various parties to the proceedings, and any other rankings which can assist the selection of an uncertainty reduction method.

The attributes particularly related to site characterization, the site characterization plan (SCP), and the exploratory shaft facility were considered in depth in the Analysis of Regulatory Uncertainties Related to the Site Characterization Plan and the Exploratory Shaft Facility; CNWRA89-002 (Ref. 1). The results of that particular analysis will not be repeated in detail in this document. Only one attribute analysis related to site characterization – the ranking with respect to the broad attribute T1: expedite site characterization – is repeated in this report. For each of the other attributes and combinations of attributes related to site characterization, the site characterization plan, and the exploratory shaft facility (ESF), a reference to the appropriate section of CNWRA89-002 is inserted at the appropriate place. Attributes related to site characterization and the ESF are included in the table of contents, but not in the tables of attribute rankings.

Section 5 of this report ranks uncertainties with respect to overall importance, time dependence and durability. The attributes particularly related to site characterization, the site characterization plan, and the exploratory shaft facility are not included in this ranking. Sensitivity analysis is also included in this section.

Section 6 presents the results of the analyses and conclusions. There are four appendices: Appendix A outlines the Program Architecture analytical procedure; Appendix B gives the texts of the regulatory uncertainties, with explanatory notes; Appendix C lists the attributes; and Appendix D consists of 10CFR60.

1.3 Results of the Analysis

This section provides a summary of the results of this unweighted attribute analysis. A complete discussion is provided in Section 6.

1.3.1 Grouping of Uncertainties for Efficient Uncertainty Reduction

The 78 uncertainties have been assembled into groups. "Generic" uncertainty reductions could be implemented, which could result in resolution of a group of uncertainties. The groups are

- Group I: Potentially adverse conditions, UN18 through UN64 (except for UN44) in 10CFR60.122(a)
- Group II: Favorable conditions – UN16 and UN17 in 10CFR60.122(b).
- Group III: Systems, structures and components important to safety – UN65 through UN75 in 10CFR60.131(b).
- Group IV: Engineered barrier system performance – UN13 and UN14 in 10CFR60.113(a).
- Group V: ALARA and radiological safety considerations – UN9 and UN10 in 10CFR60.111(a).

- Group VI: Retrievability – UN1 in 10CFR60.23, UN7 in 10CFR60.46 and UN11 in 10CFR60.111(b).

- Group VII: Conditions for construction authorization – UN3 and UN4 in 10CFR60.32.

- Group VIII: Regulation of mining safety and other non-radiological safety considerations – UN76 through UN78 in 10CFR60.131(b)(9) and 10CFR60.133(e)

- Group IX: License amendment – UN5 through UN8 in 10CFR60.51 and 10CFR60.52.

The remaining uncertainties: UN2, UN12, UN15, and UN44 need to be considered separately.

1.3.2 Important Regulatory Uncertainties Which Are the Subject of Ongoing and Planned Rulemakings

Four uncertainties with relatively high rankings in overall importance or overall time considerations are already the subject of ongoing rulemakings. These are

UN12 – "anticipated/unanticipated processes and events"

UN2 – implementation of the Nuclear Waste Policy Act provisions requiring NRC to adopt DOE's Environmental Impact Statement addresses whether the Environmental Report required by 10CFR60 is the same as the statutorily required EIS

UN13 – the meaning of "substantially complete containment"

UN14 – the definition of "gradual" postclosure releases of radionuclides – which is related to the ongoing rulemaking on the meaning of "disturbed zone" as well as "substantially complete containment."

The ongoing rulemakings should result in reduction or resolution 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 resolve this concern.

1.3.3 Somewhat Less Important Regulatory Uncertainties Which Are the Subject of Ongoing and Planned Rulemakings

UN10 – the meaning of "at all times" with regard to radiation exposure, is related to the ongoing rulemaking on the design basis accident, and is part of Group V, together with UN9. Resolution of UN9, how ALARA applies in 10CFR60.111(a), is important to mitigation of radiological health and safety effects, and could be combined with the treatment of UN10.

Group II – UN16 and UN17 are also in this category. UN17, which is the definition of "fastest path of radionuclide travel", is related to groundwater travel time but does not

encompass the scope of the ongoing rulemaking. UN16 can be grouped with UN17 and is part of the same regulation.

1.3.4 Regulatory Uncertainties Which Are the Subject of Ongoing or Planned Technical Positions

The following uncertainties are related to technical positions which are presently being formulated. The term "related" is used here in the sense that the topics of the uncertainty and the technical position are the same, but the way in which the technical position is presently worded may not remove the uncertainty. Both uncertainties which are the subject of ongoing or planned rulemakings, and uncertainties which are not presently the subject of rulemakings, are included in this list.

This section is included in this report for completeness. Relationship to a technical position does not necessarily mean that the uncertainty in question is reduced; reduction depends on the language of the technical position.

1.3.4.1 Important Regulatory Uncertainties Which Are the Subject of Ongoing or Planned Technical Positions

The Uncertainties marked with an asterisk and italics are closely related to Technical Positions and, thus, could be adressed within the scope of the potential Technical Position. The rest of the Uncertainties only tangentially relate to the Technical Position.

Uncertainty	Technical Position
**UN9*, UN10	Repository design
UN11	Retrievability
UN12	Radionuclide transport; chemical interactions in fractured unsaturated rock, pre-closure earthquake hazard evaluation methods; probabilistic seismic hazard; volcanic hazard analysis; tectonic models; natural resource assessment methods
**UN16*	Scenario identification and screening
**UN17*	Scenario identification and screening; radionuclide transport
UN18, UN19	Scenario identification and screening; extrapolation of short-term data to long-term results
UN20, UN21	Extrapolation of short-term data to long-term results; natural resource assessment methods; scenario identification and screening
UN22, UN23	Extrapolation of short-term data to long-term results; geomorphic analysis; scenario identification and screening; volcanic hazard analysis
UN24, UN25	Extrapolation of short-term data to long-term results; tectonic models; scenario identification and screening
UN26-UN29	Extrapolation of short-term data to long-term results; radionuclide transport; scenario identification and screening
UN30-UN35	Extrapolation of short-term data to long-term results; radionuclide transport, chemical interaction in fractured unsaturated rock; scenario identification and screening
UN36, UN37	Chemical interactions in fractured unsaturated rock

UN38, UN39	Tectonic models
UN42, UN43	Tectonic models
UN40-UN43 *UN44	Extrapolation of short-term data to long-term results; preclosure earthquake hazard evaluation; probabilistic seismic hazard analysis; scenario identification and screening
UN45, UN46	Preclosure earthquake hazard evaluation; probabilistic seismic hazard analysis
UN47, UN48	Volcanic hazard analysis
UN49, UN50	Geomorphic analysis
UN51, UN52	Natural resource assessment methods
UN53, UN54	Natural resource assessment methods; geologic mapping of shafts and drifts
UN57, UN58	Extrapolation of short-term data to long-term results; scenario identification and screening
UN59-UN64	Extrapolation of short-term data to long-term results; radionuclide transport; scenario identification and screening
UN16-UN64	Verification and validation of performance assessment models; data and parameter uncertainty

1.3.4.2 Less Important Regulatory Uncertainties Which Are the Subject of Ongoing or Planned Technical Positions

Uncertainty	Technical Position
*UN1	Retrievability; retrieval demonstration
*UN7	Retrievability
UN14	Waste package reliability analysis; postclosure seals
*UN65-UN75	Repository design

1.3.5 Uncertainties Which Are Not Included in Ongoing or Planned Rulemakings or Technical Positions

1.3.5.1 Uncertainties and Uncertainty Groups Which Are Important and Require Prompt Action

1. In Group I, 29 of the 48 uncertainties related to degree of resolution and significant effect on repository performance of potentially adverse conditions (10CFR60.122(c)) ranked very high or high on overall importance and overall time consideration, and very high on overall durability. Reduction of the Group I uncertainties in 10CFR60.122(c) should be undertaken in a timely fashion and in recognition of their importance, the need for involvement of parties other than NRC, and the need for a durable resolution. It may be possible to reduce the uncertain language generically.

2. UN15 – the uncertainty in when and how the lands referred to in 10CFR60.121(a)are to be acquired and/or withdrawn, ranked consistently high. Timely reduction is advisable.

3. UN44 – the uncertain phrase "typical of the area in which the geological setting is located" in 10CFR60.122(c)(14), needs timely and durable reduction, although the need for stakeholder involvement ranked only moderate.

4. The Group III uncertainties, UN65 through UN75 in 10CFR60.131(b), dealing with systems, structures and components important to safety, are important overall. The involvement of appropriate federal agencies in the uncertainty reduction would be desirable.

1.3.5.2 Uncertainties and Uncertainty Groups Which Are Important But Do Not Require Prompt Action

This category includes the following:

UN11 – the uncertainty in the meaning of "retrievability": to design for it or not to preclude it; and UN1, which deals with retrieval of radioactive materials used in site characterization.

Group VII – UN3 and UN4 in 10CFR60.51, uncertainties in the language of the construction authorization condition as it refers to health and safety. High durability is desirable for this group of uncertainties, but prompt action is not required.

1.3.5.3 Uncertainties and Uncertainty Groups Whose Reduction Is Less Important

Group VIII – UN76, UN77, UN78, rank low or very low with respect to overall time and importance, suggesting that reduction of this group of uncertainties, while perhaps readily done, is not urgent.

Group IX – UN5 through UN8, are primarily awkwardnesses and lack of clarity in the wording of 10CFR60.51 and 10CFR60.52, which deal with the language of the license. While their reduction is relatively straightforward, it needs no time precedence.

1.3.6 Conclusion

The relationships between uncertainties and uncertainty groups, and ongoing and planned rulemakings and technical positions, is illustrated in Figure 1.

Most, though not all, of the uncertainties which are not the subject of ongoing rulemakings are important and need to be resolved in a timely fashion. Virtually all of the identified regulatory uncertainties require durable resolutions, and most resolutions would have enhanced durability if stakeholders were involved in the resolution process.

This report makes no recommendations as to the methods most desirable for uncertainty reduction. In most cases, one uncertainty reduction method will resolve more than one uncertainty. This principle is particularly applicable to the Group I uncertainties: UN18 through UN65 (exclusive of UN44).

UNCERTAINTIES WHICH ARE PART OF ONGOING/PLANNED RULEMAKINGS				UNCERTAINTIES WHICH ARE NOT PART OF ONGOING/PLANNED RULEMAKINGS	
MORE IMPORTANT		LESS IMPORTANT		MORE IMPORTANT	LESS IMPORTANT
UN/UN Group	Rulemaking	UN/UN Group	Rulemaking	UN/UN Group	UN/UN Group
UN12	anticipated/ unanticipated processes/events	Group II	groundwater travel time	Group I UN15	Group VIII Group IX
UN2	10CFR51: EIS	Group VII	license application content and criteria	UN44 Group III Group V	
Group IV	substantially complete containment	UN10	design basis accident	Group VI (prompt action not needed)	
The uncertainty groups and the rulemakings are briefly defined in Sections 6.1 and 6.2. Section 6.4 includes a discussion of the information in this figure.					

Figure 1a. Table of Correlation Between Regulatory Uncertainties and Ongoing Rulemakings.

UNCERTAINTIES WHICH ARE PART OF ONGOING/PLANNED TECHNICAL POSITIONS				UNCERTAINTIES WHICH ARE NOT PART OF ONGOING/PLANNED TECHNICAL POSITIONS	
MORE IMPORTANT		LESS IMPORTANT		MORE IMPORTANT	LESS IMPORTANT
UN/UN Group	Tech. Position	UN/UN Group	Tech. Position	UN/UN Group	UN/UN Group
Group I *Group II*	Verify/validate performance assessment models	UN30-UN37	Chem. interactions in fractured unsaturated rock	UN2 UN15	Group VII Group VIII Group IX
Group I *Group II*	Data/parameter uncertainty	UN51-UN54	Natural resource assessment methods		
UN18-UN35	Extrapolation of short-term data to long-term results	UN38-UN39 UN42-UN43	Tectonic models under 10CFR60		
UN18-UN35	Scenario identification and screen	UN47-UN48	Volcanic hazard analysis		
Group II	Scenario identification and screen	*Group III*	Repository design		
UN40-UN43 UN57-UN64 *UN44*	Extrapolation of short-term data to long-term results	Group V	Repository design		
UN40-UN44 UN57-UN64	Scenario identification and screen	Group VI	Retrievability		
UN26-UN35 UN59-UN64	Radionuclide transport	*Group VI*	Retrieval demonstration during site char.		
UN12	Radionuclide transport	UN53-UN54	Geologic mapping of shafts/drifts		
Group II	Radionuclide transport				

The uncertainty groups and the technical positions are briefly defined in Sections 6.1 and 6.3. Section 6.4 includes a discussion of the information in this figure. The uncertainties marked with an asterisk and italics are closely related to Technical Positions and thus could be addressed within the scope of the potential Technical Positions. The rest of the uncertainties are only tangentially related to the Technical Position.

Figure 1b. Table of Correlation Between Regulatory Uncertainties and Ongoing Technical Positions.

UNCERTAINTIES WHICH ARE PART OF ONGOING/PLANNED TECHNICAL POSITIONS			
MORE IMPORTANT		LESS IMPORTANT	
UN/UN Group	Tech. Position	UN/UN Group	Tech. Position
UN12	Chem. interactions in fractured unsaturated rock		
UN12 UN40-UN46	Preclosure earthquake hazard eval. methods		
UN12 UN40-UN46	Probablistic seismic hazard analysis		
UN12 UN20-UN21	Natural resource assessment methods		
UN12 UN24-UN25	Tectonic models under 10CFR60		
UN12 UN22-UN23	Volcanic hazard analysis		
UN18-UN19 UN22-UN23 UN49-UN50	Geomorphic analysis		
Group IV	Postclosure seals in unsat. media		
Group IV UN55-UN56 UN63-UN64	Postclosure seals in unsat.media		
Group IV	Waste package reliability anal.		
The uncertainty groups and the technical positions are briefly defined in Sections 6.1 and 6.3. Section 6.4 includes a discussion of the information in this figure. The uncertainties marked with an asterisk and italics are closely related to Technical Positions and thus could be addressed within the scope of the potential Technical Positions. The rest of the uncertainties are only tangentially related to the Technical Position.			

Figure 1b. Table of Correlation Between Regulatory Uncertainties and Ongoing Technical Positions. (continued)

2.0 INTRODUCTION – ELUCIDATION OF REGULATORY UNCERTAINTIES

2.1 Background of the Project

The basis for the present analysis is the result of an acceleration of the Program Architecture development. This acceleration was designed both to provide an early "proof of system" and to provide particular analyses for use by Center and NRC staff. The Program Architecture, shown in the process diagram in Figure 2, provides a systematic basis for analyzing regulations. The acceleration was structured as follows:

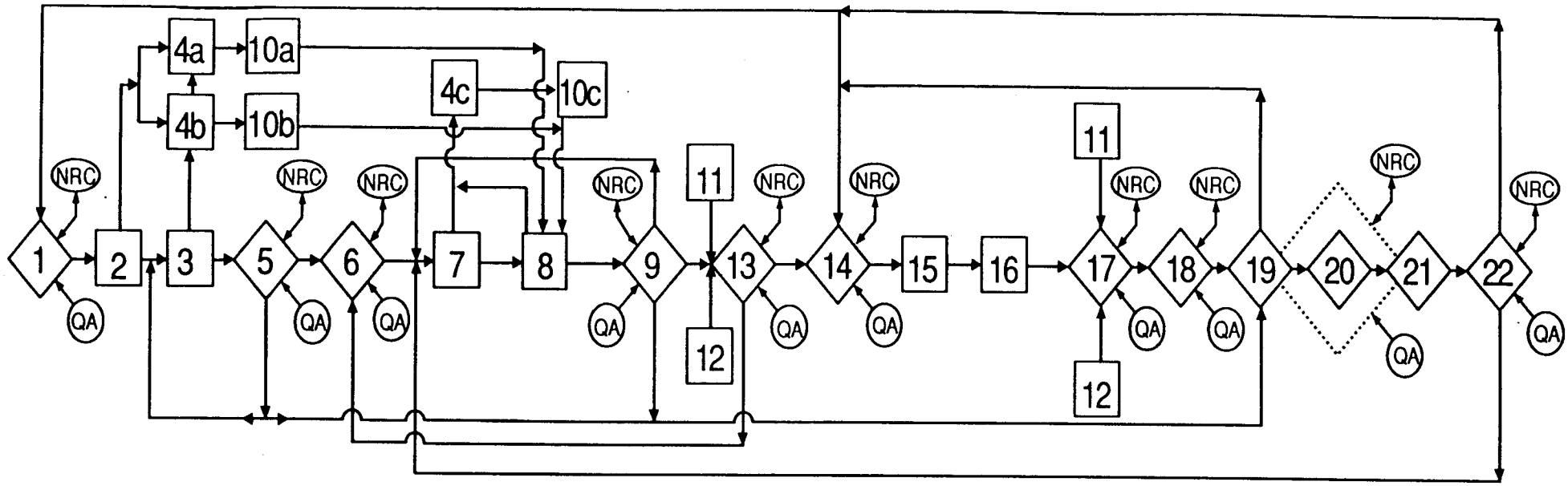
- Subparts B and E of 10CFR60 were selected for analysis.
- Regulations incorporated by reference in Subparts B and E were included in the analysis to the extent practicable.
- Regulations of other agencies dealing with high-level radioactive waste, analogous non-high-level waste NRC regulations, and enabling statutes were included in the analytical base.
- Seventy-five candidate regulatory requirements were identified by a process controlled by technical operating procedures (TOPs) and evaluated by independent Program Architecture Review Committees (PARCs).
- A total of 78 regulatory uncertainties were identified during this analysis. The sections of the TOP which govern the identification of regulatory uncertainties are given in Appendix A.
- Work is ongoing to identify uncertainties in other portions of the regulations and to define uncertainty reduction methods.

The acceleration of the Program Architecture analysis resulted in a modified analytical strategy. This report is thus based on a preliminary examination of 10CFR60: what could be considered as an analytical "first cut", and should be read with this in mind. Only subparts B and E were included, no regulation was addressed in depth except 10CFR60, and the results were "frozen" as of 15 February 1989. As is discussed in Appendix A, each regulatory requirement and thus each uncertainty is reviewed by a Program Architecture Review Committee (PARC). Acceleration of the regulatory analysis had the result that all of the uncertainties were not reviewed completely by the PARC process; technical uncertainties and, more crucially, elements of proof have not been considered.

2.2 Identifying the Uncertainties

The definition of "regulatory uncertainty" in the TOP is as follows: a regulation is said to contain an uncertainty when there is lack of clarity in the quoted statement, when an essential requirement has been omitted from the legislation, 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 both of the following questions cannot be answered:

- Does DOE know what to do in order to show compliance with the regulation?
- Does NRC know what to do to determine compliance with the regulation?



X PHASE OF THE PROCESS REQUIRING WORK AT AND INPUT FROM THE PROGRAM ELEMENTS

X PHASE OF THE PROCESS REQUIRING INTEGRATION

NRC REVIEW AND APPROVAL BY NUCLEAR REGULATORY COMMISSION

QA REVIEW AND APPROVAL BY QUALITY ASSURANCE

1. IDENTIFY POTENTIALLY APPLICABLE REGULATIONS
2. ANALYZE REGULATORY REQUIREMENTS
3. IDENTIFY AND LIST ELEMENTS OF PROOF

4a. IDENTIFY AND DESCRIBE INSTITUTIONAL UNCERTAINTIES

4b. IDENTIFY AND DESCRIBE REGULATORY UNCERTAINTIES

4c. IDENTIFY AND DESCRIBE TECHNICAL UNCERTAINTIES

5. INTEGRATE AND REVIEW REGULATORY REQUIREMENTS; AND INTEGRATE, REVIEW, AND REVISE ELEMENTS OF PROOF
6. SELECT SUBSET OF REGULATIONS FOR FURTHER ANALYSIS BASED ON TIME-CRITICAL NATURE
7. IDENTIFY BASIC APPROACH FOR COMPLIANCE DETERMINATION METHODS (REVISE AT SUBSEQUENT ITERATIONS)
8. INTEGRATEIDENTIFY INFORMATION REQUIREMENTS
9. INTEGRATE, REVIEW, AND REVISE COMPLIANCE DETERMINATION METHODS, ELEMENTS OF PROOF, AND INFORMATION REQUIREMENTS

10a. IDENTIFY INSTITUTIONAL UNCERTAINTY QUESTIONS

10b. IDENTIFY REGULATORY UNCERTAINTY QUESTIONS

10c. IDENTIFY TECHNICAL UNCERTAINTY QUESTIONS

11. OBTAIN DOE "ISSUES", INFORMATION NEEDS AND UNCERTAINTIES
12. OBTAIN STATE, TRIBE, AND OTHER AFFECTED PARTIES "ISSUES", INFORMATION NEEDS AND UNCERTAINTIES
13. INTEGRATE, CONSOLIDATE, AND RANK UNCERTAINTIES AND UNCERTAINTY QUESTIONS (INCLUDING DOE AND STATE ITEMS)
14. IF UNCERTAINTY, UNCERTAINTY QUESTION, OR INFORMATION REQUIREMENT IS UNRESOLVED, FLAG AS OPEN ITEM; SELECT ITEMS FOR NRC ACTION; IDENTIFY OTHER ACTION PARTIES

15. IDENTIFY UNCERTAINTY REDUCTION METHODS AND RELATED INFORMATION REQUIREMENTS; SPECIFY ALTERNATE NRC PROGRAMS FOR UNCERTAINTY REDUCTION
16. DEVELOP COSTS, SCHEDULES, AND LEAD TIMES FOR NRC PROGRAMS
17. ANALYZE ALTERNATIVES AND NRC PROGRAM TRADEOFFS
18. RECOMMEND NRC PROGRAM INCLUDING OVERALL RESEARCH PROGRAM PLAN
19. DEVELOP AND DISPLAY 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 NRC PROGRAM

Figure 2. Process Diagram for the Program Architecture

Although virtually all of the uncertainties identified are considered valid, they are not equally important, nor is the need for their reduction equally pressing, nor is the need for durability equivalent for all. As has been pointed out, resolution of some uncertainties is complex and will take considerable time; others can easily be reduced, and it is important to reduce still others in a timely fashion. The reduction or resolution of some uncertainties should be able to withstand the test of time, while others can be reduced with a temporary expedient.

Importance of the reduction of an uncertainty is not necessarily the same as the need for either timely resolution or slower deliberate resolution, nor is permanence (durability) necessarily equivalent to importance, timeliness, or the need for slower, more deliberate resolution. The present analysis identifies the uncertainties in several categories, and prioritizes their reduction with respect to these categories. The categories are:

- Importance: how "bad" an uncertainty is in the sense of potential impacts if it goes unresolved.
- Desired timing of resolution or reduction.
  - Is reduction of the uncertainty a time priority?
  - Can the uncertainty be reduced quickly?
- Durability: the potential for the reduction of the uncertainty to withstand the test of time.

The combination of importance, desired timing and durability of the resolution of a given uncertainty will serve as a guide to the uncertainty reduction method. The present study does not suggest any reduction method or alternative reduction methods for any uncertainty. Rather, the analysis is designed to provide input for the selection of the appropriate uncertainty reduction method by the NRC.

Statements of the currently identified uncertainties are given in Appendix B. It should be noted that more than half of the uncertainties arise in 10CFR60.122(c): the regulation which lists twenty-four potentially adverse conditions. For each of these, there are two uncertainties: what the degree of resolution or precision of the investigation of the condition should be, and what is meant, for the particular condition, by "significant effect on repository performance". Although only two phrases in the regulation are uncertain, the resolution of the uncertainty for each of these two is somewhat different for each of the 24 conditions to which it applies. It may, however, be practical and efficient to reduce all 48 of these uncertainties with two generic and generally applicable actions or clarifications.

3.0 THE ATTRIBUTES

3.1 Selecting Appropriate Attributes

Attributes were developed in order to provide a basis for prioritizing the reduction or resolution of regulatory uncertainties, so that DOE could receive early feedback on the most important uncertainties.

How is the need for resolution or the need for timely resolution, prioritized? To say that an uncertainty is "important" or that "timely resolution is desirable" is not precise enough for an outside observer to follow the logic of such a decision. Writing attributes of the decision, however, allows the decision logic to be made explicit. Attributes are statements answering the questions "why is reduction of this uncertainty important?", "why is its timely resolution desirable?" and "why should the resolution withstand the test of time?"

Since there are 78 uncertainties, but only 26 attributes, this report groups uncertainties by rank with the related attribute. Each attribute is identified by an alphanumeric designator. The alphabetic portion is either a "T" denoting a timeliness attribute, an "I" denoting an importance (other than, and distinct from, timeliness) attribute, or a "D" denoting a durability attribute. The tables listing the rankings are also identified by these alphanumeric designators.

3.2 Method of Ranking or Prioritizing the Uncertainties

A method for sorting out differences among uncertainties, refining attributes and making them more precise, and prioritizing reduction of the uncertainties was developed, using the multi-attribute utility analysis method of Keeney and Raiffa (Ref. 2). A total of 26 attributes was developed, and the uncertainties were ranked against these attributes. A flow diagram for the ranking analysis is shown in Fig. 3. For clarity, the diagram of Fig. 3 does not include the attributes or combinations of attributes which are specific to site characterization, the site characterization plan, and the ESF. These are discussed in Ref. 1. Ranking with respect to each attribute was done by CNWRA personnel, using a six-step ranking system with numerical analogs; numerical analogs allow development of composite rankings. The numerical analogs are:

Very high	=	9
High	=	7
Moderate	=	5
Low	=	3
Very low	=	1
NA	=	not applicable: no numerical analog

Prioritizing the resolution of the uncertainties and thus selecting the appropriate method or methods for uncertainty reduction, can be inferred from this type of analysis, but only with the consideration that all attributes in the analysis have equal weight. Giving some attributes a higher or lower weight than others (i.e., considering some attributes more important than others) is the prerogative of the decision maker – the NRC in this case – and is not within the purview of the decision analyst.

Differential weighting of the attributes may well yield a different set of priorities. The sensitivity analysis of Section 5.5 suggests how such priorities may emerge as a result of weighting the attributes. Setting priorities suggests methods for uncertainty reduction such as staff technical positions or rulemaking, but does not recommend any particular method – a recommendation which is the prerogative of the decision maker.

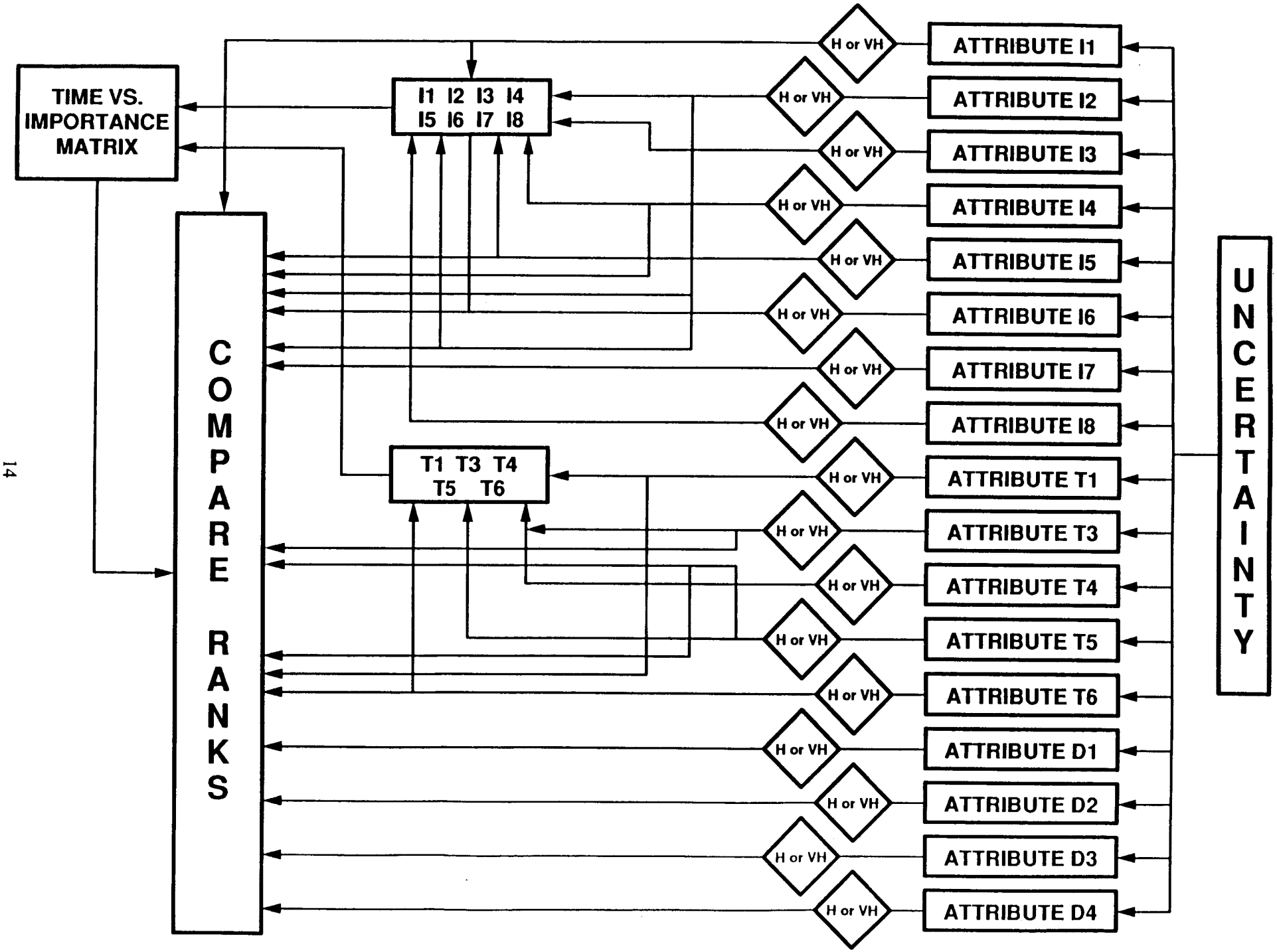


Figure 3. Flow Diagram for Prioritizing Uncertainties

4.0 THE RELATIONSHIP OF THE UNCERTAINTIES TO THE ATTRIBUTES

As was indicated in the preceding section, the attributes are divided into three groups: attributes related to importance of an uncertainty, attributes related to timeliness considerations, and attributes related to durability of the uncertainty reduction – how well the reduction will last. The attributes are stated in this section; virtually all of the statements are self-explanatory (the attributes are also given in Appendix C). Where the meaning is not manifest in the statement of the attribute, it is expanded upon and clarified in the accompanying text.

In this section, the ranking of the uncertainties against each of the attributes is analyzed and discussed. Attributes are grouped; within each group, the attributes are closely related. The uncertainties which rank "very high" with respect to any attribute are examined for their ranks with respect to other attributes in the same group, then with respect to other attributes outside the group. Priorities for uncertainty reduction are derived from these discussions. In a few cases, this analysis extends to uncertainties ranking "high" as well as to those ranking "very high".

An additional analysis was performed, which grouped all "importance" attributes, all "timeliness" attributes, and all "durability" attributes. These groupings are discussed in Section 5.

Reference 1 (CNWRA89-002) contains a thorough attribute analysis of uncertainties with respect to attributes related to site characterization plan review, the exploratory shaft, and site characterization. Only one of these attribute analyses is repeated here: T1 – the broad attribute related to expeditious site characterization. For each of the other attributes and combinations of attributes related to site characterization, the Site Characterization Plan, and the Exploratory Shaft Facility, the attribute is restated and the reader is referred to the appropriate section of CNWRA89-002.

In the sections below, the uncertainties discussed are cited by identification number (UN1 through UN78), the regulatory citation from 10CFR60 is given, and the regulatory text is stated with the uncertain language highlighted. In some cases, a highlighted phrase is added explaining the uncertainty. Complete texts of the uncertainties analyzed in this report, and the uncertainty notes, are given in Appendix B. The text of the applicable regulation is given in Appendix D.

4.1 Uncertainties Closely Correlated to Attributes Related to Importance

4.1.1 Two Independent Attributes

The first two attributes, I1 and I7, discussed are not readily grouped with any others, and are thus discussed as separate entities. They address considerations independent of any other importance criteria, and of each other.

4.1.1.1 Analytical Methods Not Available

I1. It appears that technology for testing and analytical methods for obtaining information and/or data needed to reduce the uncertainty will not be obtainable in a timely manner, so that data needed to reduce the uncertainty cannot be collected. Table I

A high rank with respect to this attribute suggests two possible options for reducing the uncertainty: either begin the reduction process early on, or look to

another part of the regulation to accomplish the same purpose as the uncertain regulation. An uncertainty ranking high only with respect to this "importance" attribute, and not to any other, might also be deferred for consideration.

There are eight uncertainties which rank "very high" with respect to this attribute. UN5 – 10CFR60.51(a)(2)(ii) – which deals with consultation of archives by potential human intruders, appears to be relatively unimportant in all other respects, and could thus be deferred.

The remaining seven uncertainties which rank "very high" with respect to this attribute also rank high or very high with respect to many other importance attributes. In these cases, the high ranking suggests that reduction of these uncertainties be addressed early in the process.

The first of these seven uncertainties, UN12, is the subject of an ongoing rulemaking. For the remainder, the significance of ranking with respect to this attribute is that there is no apparent way to obtain enough appropriate information to resolve the uncertainty directly. This attribute might thus dictate the method of uncertainty reduction, regardless of ranking with respect to other attributes.

These remaining uncertainties are:

(UN 12) **10CFR60.112** ...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**

(UN44) **10CFR60.122(c)** Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(14)** More frequent occurrence of earthquakes or earthquakes of higher magnitude than is **typical of the area in which the geological setting is located**.

(UN16) **10CFR60.122(b)(1)** The nature and rates of...processes operating within the geologic setting during the Quaternary Period, **when projected,** would not affect or would favorably affect the ability...to isolate waste. **[How far into the future?]**

(UN29 and UN49) **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(6)** Potential for changes in hydrologic conditions resulting from reasonably foreseeable climate changes

122(c)(17) The presence of naturally occurring minerals... in such form that ... economic extraction is...feasible...

(UN28 and UN43) **10CFR60.122(a)(iii)(A)** The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

122(c)(6) Potential for changes in hydrologic conditions resulting from reasonably foreseeable climate changes.

122(c)(14) More frequent occurrence of earthquakes or earthquakes of higher magnitude than is typical of the area in which the geological setting is located.

4.1.1.2 Other Uncertainties Depend on This Uncertainty

I7. Reduction of other uncertainties is highly dependent on reduction of this one: i.e., when this one is reduced, others will either be reduced more easily or will no longer exist. Table VII

A total of 48 uncertainties rank "very high" with respect to this attribute. These uncertainties, UN18 through UN64 (except for UN44), cite potentially adverse conditions and are interdependent. The same two uncertain phrases apply to each of twenty-four potentially adverse conditions. Thus, when the two uncertain phrases cited below are resolved, a framework will have been establish to reduce all of the uncertainties related to potentially adverse effects. (In the discussion of uncertainties UN18 through UN64 in Appendix B, only UN18 and UN19 are discussed fully. The discussion then may be applied to the remaining 23 potentially adverse conditions.)

The uncertain language is part of 10CFR60.122(c):

10CFR60.122(a)(i) The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

and

10CFR60.122(a)(iii)(A) The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

Two other uncertainties, UN9 and UN12, rank "very high" with respect to this attribute. The second of these, UN12, has already been cited as the subject of an ongoing rulemaking; its resolution will manifestly simplify resolution of a

number of other uncertainties. Resolution of UN9 will aid in the resolution of a number of design uncertainties.

Uncertainties dealing with systems structures and components important to safety are also interrelated; these uncertainties all ranked "high" with respect to this attribute.

(UN9) **10CFR60.111(a)** The geologic repository operations area shall be designed so that...radiation exposures...and releases of radioactive materials...will at all times be maintained within the limits specified in Part 20 of this chapter...**[How does ALARA apply in this instance?]**

and

(UN12) **10CFR60.112** ...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**

4.1.2 Attributes I3, I4, I5, I6: Uncertainties Important to Mitigation of Health and Safety Effects (Both Radiological and Non-Radiological) and Environmental Damage

4.1.2.1 Mitigation of Non-Radiological Health and Safety Effects

I3. Reducing the uncertainty displays a high potential for avoiding or mitigating adverse non-radiological health and safety effects in the operational phase. Table III

All together, sixteen uncertainties ranked "very high" for both this attribute (I3) and the next (I4); that is, for mitigating both adverse non-radiological and radiological health and safety effects. Four of these – UN11, UN12, UN59, UN67 – also ranked "very high" with respect to Attribute I6: mitigation of potential environmental damage; taken as a group, these are the most important uncertainties to resolve in order to prevent or mitigate damage in and around the geological operations area.

In analyzing these uncertainties with respect to other attributes, it was found that three of these four uncertainties – UN11, UN12, UN59 – ranked "very high" with respect to one or more time priority attributes. UN12, as is noted throughout this document, is the subject of an ongoing rulemaking.

The four uncertainties, which ranked very high for Attributes I3, I4 and I6, are:

(UN11) **10CFR60.111(b)(1-3)** The geologic repository operations area **shall be designed to preserve the option of waste retrieval**... shall be **designed so that...emplaced waste could be retrieved on a reasonable schedule...[Does this mean designed to permit retrieval or not to preclude retrieval?]**

(UN12) **10CFR60.112** ...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**

(UN59)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and **taking into account the degree of resolution achieved by the investigations**.

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(22)** Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the saturated zone.

(UN67) **10CFR60.131(b)(3)** Protection against fires and explosions **[Should explosion suppression be included, as in 10CFR72?]**

The dozen uncertainties which ranked "very high" with respect to both Attribute I3 and Attribute I4 are listed below. Eight of these twelve uncertainties – UN9, UN38, UN40, UN57, UN60, UN63, UN64, UN65 – also ranked "very high" with respect to one or more time priority attributes.

(UN9) **10CFR60.111(a)** The geologic repository operations area shall be designed so that...radiation exposures...and releases of radioactive materials...will at all times be maintained within the limits specified in Part 20 of this chapter...**[How does ALARA apply in this instance?]**

(UN13) **10CFR60.113(a)(1(i))**: The engineered barrier system shall be designed so that...**containment of HLW will be substantially complete**...

(UN21, UN23, UN27, UN60, UN64) **10CFR60.122(a)(iii)(A)** The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(2)** Potential for foreseeable human activity to adversely affect the groundwater flow system...
>
> **122(c)(3)** Potential for natural phenomena ...of such a magnitude that large-scale surface water impoundments could be created that could change the regional groundwater flow system...
>
> **122(c)(5)** Potential for changes in hydrologic conditions that would affect the migration of radionuclides to the accessible environment...

122(c)(22) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the unsaturated zone.

122(c)(24) Potential for the movement of radionuclides in the gaseous state...to the accessible environment.

(UN38, UN40, UN57, UN59, UN63) **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

122(c)(12) Earthquakes which have occurred historically that if they were to be repeated could affect the site significantly.

122(c)(13) Indications...that either the frequency of occurrence or the magnitude of earthquakes may increase.

122(c)(21) Geomechanical properties that do not permit design of the underground opening that will remain stable through permanent closure.

122(c)(22) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the unsaturated zone.

122(c)(24) Potential for the movement of radionuclides in the gaseous state...to the accessible environment.

4.1.2.2 Mitigation of Radiological Health and Safety Effects

I4. Reducing the uncertainty displays a high potential for avoiding or mitigating adverse effects on radiological safety and/or waste isolation. Table IV

When the "very high" ranked uncertainties for Attributes I3 and I4 are considered together, it is evident that virtually the entire spectrum of uncertainties concerning potentially adverse conditions is closely related to the mitigation of adverse radiological health and safety effects.

The uncertainties which rank "very high" with respect to both Attribute I4 and the preceding Attribute (I3) have already been discussed. There are ten additional uncertainties which rank "very high" with respect to Attribute I4. One of these, which also ranks "very high" with respect to a time priority attribute, is:

(UN61)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to

which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(23)** Potential for...future perched water bodies...that may provide a faster flow path...to the accessible environment.

The additional uncertainties which rank "very high" with respect to this attribute but not to the preceding one (I3) are:

(UN45, UN47, UN49, UN51, UN52, UN53, UN62) **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(15)** Evidence of igneous activity since the start of the quaternary period
>
> **122(c)(16)** Evidence of extreme erosion during the Quaternary period.
>
> **122(c)(17)** The presence of naturally occurring materials, whether identified or unidentified, within the site...
>
> **122(c)(18)** Evidence of subsurface mining for resources within the site.
>
> **122(c)(19)** Evidence of drilling for any purpose within the site.

10CFR60.122(a)(iii)(A) The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(18)** Evidence of subsurface mining for resources within the site
>
> **122(c)(23)** Potential for...future perched water bodies...that may provide a faster flow path...to the accessible environment.

(UN70)**10CFR60.131(b)(6)** Structures, systems and components important to safety...shall be designed to permit periodic inspection and maintenance...**[the analogous section of 10CFR72 is more precise and specific].**

(UN71)**10CFR60.131(b)(7)**Criticality control...**[the analogous section of 10CFR72 is more precise and specific].**

4.1.2.3 Mitigation of Chemical Contamination

I5. Reducing the uncertainty displays a high potential for avoiding or mitigating chemical contamination problems. Table V

This attribute was written to address the contingency that some repository operations might lead to chemical contamination during the operational phase or the postclosure phase. Examples of such contamination might include invasion of drilling fluid additives into the rock and chemical contaminants introduced by fire suppression, construction activities, etc. However, only one uncertainty ranked "very high" with respect to this attribute, and nine ranked "high. Virtually all of these involved systems, structures and components important to safety. The "very high"-ranked uncertainty is:

(UN67) **10CFR60.131(b)(3)** Protection against fires and explosions **[Should explosion suppression be included, as it is in 10CFR72?]**

4.1.2.4 Mitigation of Irreversible Environmental Disturbance

I6. Reducing the uncertainty displays a high potential for avoiding or mitigating irreversible environmental disturbance. Table VI

Five uncertainties ranked "very high" with respect to this uncertainty. Four of these ranked "very high" with respect to both Attribute I3 and Attribute I4; three, with respect to one or more of the time priority attributes. These four uncertainties are:

(UN11) **10CFR60.111(b)(1-3)** The geologic repository operations area **shall be designed to preserve the option of waste retrieval**... shall be **designed so that...emplaced waste could be retrieved on a reasonable schedule...[Does this mean designed to permit retrieval or not to preclude retrieval?]**

(UN12) **10CFR60.112** ...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**

(UN59)**10CFR60.122**(a)(i) The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(22)** Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the saturated zone.

(UN67) **10CFR60.131(b)(3)** Protection against fires and explosions **[Should explosion suppression be included, as in 10CFR72?]**

The fifth "very high" ranking uncertainty, which also ranked "very high" with respect to Attribute I4 (but not Attribute I3) is:

(UN61)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(23)** Potential for...future perched water bodies...that may provide a faster flow path...to the accessible environment.

4.1.3 Attributes I2, I8: Uncertainties Important to Waste Confidence and the Overall Repository Program

4.1.3.1 Pervasive Effect on Repository Program

I2. Reducing this uncertainty has a pervasive effect on the repository program, in that more than one phase of the program will be affected. Table II

Slightly more than half of the uncertainties relating to potentially adverse conditions (10CFR60.122(c)) – UN18 through UN64 – ranked "very high" or "high" with respect to this attribute. Such a result is not surprising since these conditions are potentially adverse in part because they do have a pervasive effect on the repository and thus on the repository program. Any uncertainty which has a pervasive effect on the repository program is an important uncertainty.

In particular, five uncertainties rank "very high" with respect to attribute I2. One of these, UN12, ranks "very high" with respect to thirteen of the attributes discussed in this report, including the previously discussed attribute, and "high" with respect to three attributes. UN12 is also, as has been mentioned, the subject of an ongoing rulemaking.

The other four uncertainties which rank "very high" are UN26, UN50, UN59, UN60. UN59 and UN60, the uncertainties related to potential rise in the water table, rank "very high" or "high" with respect to six of the seven other importance attributes analyzed in this report, including effect on waste confidence and dependence of resolution of other uncertainties on these. In addition, these uncertainties rank "very high" with respect to several time attributes, including expediting licensing review. UN59 and UN60 thus emerge as very important uncertainties.

(UN12) **10CFR60.112** ...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**

(UN50 and UN60) **10CFR60.122(a)(iii)(A)** The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(17)** The presence of naturally occurring minerals... in such form that ... economic extraction is...feasible...
>
> **122(c)(22)** Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the unsaturated zone.

(UN26 and UN59)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(5)** Potential for changes in hydrologic conditions that would affect the migration of radionuclides to the accessible environment...
>
> **122(c)(22)** Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the unsaturated zone.

4.1.3.2 Significant Impact on Waste Confidence

I8. Reducing the uncertainty has a significant impact on the waste confidence decision. Table VIII

The four uncertainties which rank "very high" with respect to attribute I8 are identical with four of the five which rank "very high" with respect to the preceding attribute: having a pervasive effect on repository performance. Moreover, overlap between the total of "very high" and "high" ranking uncertainties for Attribute I8 and Attribute I2 is almost complete. This is not surprising, since a phenomenon having a pervasive effect on repository performance is bound to affect the waste confidence decision, and vice versa.

One may also conclude that reduction of uncertainties UN12, UN26, UN50, UN59 and UN60 is very important.

4.1.4 Uncertainties Important to Site Characterization and the Site Characterization Plan and the ESF, and Analyzed in CNWRA89-002

4.1.4.1 Significant Irreversible Effect on Repository Performance

I9. There is a high potential for significant and irreversible adverse effects on repository performance (radiological safety and/or waste isolation) if this uncertainty is not reduced before site characterization proceeds.

See CNWRA89-002 (Ref. 1), page 10.

4.1.4.2 Significant Irreversible Effects on Characterization

I10. There is a high potential for significant and irreversible/unmitigable effects on characterization that would physically preclude obtaining the information necessary for licensing if this uncertainty is not reduced before site characterization proceeds.

See CNWRA89-002 (Ref. 1), page 10.

4.1.4.3 Misinterpretation or Misapplication of Standards – Radiological

I11. There is a high potential for misinterpretation or misapplication of the pertinent 10CFR60 standards regarding radiological safety and/or waste isolation during Exploratory Shaft Facility (ESF) design, construction, and/or construction testing if this uncertainty is not reduced.

See CNWRA89-002 (Ref. 1), page 12.

4.1.4.4 Misinterpretation or Misapplication of Standards – Nonradiological

I12. There is a high potential for misinterpretation or misapplication of the pertinent 10CFR60 standards other than those concerning radiological safety and/or waste isolation during Exploratory Shaft Facility (ESF) design, construction, and/or construction testing if this uncertainty is not reduced.

See CNWRA89-002 (Ref. 1), page 12.

4.2 Uncertainties Closely Correlated to Attributes Related to Time Dependence and Time Priority

4.2.1 Uncertainties Which Should Be Reduced in a Timely Fashion, Though Timely Reduction May Be Difficult

This group of attributes addresses the question of time precedence, and suggests that resolution of uncertainties ranking "high" or "very high" for any combination of these attributes be given a relatively high priority.

4.2.1.1 *Expedite Site Characterization*

T1. Reducing the uncertainty will enable site characterization to be performed expeditiously. Table IX

This is a very broadly written attribute, and can best be thought of as a general screen for the relation of uncertainties to site characterization. Table IX lists the regulatory uncertainties in rank order for this attribute.

Three uncertainties were ranked "very high" with respect to attribute T1, and two of these have to do with NRC jurisdiction over mine safety, which is important because of construction activities. However a large number of uncertainties (50) ranked "high", including the uncertainties in 10CFR60.122(c) regarding the degree of resolution and the significance of effect on repository performance of the entire range of potentially adverse conditions.

The need for timely resolution of these uncertainties is self-evident: UN75 and UN77 will impinge on site characterization activity, since they involve mine safety. For UN44, the area must be defined early on in the investigation; otherwise, how can one say what is typical of the area? Each of these three uncertainties also ranks "high" in at least one importance attribute (See Section 5).

The three uncertainties which ranked "very high" are:

(UN44) **10CFR60.122(c)** Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(14)** More frequent occurrence of earthquakes or earthquakes of higher magnitude than is **typical of the area in which the geological setting is located.**

(UN75) **10CFR60.131(b)(9)** Structures, systems and components important to safety; compliance with mining regulations. To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977...**the design of the geologic repository shall nevertheless include such provisions for worker protection...[Are procedures included, or only design?]**

(UN77) **10CFR60.131(b)(9)** Structures, systems and components important to safety; compliance with mining regulations. **To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977**...the design of the geologic repository shall nevertheless include such provisions for worker protection...

4.2.1.2 *DOE Needs Guidance*

T4. It is desirable to reduce this uncertainty relatively quickly because DOE needs guidance with respect to the uncertainty. Table XI

Eleven uncertainties ranked "very high" in both attributes T4 and T6 (Expedite Licensing Review). Two of these, UN12 and UN59, rank "very high" with respect to six of the importance attributes, including impact on the waste confidence decision; the need for expeditious resolution of these two uncertainties is thus clearly demonstrated, even taking into account the sensitivity analysis of Section 6. These two are:

(UN12) **10CFR60.112** ...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**

and

(UN59) **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and **taking into account the degree of resolution achieved by the investigations**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(22)** Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the unsaturated zone.

Six of the uncertainties ranking "very high" for both attribute T4 and attribute T6 also ranked "very high" for attributes I3 and I4 – mitigation of radiological and non-radiological health and safety effects – and for attribute I7. The last dependence indicates that resolving these uncertainties will aid in the resolution of a number of others. These six uncertainties are UN9, UN38, UN40, UN59, UN63, and UN64.

(UN9) **10CFR60.111(a)** The geologic repository operations area shall be designed so that...radiation exposures...and releases of radioactive materials...will at all times be maintained within the limits specified in Part 20 of this chapter...**[How does ALARA apply in this instance?]**

(UN38, UN40, UN59, UN63) **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and **taking into account the degree of resolution achieved by the investigations**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(12)** Earthquakes which have occurred historically that if they were to be repeated could affect the site significantly.

122(c)(13) Indications...that either the frequency of occurrence or the magnitude of earthquakes may increase.

122(c)(22) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the saturated zone.

122(c)(24) Potential for the movement of radionuclides in the gaseous state...to the accessible environment.

(UN64)**10CFR60.122(a)(iii)(A)** The potentially adverse ... condition...is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

122(c)(24) Potential for the movement of radionuclides in the gaseous state...to the accessible environment.

Three uncertainties – UN14, UN15, UN16 – rank "very high with respect to both attribute T4 and attribute T6, but not particularly high with respect to any of the importance attributes. Thus, not only does DOE need guidance on these topics, but reducing the uncertainties will expedite the licensing process. Priority for the reduction of these is still high, but perhaps not as high as for those listed above.

(UN14) **10CFR60.113(a)(1)(i)(B)**: ...any release of radionuclides from the engineered barrier system **shall be a gradual process which results in small fractional releases...**

(UN15) **10CFR60.121(a)...lands that are either acquired lands under jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use. [when and how are such lands to be acquired and/or withdrawn?]**

(UN16)**10CFR60.122(b)(1)** The nature and rates of...processes operating within the geologic setting during the Quaternary Period, **when projected,** would not affect or would favorably affect the ability...to isolate waste. **[How far into the future?]**

Three uncertainties – UN11, UN26, UN65 – rank "very high" with respect to attribute T4, indicating priority for resolution only because DOE needs guidance, and also rank "very high" with respect to three of the importance attributes which deal with mitigation of adverse effects. UN26, dealing with potentially adverse hydrologic conditions, might take precedence over the other two in priority because it ranked "very high" both with respect to effect on the waste confidence decision and with respect to a number of attributes which dealt with site characterization plan review and site characterization (See CNWRA89-002).

(UN11)**10CFR60.111(b)(1-3)** The geologic repository operations area **shall be designed to preserve the option of waste retrieval**... shall be **designed so that...emplaced waste could be retrieved on a reasonable schedule**...**[Does this mean designed to permit retrieval or not to preclude retrieval?]**

(UN26)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and **taking into account the degree of resolution achieved by the investigations**.

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(5)** Potential for changes in hydrologic conditions that would affect the migration of radionuclides to the accessible environment...

(UN65)**10CFR60.131(b)(3)** Protection against fires and explosions **[Does redundancy permit failure of some systems?]**

Six uncertainties – UN9, UN38, UN40, UN59, UN63, UN65 – ranked "very high" for both Attribute T4 and Attribute T6, and for Attributes I3 and I4.

4.2.1.3 Expedite Licensing Review

T6. The statutory licensing review will be expedited in the course of reducing the uncertainty because the potential for protracted litigation will have been avoided. Table XIII

The uncertainties which rank "very high" with respect to both attribute T6 and T4 have already been discussed above. There are six uncertainties which rank "very high" with respect to T6 but not with respect to T4. One of these also ranks "very high" with respect to six importance attributes, including a pervasive effect on the repository program and a significant effect on the waste confidence decision. This uncertainty is:

(UN60) **10CFR60.122(a)(iii)(A)** The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(22)** Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located within the unsaturated zone.

Thus, this uncertainty is very important, but the priority rank of its resolution depends only on the fact that resolving it will expedite the licensing program.

This one time-related, priority attribute may be enough to give its resolution a certain degree of precedence, however.

The other five uncertainties ranking "very high" with respect to this attribute are UN42, UN49, UN57, UN62, UN71. All except one (UN71) ranked "very high" on one or two importance attributes related to effects on health and safety or environment.

(UN42, UN49,UN57)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(14)** More frequent occurrence of earthquakes or earthquakes of higher magnitude than is typical of the area
>
> **122(c)(17)** The presence of naturally occurring materials, whether identified or unidentified, within the site...
>
> **122(c)(21)** Geomechanical properties that do not permit design of the underground opening that will remain stable through permanent closure.

(UN62) **10CFR60.122(a)(iii)(A)** The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(23)** Potential for...future perched water bodies...that may provide a faster flow path...to the accessible environment.

(UN71) **10CFR60.131(b)(7)** All systems for...isolation of radioactive waste shall be designed to ensure that a nuclear criticality accident is not possible unless...**[Regulation does not provide for criticality control]**

4.2.2 Uncertainties Which Can Be Reduced in a Timely Fashion Although Timely Reduction May Not Be Needed

Two attributes (T3 and T5) relate to this criterion. As will become evident in the discussion below, they form a logical group, but can be considered separately.

4.2.2.1 Proceed Without Reducing Other Uncertainties

T3. Reduction of this uncertainty can proceed without prior reduction of other uncertainties or prior NRC rulemaking. Table X

All of the uncertainties except one ranked "very high" (80%) or "high" (20%) with respect to attribute T3, indicating that virtually all of the regulatory uncertainties identified are independent of each other. A potential constraint on uncertainty reduction has thus been shown to be absent.

4.2.2.2 *Long Time Not Needed for Closure*

T5. A long time will not be needed to come to closure on reduction of the uncertainty. Table XII

Four uncertainties – UN1, UN11, UN14, UN78 – ranked "very high" with respect to attribute T5. One of these, UN11, also ranked "very high" with respect to mitigating adverse radiological health and safety effects (attribute I4), and adverse environmental effects (attribute I6), and "high" with respect to impact on the waste confidence decision (attribute I8). UN1, UN14 and UN78, on the other hand, do not rank particularly high with respect to any other attribute. Their reduction could thus be accomplished at any time before licensing.

Clarification of the language in UN1 describing the retrievability option could thus be undertaken in a timely manner, since it can be done reasonably expeditiously and since this is an important uncertainty.

These uncertainties are:

(UN1) **10CFR60.16, 60.17, 60.23: The nature of the uncertainty is not found in the regulatory language. 42USC10133(c)(2)requires that radioactive material used for testing be "completely retrievable": the meaning of this phrase is unclear.**

(UN11)**10CFR60.111(b)(1-3)** The geologic repository operations area **shall be designed to preserve the option of waste retrieval**... shall be **designed so that...emplaced waste could be retrieved on a reasonable schedule...[Does this mean designed to permit retrieval or not to preclude retrieval?]**

(UN14) **10CFR60.113(a)(1)(i)(B)**: ...any release of radionuclides from the engineered barrier system **shall be a gradual process which results in small fractional releases...**

(UN78) **10CFR60.133(e)**Openings in the underground facility shall be designed so that **operations can be carried out safely...[Will NRC regulate non-radiological safety?]**

4.2.3 Attributes Relating to Site Characterization and the SCP Analyzed in CNWRA89-002

4.2.3.1 Expand Scope of DOE Site Characterization Activity

T2. If the uncertainty is not resolved there is potential for expansion of the scope of DOE's site characterization activities.

See CNWRA89-002 (Ref. 1), page 9.

4.2.3.2 Significant Redirection of DOE Activities

T7. There is a high potential for significant redirection of DOE's studies that would result in disruption to characterization schedules and sequencing of studies and would interfere with DOE's ability to obtain the information necessary for licensing if this uncertainty is not reduced before site characterization proceeds.

See CNWRA89-002 (Ref. 1), page 11.

4.2.3.3 Adverse Effects on Licensing Process

T9. There is high potential for significant adverse effects on the repository licensing process (but not for irreparable damage to repository performance) if the uncertainty is not reduced before site characterization proceeds.

See CNWRA89-002 (Ref. 1), pages 12-13.

4.2.3.4 Significant but Correctable Schedule Disruption

T10. There is high potential for significant but correctable or mitigable disruption to characterization schedules and sequencing of studies that would interfere with and/or delay DOE's schedule for obtaining the information necessary for licensing if the uncertainty is not reduced before site characterization proceeds.

See CNWRA89-002 (Ref. 1), page 13.

4.2.4 Inadequacies in QA Program

T8. There is a high potential for inadequacies to arise in the QA program which must be resolved prior to commencement of site characterization if this uncertainty is not reduced before site characterization proceeds.

There were no uncertainties related to this attribute.

4.3 Uncertainties Closely Correlated to Attributes Related to Durability

The category of "durability" combines a direct durability attribute – that the uncertainty reduction stand the test of time well, and not be likely to be overturned by subsequent events – with three attributes which gauge the desirability of involving parties other than NRC in the uncertainty reduction. This grouping was arrived at because involvement of additional parties in regulatory decisions has historically tended to enhance the durability of these decisions.

It should be noted also that, although rulemaking generally cannot be challenged in a licensing proceeding (SECY 88-285, Ref. 3), "high" or "very high" durability is not a sufficient justification to support a recommendation for rulemaking. A number of uncertainties are of such a nature that their reduction is not likely to be challenged, particularly if interested parties other than NRC are part of the uncertainty reduction process.

4.3.1 Stakeholder Involvement

D1. A high level of stakeholder involvement is desirable in reducing this uncertainty – it is the sort of uncertainty in which the stakeholders are judged to be appropriately involved. (Stakeholders include the public, utilities, interest groups, Tribes.) Table XIV

It should be noted that Native American Tribes are included with other stakeholders; this inclusion would not be applicable if a proposed repository were located directly on Tribal land and an affected Tribe had been designated. In that circumstance, an attribute would have been written for the involvement of the affected Tribe.

Attribute D1 indicates the wisdom of involving the general public in reduction of the uncertainty; that is, reducing or resolving the uncertainty by a public process. Thirteen uncertainties ranked "very high" with respect to attribute D1. Eleven of these ranked "very high" with respect to all four of the "durability" attributes, indicating that reduction of these uncertainties could well involve other agencies and the general public, and indicating further that a high degree of durability is desirable for the uncertainties. The sections of the regulation involved deal with two general topics which are now highly visible and have thus generated public concern. The first of these is environmental damage and radioactive releases; the second, land ownership and economic resource extraction. At present, people want to be integrally involved in decisions in these areas.

The eleven uncertainties ranking "very high" for all four durability attributes are:

(UN2)**10CFR21(a) ...An environmental report shall be prepared in accordance with Part 51 of this Chapter and shall accompany this application...[how is this ER related to the EIS required by statute?]**

(UN3) **10CFR60.32(a)** A construction authorization shall include such conditions as the commission finds to be necessary to protect **the health and safety of the public, the common defense and security, or environmental values.**

(UN9 and UN10) **10CFR60.111(a), 132(a) and(b)**: proper application of ALARA (in analogy to the appropriate section of 10CFR72) and the meaning of the phrase "radiation exposures...will **at all times** be maintained within the limits specified in Part 20..." **[How does ALARA apply in this instance?]**

(UN11) **10CFR60.111(b)(1-3)** The geologic repository operations area **shall be designed to preserve the option of waste retrieval**... [and] shall be **designed so that...emplaced waste could be retrieved on a reasonable schedule**...**[does design "to preserve the option of retrievability" mean design to permit retrieval or design not to preclude retrieval?]**

(UN13) **10CFR60.113(a)(1(i))**: The engineered barrier system shall be designed so that...**containment of HLW will be substantially complete**... and any release of radionuclides **shall be a gradual process...**

(UN15) **10CFR60.121(a)...lands that are either acquired lands under jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use. [when and how are such lands to be acquired and/or withdrawn?]**

(UN16 and UN17) **10CFR60.122(a)(1), 122(b(7))**: A geologic setting shall exhibit...pre-waste-emplacement ground water travel time along the **fastest path of likely radionuclide travel** ...

(UN49 and UN50) **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and **taking into account the degree of resolution achieved by the investigations**....and... the potentially adverse human activity or natural condition is shown...**not to affect significantly** the ability of the geologic repository to meet the performance objectives relating to isolation of the waste.

10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....

> **122(c)(17)** The presence of naturally occurring materials, whether identified or unidentified, within the site...

The two additional uncertainties which ranked "very high" for all durability attributes except D3 are:

(UN72 and UN73) **10CFR60.131(b)(7)**: All systems for ... isolation of radioactive waste shall be designed to ensure that a nuclear criticality accident is not possible...**[the cited 10CFR60 regulation on criticality control is not as precise or stringent as the analogous regulation in 10CFR72.**

The potential for criticality, no matter how remote, raises public apprehension, and prudence suggests a high degree of public involvement in any decisions involving this potentiality.

4.3.2 State of Nevada Involvement

D2. A high level of State of Nevada involvement is desirable in reducing this uncertainty – it is the sort of uncertainty in which the State of Nevada is judged to be appropriately involved. Table XV

Sixty-seven of 78 uncertainties ranked "high" or "very high" with respect to attribute D2, confirming the mandate for heavy affected state involvement in decisions about the repository. The durability of reductions of all of the uncertainties will be enhanced by allowing the State of Nevada to be part of the uncertainty reduction process.

4.3.3 Other Federal Agency Involvement

D3. A high level of Federal agency involvement is desirable in reducing this uncertainty. Table XVI

Twenty-two uncertainties ranked "very high" with respect to attribute D3. In addition to the eleven cited above, these included the remaining sections of 10CFR60.122(c) – all of the potentially adverse conditions – as well as:

(UN77) **10CFR60.131(b)(9)** Structures, systems and components important to safety; compliance with mining regulations. **To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977**...the design of the geologic repository shall nevertheless include such provisions for worker protection...

and

(UN78) **10CFR133(e)** Openings...shall be designed **so that operations can be carried out safely...[Will NRC regulate non-radiological safety?]**

Reduction of these twenty-two regulatory uncertainties will involve some regulatory overlap with one or another agency.

4.3.4 Uncertainty Reduction Should Be Durable

D4. It is desirable that the reduction of this uncertainty be durable, that the reduction would stand the test of time well, and would not be likely to be countermanded by subsequent events, such as advances in technology or new siting information. Table XVII

Seventy of 78 uncertainties – essentially all of them – ranked "very high" or "high" with respect to attribute D4, indicating that durable or permanent reductions or resolutions are desired for virtually all of the uncertainties presently identified.

4.4 Summary Diagram of Attributes and Uncertainties

A summary diagram which correlates attributes, uncertainties, and ranks is given in Figure 4.

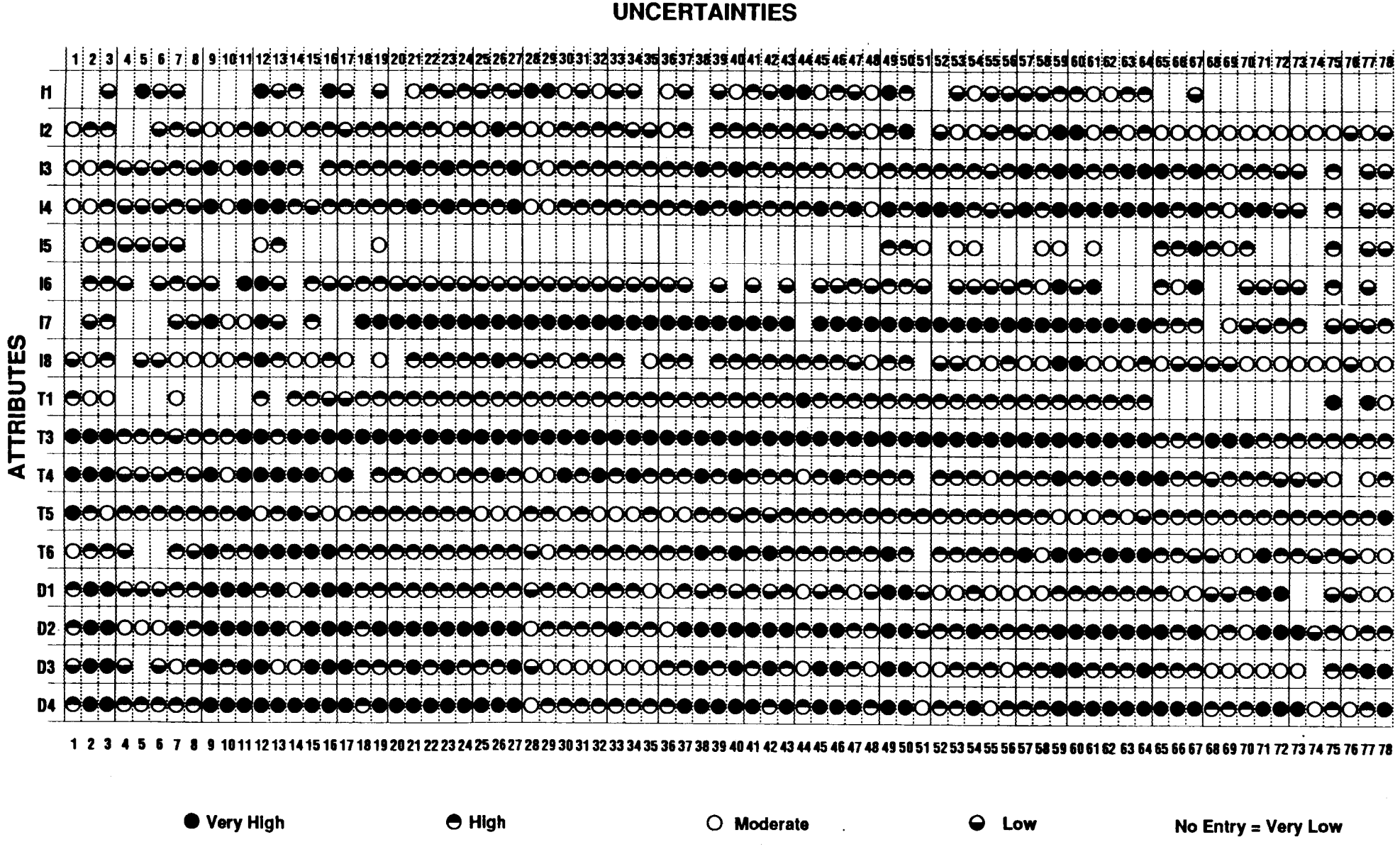


Figure 4. Summary Chart of Ranks of Attributes for Each Uncertainty

5.0 RANKING OF UNCERTAINTIES BY COMBINATIONS OF ATTRIBUTES

The ranking of uncertainties with respect to various combinations of attributes is shown in Figure 5. In general, the following categories are designated for combinations of attributes.

Very high = top 10% of combined ranks
High = next 20% of combined ranks
Moderate = middle 40% of combined ranks
Low = next-to-lowest 20%
Very low = lowest 10%

IMPORTANCE	TIME				
	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
VERY LOW	4 5 6 8 74 76	77 78	1		
LOW	68 72 73	10 17 51 69 71	15 38 52 34	2 55	14
MODERATE		7 9 28 29 70 75 66	13 16 23 20 25 33 35 36 37 39 42 45 47 48 53 56 58	30 31 44 54 62	18
HIGH	67	65	3 11 19 21 27 41 61	22 24 40 32 46 63	57
VERY HIGH			43	26	12 49 50 59 60 64

Figure 5. Matrix of Overall Importance Ranking And Overall Time Consideration Ranking for the 78 Uncertainties.

These categories coincided rather well with natural "clusters" of importance and time combinations. However, 77% of the uncertainties ranked "high" or "very high", with respect to durability, so that the categories are not meaningful for durability. Durability is thus used only in comparison with time and importance. The ranks for durability retain the definitions of ranks for single attributes, as given in Section 3.2.

5.1 Uncertainties Ranking "High" in Importance

5.1.1 Uncertainties Ranking "Very High" in Importance

When all importance attributes are taken together, the eight uncertainties ranking "very high" are UN12, UN26, UN43, UN49, UN50, UN59, UN60 and UN64. Six of these – UN12, UN49, UN50, UN59, UN60, UN64 – also rank "very high" with respect to timeliness, and most of these rank "very high" with respect to expediting licensing review. This list also includes the four uncertainties which rank "very high" with respect to impact on waste confidence and the five which rank "very high" with respect to pervasive impact on the repository program: UN12, UN26, UN50, UN59, UN60. All of these uncertainties rank "very high" with respect to durability.

5.1.2 Uncertainties Ranking "High" in Importance

Sixteen uncertainties rank "high" with respect to importance: UN3, UN11, UN19, UN21, UN22, UN24, UN27, UN32, UN40, UN41, UN46, UN57, UN61, UN63, UN65, UN67. Six of these – UN22, UN24, UN32, UN40, UN46, UN63 – also rank "high" with respect to time. With one exception (UN21, which ranks well into the "moderate" range on time) the remainder rank in the high part of the "moderate" range with respect to time.

5.2 Uncertainties Ranking "High" With Respect to Time Considerations

5.2.1 Uncertainties Ranking "Very High" in Time Dependence

In addition to the six which also rank "very high" for importance, and are listed in Section 5.1.1, above, Uncertainties UN14 and UN18 ranked "very high" with respect to time considerations. UN18 ranks "very high" with respect to DOE's need for guidance, and UN14 ranks "very high" both with respect to DOE's need for guidance and expediting the licensing process. However, UN14 ranks "low" in overall importance, and UN18 ranks in the low "moderate" range for importance. Both rank "high" for durability.

These rankings suggest that these two uncertainties require a timely reduction method, but are not as important as those discussed in the foregoing section. The lower ranking of UN14 is caused by "low" ranks in attributes dealing with chemical contamination, environmental disturbance, and dependence on other uncertainties. Similarly, the ranking of UN18 is influenced by "low" ranks in attributes dealing with availability of analytical methods, chemical contamination, and impact on waste confidence. Different weightings of these attributes could lead to higher ranks for each of these uncertainties. The uncertainties are:

> (UN14) **10CFR60.113(a)(1)(i)(B)**: ...any release of radionuclides from the engineered barrier system **shall be a gradual process which results in small fractional releases...**
>
> (UN18)**10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**
>
> 10CFR60.122(c) Potentially Adverse Conditions. The following conditions are potentially adverse conditions....
>
> **122(c)(1)** Potential for flooding of the underground facility...

5.2.2 Uncertainties Ranking "High" in Time Dependence

In addition to the uncertainties mentioned in Section 5.2.1, seven uncertainties rank "high" with respect to time: UN2, UN30, UN31, UN44, UN54, UN55, UN62. One of these, UN55, ranks "low" in overall importance; another, UN2, ranks at the low end of "moderate" and might have been considered as ranking "low". The other five rank "moderate" in overall importance.

However, when one examines ranks with respect to attribute I2, pervasive effect on repository performance, and attribute I8, effect on waste confidence, a slightly different picture emerges. Two uncertainties, UN31 and UN44, rank "high" with respect to both of these attributes, and three – UN2, UN30, UN62 – rank "high" with respect to attribute I2. Depending on how individual attributes are weighted, UN31 and UN44 could be considered "high" in both importance and time dependence, UN2, UN30, and UN62 almost as "high".

5.3 Uncertainties Ranking "High" in Durability

As has been pointed out, all of the uncertainties considered in Sections 5.1 and 5.2 rank "high" or "very high" (7.5 to 9.0) with respect to need for durability in their resolution.

5.4 Correlation Between Importance and Time Ranks

Figure 5 is a diagram showing correlations between overall importance rank and rank for overall time considerations. The uncertainties, referred to by number in the diagram, cluster in a nearly diagonal matrix. The matrix demonstrates some expected relationships between time and importance.

1. Approximately 90% of the uncertainties either have the same qualitative rank for overall time considerations as for overall importance, or the rank differs by only one bracket.

2. Deviations from this condition – situations where an uncertainty has a markedly different rank for overall importance than for time – are symmetrical; that is, "high" rank for time and "low" rank for importance occur approximately as often as the reverse.

5.5 Sensitivity Considerations

To estimate how sensitive the overall importance and time rankings are to changes in the rank of one or two individual attributes, two types of sensitivity analyses were done. The first sensitivity analysis consisted of changing the ranking of all uncertainties by one rank, first for attribute I2 then, in addition, for attribute I8. The resulting overall importance ranks did not change relative to each other. However, the change in the actual rank ranged from 6% to 29%, with an average and a median of 10%. If the six lowest-ranking uncertainties are not included, the range is from 6% to 15%. This analysis was repeated for time considerations, changing attribute T4 and the attribute T6. Results were the same as for importance, except that the change in actual rank ranged overall from 1% to 20%.

The second sensitivity analysis consisted of weighting one of the attributes in each category (importance and time) twice as "high" as any of the others. The attributes chosen for double-weighting were I8 and T6, judged to be among the most critical attributes. The relative importance ranks changed as follows:

25% of the uncertainties ranked one category lower.
12.5% of the uncertainties ranked two categories lower.
20% of the uncertainties ranked one category higher.
10% of the uncertainties ranked two categories higher.

A "category" refers to "very high", "high", etc. The overall ranks changed from 1% to 28%, with an average change of 13% and a median change of 14%.

In the similar sensitivity analysis performed for overall time considerations, the relative ranks of the uncertainties did not change, and the ranks changed from 6% to 28%, with an average of 16%.

The overall ranking of any uncertainty with respect to time considerations or importance is thus sensitive to the weight given to any single attribute. However, there is a limit to productive quantitative dissection of an essentially qualitative analysis like this one. The authors believe that the analysis is not aided by performing a more exhaustive sensitivity analysis. The overall rankings for time and importance are really less consequential to prioritizing uncertainties than consideration of rank with respect to individual attributes, or with respect to groups of two or three attributes which address similar questions. Thus, more precise interpretations of the results of the analysis are found in perusal of ranks with respect to the individual attributes.

The sensitivity analysis does give an indication of the extent to which any conclusion drawn might change as a result of differential weighting of the attributes. Weighting the attributes is a way for the decision maker to demonstrate the relative importance of the attribute to the decision: e.g. if waste confidence is twice as important as mitigation of environmental disturbance, it could receive twice the weight. However, weighting is the prerogative of the decision maker rather than of the decision analyst. The decision maker can take the rankings from the present unweighted analysis and assign relative weights, if weighting is desired.

6.0 RESULTS AND CONCLUSIONS

6.1 Grouping of Uncertainties for Efficient Uncertainty Reduction

The 78 uncertainties may be assembled into groups which deal with similar topics and are generally drawn from the same section or subsection of 10CFR60. Thus, a single more general or generic uncertainty reduction might suffice to resolve an entire group of uncertainties. Sections 6.2 and 6.3 discuss the parameters of uncertainty reductions for these groups. The complete wording of the uncertainties, and the rationale for them, are found in Appendix B. Each of the logical groups is discussed, in turn, below.

- Group I: Potentially adverse conditions

Two uncertainties apply to the entire group of 24 potentially adverse conditions in 10CFR60.122(c); these uncertainties are identified as UN18 through UN64, except for UN44. The first example of uncertain language in 10CFR60.122(a), which has been identified as a separate uncertainty for each of the 24 potentially adverse conditions, is:

> **10CFR60.122(a)(iii)(A)** The potentially adverse ... condition ... is shown **not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste.**

The emphasized phrase needs to be clarified because alternative interpretations are possible. A potentially adverse condition could be considered to have a significant effect only when it caused performance objectives to be breached. On the other hand, "significant effect" could be defined to include a "margin of safety" placed on breach of performance objectives. A third possibility is that an adverse condition could be considered a significant threat to repository performance based on some to-be-identified change in the level of ambient condition.

Moreover, the role played by an aggregation of potentially adverse effects, or synergistic combinations of adverse effects, is not clear: what if two effects separately would not affect repository performance significantly, but the combination would?

Although the "significant effect" would clearly be different for each of the 24 potentially adverse conditions, it appears likely that a "generic" uncertainty reduction method could resolve this uncertain phrase in the regulation. The resolution could, for example, be to define "significant effect" as the potential breach of repository performance either by a single potentially adverse effect or by the synergistic action of two (or more) potentially adverse effects acting in concert.

The second example of uncertain language in this regulation, which has been identified as a separate uncertainty for each of the 24 potentially adverse conditions, is:

> **10CFR60.122(a)(i)** The potentially adverse human activity or natural condition on the site has been adequately investigated, including the extent to which the condition may be present and still undetected **taking into account the degree of resolution achieved by the investigations.**

The phrase "taking into account the degree of resolution" could imply a number of things. One is evaluation of the probability of undetected adverse conditions and their possible effect on performance expectations. Another is the allowance of a safety margin applied to the evaluation of any adverse condition while it is being evaluated. A third is allowance for the precision to which

any adverse condition may be evaluated. A fourth is an assessment of the relative correctness of different evaluations of adverse conditions.

There is a further uncertainty within any one of these possibilities. Consider the third, for example: different adverse effects can be measured to different degrees of precision, with varying amounts of difficulty. Moreover, while the measurement of one adverse condition may be needed to four or five significant figures, for another, a handbook value to two or three significant figures might suffice.

As in the preceding case, a "generic" resolution is possible. A definition and/or benchmark can be specified for the phrase "taking into account the degree of resolution" to which a potentially adverse condition must be known. Such criteria can be developed from the required repository performance, and subsequent technical resolutions can be written for each potentially adverse condition.

- Group II: Favorable conditions

UN16 and UN17 in 10CFR60.122(b) both deal with projections into the future of groundwater travel time and consequent movement of radioactive materials to the accessible environment, and thus with possible scenarios for such releases of radionuclides. UN16 lies in the following language:

10CFR60.122(b)(1) The nature and rates of...processes operating within the geologic setting during the Quaternary Period, **when projected**, would not affect or would favorably affect the ability of the geologic repository to isolate the waste.

The lack of clarity is in the meaning of "when projected." The few million years in the Quaternary may be too long a period to project if the site is to be judged secure for 10,000 years. Appropriate projections also vary with probabilities of occurrence and with risks: a one-in-a-million year earthquake might have only a small probability of occurrence during the projected period but could have catastrophic consequences.

UN17 is in **10CFR60.122(b)(7)** Pre-waste-emplacement groundwater travel time along the **fastest path to the accessible environment that substantially exceeds 1000 years.**

This statement is judged to contradict 60.133(a)(2), in which the time of travel is to be at least 1000 years. Thus, 1001 years would qualify under the latter regulation but probably would not be considered to "substantially exceed" 1000 years.

These two uncertainties thus may, in one way or another, be resolved in an ongoing rulemaking concerning groundwater travel time.

- Group III: Systems, structures and components important to safety

UN65 through UN75 in 10CFR60.131(b) are uncertainties in the functions required of systems, structures and components important to safety. These uncertainties arise primarily because of differences between the language of these sections and analogous sections of 10CFR72: 10CFR60.131(b)(4) reads "the geologic repository operations area shall be designed to include onsite and available offsite emergency facilities and services..." while 10CFR72.72(g) reads "the

design must provide for accessibility to the equipment of onsite and available offsite emergency facilities and services..." In this instance, as in others, 10CFR60 is less stringent and less precise than 10CFR72, resulting in identification of an uncertainty in 10CFR60. In the reverse case, where 10CFR72 is less stringent or precise, an uncertainty may be identified in 10CFR72, but not in 10CFR60.

In some cases, there are inconsistencies between sections of 10CFR60.131. For example, 10CFR60.131(b)(3)(iv) reads "the geologic repository operations area include explosion and fire...suppression systems" while 10CFR131(b)(3)(iii)gives criteria only for design of fire suppression systems.

The uncertainty reduction would be similar for every uncertainty in this group, and would result in removal of inconsistencies in the language of analogous sections.

- Group IV: Engineered barrier system performance

UN13 in 10CFR60.113(a) deals with potential release of radionuclides from the engineered barrier system, and is related to the concept of substantially complete containment. The term "substantially complete" in 113(a)(1)(i)(A) may need definition and clarification so that there will be a specification for container design and so that NRC will have criteria by which to determine the acceptability of the design.

UN14 in 10CFR60.113(a)(1)(i)(B) speaks of gradual release, and 113(a)(ii)(B) specifies maximum release rates. This may not adequately address or may be somewhat inconsistent with 10CFR60.135(c)(1), which states that "all...such radioactive wastes shall be in solid form," and does not consider the possible presence of fission product gases, whose release rate would differ from that of a leached or dispersed solid. Moreover, the wording of 135(c)(1) could be construed as requiring processing of spent fuel rods to remove gaseous fission products.

It is likely that these inconsistencies will be resolved by the ongoing rulemaking on "substantially complete containment."

- Group V: ALARA and radiological safety considerations

UN9 and UN10 in 10CFR60.111(a) are uncertainties in the description of protection against radiation exposure during the period through permanent closure ("until permanent closure has been completed"). UN9 is that 10CFR60.111(a) does not have a reference to ALARA, while the analogous section of 10CFR72 – 10CFR72.67(b) – has such a reference. (This uncertainty could have been included in Group III with the others that deal with inconsistencies between 10CFR60 and 10CFR72. The concern with radiation safety was the overriding criterion for the chosen grouping.)

UN10 in 10CFR60.111(a) is the phrase "at all times" during the preclosure phase of the repository, in the language "... radiation levels and releases of radioactive materials to unrestricted areas **will at all times** be maintained within the limits specified in Part 20...and such...standards...as may have been established by the Environmental Protection Agency." The intent could refer to normal operation only, or to time of normal operation, off-normal operation and accidents. The second interpretation would force EPA limits on releases during and after an accident.

UN10 is being addressed in the ongoing rulemaking on the design-basis accident. UN9 could be dealt with together with other inconsistencies between 10CFR60 and 10CFR72.

- Group VI: Retrievability

UN1, UN7 and UN11 are included in this group. UN11 in 10CFR60.111(b), which requires that the "option of waste retrieval" be maintained up to 50 years after waste emplacement is begun, is the uncertainty in the meaning of retrievability: does this mean to design for retrievability or simply not to preclude it? The two possible interpretations have very different design consequences: the first implies that retrieval is an important design consideration, while the second implies only that retrieval should not be made impossible or impractical by design. The confusion in the language persists in NUREG-0804 and is echoed by the EPA in 40CFR191.14(f), both of which imply the passive design criterion "not to preclude retrieval."

UN7 in 10CFR60.46, on the other hand, requires a license amendment whenever an action is taken that would "substantially increase the difficulty of retrieval," implying that retrieval should be actively designed for. If the passive design criterion were used, the phrase "substantially increase the difficulty of retrieval" would be meaningless. These differences raise an uncertainty. UN7 could have been grouped with other license amendments in Group IX; it is placed in this group because reduction of any "retrievability" uncertainty is likely to subsume UN7.

UN1 in 10CFR60.15 and 10CFR60.17(a)(2)(ii) concerns a much narrower application of the retrievability concept: what is meant by retrievability of radioactive tracers used in site characterization. The enabling statute (42USC10133(c)) directs that radioactive materials used in site characterization be "fully retrievable"; how "full retrievability" can be applied to the use of radioactive tracers is not clear.

The three uncertainties are grouped together because resolution of the first will greatly clarify and simplify resolution of the second and third.

- Group VII: Conditions for construction authorization

UN3 and UN4 occur in the same phrase in 10CFR60.32: "A construction authorization shall include **such conditions as the Commission finds to be necessary** to protect the health and safety of the public, the common defense and security, **or** environmental values." The use of the word "or" (UN3) may be literally interpreted to mean that satisfying any one of the three conditions is sufficient to obtain a construction authorization. The word "and" in place of "or" is clearly what was intended by the regulation.

UN4 lies in the lack of definition of "such conditions." Although the regulation clearly assigns the responsibility of defining the necessary conditions to the Commission, they must be defined before DOE can proceed with an application for construction authorization. The correction in UN3 could be accomplished in the same action as the definition called for by UN4.

- Group VIII: Regulation of mining safety and other non-radiological safety considerations

UN76 and UN77 in 10CFR60.131(b)(9) and UN78 in 10CFR60.133(e) deal with jurisdiction over non-radiological safety and could be considered institutional, rather than regulatory, uncertainties. UN76 is the uncertainty in 10CFR60.131(b)(9) where Subchapter N is referred to and thus

30CFR56, "Surface Mining Regulations," is invoked. 30CFR57, "Deep Surface Mining Regulations," is more inclusive than 30CFR56, and may have been what was intended.

UN77 is in 10CFR131(b)(9), which also refers to Subchapter N and requires inclusion of provisions for worker protection "to the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977." DOE is not subject to MSHA regulatory jurisdiction, and it is not clear what NRC's role in enforcement of worker protection provisions should be.

UN78 is in 10CFR133(e)(1), which deals with design of underground openings. The uncertainty was included in this group because the regulation states "openings...shall be designed so that operations can be carried out **safely**..." and thus is logically included in a group of uncertainties dealing with safety. The uncertainty is whether NRC will regulate worker safety totally unrelated to radiological safety.

The reduction of these uncertainties depends partly on the definition of jurisdictions, and partly on a clearer definition of what is encompassed by non-radiological safety protection.

- Group IX: License amendment

UN5 UN6 and UN8 in 10CFR60.51 and 10CFR60.52 are examples of confusing regulatory wording dealing with potential license amendments. UN5 and UN6 are in 10CFR60.51(a)(2)(i) and (ii): "Identification of the controlled area...by monuments that have been designed to be **as permanent as practicable**; and placement of records in... **that would be likely to be consulted by potential human intruders**..." The regulation needs to be reworded, or the wording supplemented, to more clearly define this statement so that compliance with the requirement by DOE can be assessed with confidence. As the regulation presently reads, the criterion "as permanent as practicable" is confusing to implement, and "likely to be consulted by potential human intruders," is virtually impossible to implement.

UN8 is derived from the language of 10CFR60.52(a) "...DOE may apply for an amendment to terminate the license..." and (c)(3) "a license shall be terminated...the termination of the license is authorized by law, including sections 57, 62 and 81 of the Atomic Energy Act, as amended." However, the provisions of the Atomic Energy Act result in an uncertainty. Simply put: (1) spent fuel contains "special nuclear material," "byproduct material," and "source material;" (2) possession or transfer of these requires a license; (3) DOE will have title at closure and therefore will either retain title or transfer title and possession. Under what conditions could the license conditions be terminated with these regulations and statute in place?

The remaining uncertainties – UN2, UN12, UN15, and UN44 – need to be considered separately.

- UN2: Environmental Report

UN2 stems from the language in 10CFR60.21(a) which requires the preparation of an environmental report which "shall accompany" the license application, juxtaposed with the language of 42USC10134(f)(4), which states "...any environmental impact statement prepared...shall, to the extent practicable, be adopted by the Commission..." The uncertainty is that it is not clear if the environmental report referred to is the same as the environmental impact statement mentioned in the statute. It is anticipated that the ongoing rulemaking on 10CFR51, which deals with the environmental impact statement in the statute, will resolve this uncertainty.

- UN12: Anticipated/Unanticipated Processes and Events

The uncertainty is in the language of 10CFR60.112 "...Assure that releases of radioactive materials to the accessible environment ... conform to ... general standards ... with respect to **anticipated and unanticipated processes and events.**" The highlighted terms require further definition to permit uniform interpretation of the regulatory requirement, since there are several conflicting definitions extant. 10CFR60.2 differentiates between "anticipated" and "unanticipated" by whether or not the event or process is "reasonably likely to occur." NUREG-0804 (p.19) notes that the distinction relates only to natural processes and events affecting the geologic setting. NUREG-0804 also identifies unanticipated processes and events as those not evidenced during the Quaternary period.

A draft Generic Technical Position entitled "Guidance for Determination of Anticipated Processes and Events and Unanticipated Processes and Events" has been issued. This Generic technical Position will most probably resolve the uncertainty.

- UN15: Land Ownership and Control

10CFR60.121(a) refers to lands that are either **acquired lands under jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use**, but it is not clear when and how such lands are to be acquired and/or withdrawn. The only opportunity for NRC review of compliance with this requirement is during evaluation of DOE's license application. However, control must be established (or assured) prior to license application, and DOE must exercise some control during site characterization. The exact nature of the latter and the extent of control needed prior to actual operations at the repository site are not clear. Ongoing and planned rulemakings do not address this uncertainty.

- UN44: Earthquakes "Typical of the Area"

The uncertainty is in the description of the potentially adverse condition of 10CFR60.122(c)(14) "more frequent occurrence of earthquakes or earthquakes of higher magnitude than is **typical of the area** in which the geological setting is located." Definition of the area under consideration is needed in order to determine what is typical.

6.2 Uncertainties Which Are the Subject of Ongoing and Planned Rulemakings

There are ten ongoing or planned NRC rulemakings which relate to 10CFR60:

1. Conforming 10CFR60 to the EPA high-level waste standard
2. Devising methodology for demonstrating compliance with the EPA standard
3. Amplification of the phrase "anticipated processes and events and unanticipated processes and events"
4. Amplification of the phrase "disturbed zone"
5. Amplification of the phrase "substantially complete containment"

6. Amplification of the phrase "pre-waste emplacement groundwater travel time"

7. Establishment of criteria for disposal of "greater than Class C" low-level waste in a deep geologic repository

8. Definition of "design basis accident dose limit"

9. Establishment of emergency planning criteria under Subpart I of 10CFR60

10. Content of, and criteria for, the license application

An additional ongoing rulemaking relates indirectly but closely to 10CFR60, although it is actually a rulemaking for 10CFR51. This is:

11. Implementation of the Nuclear Waste Policy Act provisions requiring NRC to adopt DOE's Environmental Impact Statement

As may be seen from the discussion which follows, some regulatory uncertainties are already the subject of ongoing and planned rulemakings, and could, in principle, be resolved by the ongoing or planned rulemakings.

6.2.1 Important Regulatory Uncertainties Which are the Subject of Ongoing and Planned Rulemakings

Four uncertainties with relatively high rankings in overall importance or overall time considerations are already the subject of ongoing rulemakings.

UN12 – anticipated/unanticipated processes and events – ranks "very high" in both overall importance and time considerations. In fact, this uncertainty had the highest rank for overall importance and the second highest for overall time considerations; no matter how the attributes are weighted, therefore, this is an exceeding important uncertainty. UN12 ranks "very high" with respect to attribute I1: information to reduce the uncertainty cannot be obtained in a timely manner, so that an early start at uncertainty reduction was indicated, and such a reduction has been initiated with the ongoing rulemaking.

UN2 – whether the Environmental Report required by 10CFR60 is the same as the statutorily required EIS – ranks "high" in time considerations and in several importance attributes (although "moderate" in overall importance). The uncertainty in the rule may be reduced by the ongoing 10CFR51 rulemaking on the role of the DOE Environmental Impact Statement, if the rulemaking addresses the particular question raised by the uncertainty.

UN13 – the meaning of substantially complete containment – ranks "moderate" in overall importance and time considerations, but ranks "very high" for time priority (attributes T4 and T6) and "high" or "very high" for four importance attributes, including impact on waste confidence.

UN14 – the definition of "gradual" postclosure releases of radionuclides – is related to the ongoing rulemaking on the meaning of "disturbed zone" as well as "substantially complete containment," and could be reduced by both of these rulemakings. UN14 ranks "very high" for all time considerations, and "high" for two importance attributes, although rank for overall importance is "low", and for durability, "moderate".

The ongoing rulemakings should result in reduction or resolution 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 resolve this question.

All four of these regulatory uncertainties ranked "very high" with respect to overall durability and with respect to attribute D4 ("Uncertainty Reduction Should Be Durable"). This ranking indicates a need for involvement of other parties in the uncertainty resolution; this need is met by the ongoing rulemakings.

6.2.2 Less Important Regulatory Uncertainties Which are the Subject of Ongoing and Planned Rulemakings

UN17 – the definition of "fastest path of radionuclide travel" – is related to groundwater travel time but does not encompass the scope of the ongoing rulemaking. UN17 ranks "high" with respect to two importance attributes and one time attribute, and "low" or "moderate" with respect to the rest; the rank with respect to all durability attributes is "very high". The proposed rulemaking on groundwater travel time includes some reduction of this particular uncertainty, and the rulemaking process is responsive to the need for durability in resolution.

UN16 can be grouped with UN17 and is part of the same regulation. UN16 ranks "high" or "very high" with respect several importance attributes, most notably effect on waste confidence and pervasive effect on repository performance.

In Group VII, UN3, an uncertainty in the language of the construction authorization condition as it refers to health and safety, ranks "high" in overall importance and "moderate" in overall time (though it ranks "high" with respect to expediting the licensing procedure. UN4 will be resolved by the reduction of UN3, and ranks "very low" with respect to both overall time and overall importance. High durability is desirable for this group of uncertainties. These considerations thus suggest that prompt action is not required.

UN10 in 10CFR60.111(a), the phrase "at all times" during the preclosure phase of the repository, referring to radiological protection, is addressed in the ongoing rulemaking on the design basis accident dose limit. UN10 is grouped with UN9; the latter could be reduced either with UN10 or in a reduction of uncertainties which result from differences in the language between 10CFR60 and 10CFR72. The latter option is discussed in Section 6.4.

6.3 Uncertainties Which Are the Subject of Ongoing and Planned Technical Positions

There are twenty ongoing or planned technical positions which relate to 10CFR60. These deal with:

1. Postclosure seals in unsaturated media
2. Extrapolation of short-term data to long-term results
3. Waste retrievability
4. Retrieval demonstration during site characterization
5. Repository design, including applicable surface and subsurface design regulatory guides
6. Scope for waste package/engineered barrier testing
7. Waste package reliability analysis
8. Radionuclide transport
9. Chemical interactions in fractured unsaturated rock
10. Pre-closure earthquake hazard evaluation methods
11. Probabilistic seismic hazard analysis
12. Volcanic hazard analysis
13. Tectonic models under 10 CFR Part 60
14. Natural resource assessment methods
15. Geologic mapping of shafts and drifts
16. Geomorphic analysis
17. Scenario identification and screening
18. Verification and validation of performance assessment models
19. Data and parameter uncertainty
20. Normal use of expert judgment

Most regulatory uncertainties are related to one or more proposed technical positions. However, this relationship does not necessarily mean that the technical position as it is presently formulated will reduce the regulatory uncertainty. Such reduction depends on the precise wording of the technical position. The relationships between uncertainties and technical positions which are listed in the following sections indicate

only that the subject matter of the regulation containing the uncertainty is the same as that of the technical position. The relationship between uncertainties and present and planned rulemakings is more germane to this analysis than the relationships between uncertainties and technical positions, and thus remains independent.

6.3.1 Important Regulatory Uncertainties Which Are the Subject of Ongoing and Planned Technical Positions

The Uncertainties marked with an asterisk and italics are closely related to Technical Positions and, thus, could be addressed within the scope of the potential Technical Position. The rest of the Uncertainties are only tangentially related to the Technical Position.

Uncertainty	Technical Position
**UN9*, UN10	Repository design
UN11	Retrievability
UN12	Radionuclide transport; chemical interactions in fractured unsaturated rock, pre-closure earthquake hazard evaluation methods; probabilistic seismic hazard; volcanic hazard analysis; tectonic models; natural resource assessment methods
**UN16*	Scenario identification and screening
**UN17*	Scenario identification and screening; radionuclide transport
UN18, UN19	Scenario identification and screening; extrapolation of short-term data to long-term results
UN20, UN21	Extrapolation of short-term data to long-term results; natural resource assessment methods; scenario identification and screening
UN22, UN23	Extrapolation of short-term data to long-term results; geomorphic analysis; scenario identification and screening; volcanic hazard analysis
UN24, UN25	Extrapolation of short-term data to long-term results; tectonic models; scenario identification and screening
UN26-UN29	Extrapolation of short-term data to long-term results; radionuclide transport; scenario identification and screening
UN30-UN35	Extrapolation of short-term data to long-term results; radionuclide transport, chemical interaction in fractured unsaturated rock; scenario identification and screening
UN36, UN37	Chemical interactions in fractured unsaturated rock
UN38, UN39	Tectonic models
UN42, UN43	Tectonic models
UN40-UN43 *UN44	Extrapolation of short-term data to long-term results; preclosure earthquake hazard evaluation; probabilistic seismic hazard analysis; scenario identification and screening
UN45, UN46	Preclosure earthquake hazard evaluation; probabilistic seismic hazard analysis
UN47, UN48	Volcanic hazard analysis
UN49, UN50	Geomorphic analysis

UN51, UN52	Natural sourssessment methods
UN53, UN54	Natural resource assessment methods; geologic mapping of shafts and drifts
UN57, UN58	Extrapolation of short-term data to long-term results; scenario identification and screening
UN59-UN64	Extrapolation of short-term data to long-term results; radionuclide transport; scenario identification and screening
UN16-UN64	Verification and validation of performance assessment models; data and parameter uncertainty

6.3.2 Less Important Regulatory Uncertainties Which Are the Subject of Ongoing or Planned Technical Positions

Uncertainty	Technical Position
**UN1*	Retrievability; retrieval demonstration
**UN7*	Retrievability
UN14	Waste package reliability analysis; postclosure seals
**UN65-UN75*	Repository design

6.4 Uncertainties Which are Not Included in Ongoing or Planned Rulemakings or Technical Positions

6.4.1 Uncertainties and Uncertainty Groups Which Are Important and Require Prompt Action

Time considerations include the need to begin a reduction method early on as well as the desirability to resolve the uncertainty in a timely fashion, since timely initiation is required for both processes.

Twenty-nine of the 48 uncertainties related to degree of resolution and significant effect on repository performance of potentially adverse conditions (10CFR60.122(c)) ranked "very high" or "high" on overall importance and overall time consideration, and "very high" on overall durability. Four of these uncertainties (UN26, UN50, UN59, UN60) are seen to have a pervasive effect on the repository program and on the waste confidence decision. Moreover, a number of these uncertainties are important to Site Characterization Plan review and to the site characterization process. Virtually all of these uncertainties rank "very high" or "high" with respect to durability and involvement of parties other than NRC. One may conclude that the reduction of the Group I uncertainties in 10CFR60.122(c) should be undertaken in a timely fashion and in recognition of their importance.

It may also be possible to reduce the uncertain language generically; that is, to specify meanings and/or benchmarks for the phrases in 10CFR60.122(a): "not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste" and "taking into account the degree of resolution achieved by the investigations."

UN15, the uncertainty in when and how the lands referred to in 10CFR60.121(a)are to be acquired and/or withdrawn, ranks "low" in overall importance but does have a pervasive effect on repository performance. In addition, this uncertainty ranks "moderate" in overall time dependence, but "very high" with respect to the need to give DOE guidance and in

expediting the licensing process. It is independent of any other uncertainty. One may conclude that timely reduction for this uncertainty is advisable.

UN44 is the emphasized language in 10CFR60.122(c)(14): "More frequent occurrence of earthquakes or earthquakes of higher magnitude than is **typical of the area in which the geological setting is located.**" This uncertainty has a pervasive effect on repository performance, and ranks "high" in overall time considerations and "moderate" in overall importance considerations. Timely and durable reduction for this uncertainty is advisable, although the need for stakeholder involvement is only "moderate."

The Group III uncertainties, UN65 through UN75 in 10CFR60.131(b), dealing with systems, structures and components important to safety, rank "low", moderate or "high" in overall importance. One of this group, UN62, ranks "high" with respect to overall time, and several rank "high" or "very high" with respect to specific time attributes. This group ranks "moderate" with respect to need for stakeholder involvement, though the involvement of appropriate federal agencies would be desirable.

UN9, how ALARA applies in 10CFR60.111(a), ranked "very high" with respect to attributes I3 and I4 – mitigation of radiological and non-radiological health and safety effects, and attribute T6 – expediting licensing review. This uncertainty, although related to UN10, could be reduced with other uncertainties that result from inconsistencies between the language of 10CFR60 and 10CFR72. While neither as important nor as timely as some other uncertainty reductions, this group of two uncertainties is nonetheless worthy of early consideration.

6.4.2 Uncertainties and Uncertainty Groups Which Are Important But Do Not Require Prompt Action

UN11 is the uncertainty in the meaning of "retrievability": to design for it or not to preclude it. UN11 ranks "high" in overall importance and moderate in overall time considerations. Both overall durability and stakeholder involvement are important in reduction of this uncertainty; "retrievability" is a concept with high public visibility. The uncertainty in UN1, though not quite the same as in UN11, will most likely be resolved at least in part when UN11 is reduced.

6.4.3 Uncertainties and Uncertainty Groups Whose Reduction Is Less Important

Group VIII – UN76, UN77, UN78 – rank "low" or "very low" with respect to overall time and importance, and better than "moderate" for durability only with respect to involvement of other federal agencies in their reduction (because one uncertainty suggests a jurisdictional uncertainty with respect to the Mine Safety and Health Act). UN78 does rank "high" with respect to guidance needed by DOE, which suggests a time priority, but altogether, the rankings suggest that reduction of this group of uncertainties, while perhaps readily done, is less urgent than reduction of those listed in the two preceding sections.

Group IX – UN5 through UN8 – are primarily awkwardnesses and lack of clarity in the wording of 10CFR60.51 and 10CFR60.52, which deal with the language of the license. These uncertainties rank "very low" with respect to both overall time and overall

importance, and at the lower end of the durability attributes. While their reduction is relatively straightforward, it need take no time precedence.

6.4.4 Conclusions

Most, though not all, of the uncertainties which are not already the subject of ongoing rulemakings are important and need to be resolved in a timely fashion. Virtually all of the identified regulatory uncertainties require durable resolutions, and most resolutions would have enhanced durability if stakeholders were involved in the resolution process.

This report makes no recommendations as to the method or methods most desirable for uncertainty reduction. In most cases, one uncertainty reduction method will resolve more than one uncertainty. This principle is particularly applicable to the Group I uncertainties: UN18 through UN65 (exclusive of UN44).

It should be remembered that, in this analysis, attributes were all weighted equally. If any one or several attributes are considered far more important than the rest, then only the ranks with respect to those particular attributes will matter to the decision-maker. However, the Group I uncertainties contain "high" and "very high" ranks with respect to all of the attributes. Generic resolutions for Group I will thus result in reduction of most of the uncertainties in this list.

Finally, this analysis reflects only uncertainties in Subparts B and E of 10CFR60. This analytical method can be applied as other sections of this and other regulations are analyzed, and will almost certainly yield additional priorities for uncertainty reduction.

7.0 REFERENCES

1. Weiner, R. F. and W. C. Patrick, Analysis of Regulatory Uncertainties Related to the Site Characterization Plan and the Exploratory Shaft Facility, CNWRA89-002, Southwest Research Institute, 1989.

2. R. L. Keeney and H. Raiffa, Decisions with Multiple Objectives: Preferences and Value Tradeoffs, New York, 1976.

3. Regulatory Strategies and Schedules for the High-Level Waste Repository Program, SECY-88-285, U.S. Nuclear Regulatory Commission, 1988.

TABLE Ia. ANALYTICAL METHODS NOT AVAILABLE (ATTRIBUTE I1)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	New I1 INFO OBTAINABLE
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	9
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	9
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	9
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	7
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	7
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	7
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	5
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	5
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	5
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	5
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	5
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	5
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	5
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	5
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	5
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	5
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	3
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	3
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	3
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	3
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	3
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	3
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	3
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	3
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	3

TABLE Ib. ANALYTICAL METHODS NOT AVAILABLE (ATTRIBUTE I1)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	New I1 INFO OBTAINABLE
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	3
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	3
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	3
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	3
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	3
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	3
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	3
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	3
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	3
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	3
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	3
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	1
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	1
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	1
8	License termination	52*	Can license be terminated if DOE has spent fuel?	1
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	1
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	1
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	1
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	1
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	1
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	1
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	1
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	1
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	1
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	1
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	1
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	1
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	1
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	1
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	1
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	1
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	1
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	1
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	1
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	1

TABLE IIa. PERVASIVE EFFECT ON REPOSITORY PROGRAM (ATTRIBUTE I2)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	New I2 PERVASIVE EFFECT
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	7
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	7
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	7
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	7
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	5
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	5
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	5
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	5
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	5
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	5

TABLE IIb. PERVASIVE EFFECT ON REPOSITORY PROGRAM (ATTRIBUTE I2)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	New I2 PERVASIVE EFFECT
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	5
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	5
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	5
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	5
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	5
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	5
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	5
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	5
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	5
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	5
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	5
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	5
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	5
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	5
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	5
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	5
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	5
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	5
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	5
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	5
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	3
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	3
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	3
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	3
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	3
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	3
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	3
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	3
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	3
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	3
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	1
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	1
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	1
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	1

TABLE IIIa. MITIGATION OF NON-RADIOALOGICAL HEALTH AND SAFETY EFFECTS (ATTRIBUTE I3)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 3; I3 AVOID OPER. H&S EFFECTS
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	9
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	7
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	7
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7

TABLE IIIb. MITIGATION OF NON-RADIOALOGICAL HEALTH AND SAFETY EFFECTS (ATTRIBUTE I3)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 3; I3 AVOID OPER. H&S EFFECTS
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	7
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	7
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	5
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	5
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	5
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	5
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	5
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	5
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	3
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	3
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	3
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	3
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	3
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	1
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1

TABLE IVa. MITIGATION OF ADVERSE RADIOLOGICAL HEALTH AND SAFETY EFFECTS (ATTRIBUTE I4)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 4;14 AVOID RAD. H&S EFF.
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	9
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	9
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	9
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	9
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	9
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	9
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	9
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	7
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	7
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7

TABLE IVb. MITIGATION OF ADVERSE RADIOLOGICAL HEALTH AND SAFETY EFFECTS (ATTRIBUTE I4)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 4;I4 AVOID RAD. H&S EFF.
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
1	Site characterization plan	16*, 17*,23	Retrievability/tracers (redone 2/7/89)	5
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	5
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	5
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	5
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	5
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	3
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	3
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	3
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	3
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	3
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	3
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	3
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1

TABLE Va. MITIGATION OF CHEMICAL CONTAMINATION (ATTRIBUTE I5)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 5;I5 AVOID CHEM CONTAM.
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	7
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	5
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	5
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	5
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	5
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	5
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	5
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	5
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	5
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	3
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	3
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	3
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	1
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	1
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	1
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	1
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	1
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1
1	Site characterization plan	16*, 17*,23	Retrievability/tracers (redone 2/7/89)	NA
8	License termination	52*	Can license be terminated if DOE has spent fuel?	NA
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	NA
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	NA
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	NA
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	NA
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	NA

TABLE Vb. MITIGATION OF CHEMICAL CONTAMINATION (ATTRIBUTE 15)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 5;15 AVOID CHEM CONTAM.
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	NA
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	NA
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	NA
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	NA
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	NA
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	NA
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	NA
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	NA
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	NA
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	NA
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	NA
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	NA
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	NA
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	NA
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	NA
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	NA
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	NA
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	NA
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	NA
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	NA
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	NA
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	NA
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	NA
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	NA
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	NA
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	NA
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	NA
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	NA
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	NA
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	NA
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	NA
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	NA
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	NA
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	NA
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	NA
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	NA
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	NA
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	NA

TABLE VIa. MITIGATION OF IRREVERSIBLE ENVIRONMENTAL DISTURBANCE (ATTRIBUTE 16)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 6;16 AVOID ENVIR.DAM.
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	9
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	7
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	5
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	3
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	3
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	3
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	3
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	3
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	3
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	3
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	3
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	3
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	3
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	3
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	3
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	3
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	3
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	3
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	3
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	3
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	3

TABLE VIb. MITIGATION OF IRREVERSIBLE ENVIRONMENTAL DISTURBANCE (ATTRIBUTE I6)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 6;16 AVOID ENVIR.DAM.
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	3
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	3
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	3
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	3
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	3
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	3
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	3
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	3
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	3
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	3
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	3
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	3
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	3
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	3
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	3
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	3
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	3
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	3
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	3
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	3
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	3
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	1
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	1
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	1
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	1
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	1
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	1
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	1
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	1
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	1
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	1
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	1
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	1
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	1
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	1
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	1

TABLE VIIa. OTHER UNCERTAINTIES DEPEND ON THIS UNCERTAINTY (ATTRIBUTE 17)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 7;17 OTHERS DEPEND
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	9
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	9
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	9
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	9
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	9
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	9
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	9
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	9
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	9
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	9
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	9
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	9
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	9
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	9
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	9
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	9
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	9
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	9
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	9
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	9
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	9
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	9
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	9

TABLE VIIb. OTHER UNCERTAINTIES DEPEND ON THIS UNCERTAINTY (ATTRIBUTE 17)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 7;17 OTHERS DEPEND
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	9
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	9
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	7
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	7
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	7
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	7
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	5
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	3
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	3
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	3
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	3
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	3
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	3
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	3
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	1
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	1
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	1
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	1
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	1
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	1
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	1
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	1
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	1
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1

TABLE VIIIa. SIGNIFICANT IMPACT ON WASTE CONFIDENCE (ATTRIBUTE I8)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	New I8 WASTE CONFIDENCE
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	7
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	7
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	7
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	7
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	5
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	5
8	License termination	52*	Can license be terminated if DOE has spent fuel?	5
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	5
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	5
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	5
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	5

TABLE VIIIb. SIGNIFICANT IMPACT ON WASTE CONFIDENCE (ATTRIBUTE I8)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	New I8 WASTE CONFIDENCE
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	5
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	5
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	5
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	5
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	5
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	5
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	5
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	5
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	5
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	5
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	5
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	5
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	5
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	5
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	5
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	5
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	5
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	5
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	5
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	5
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	5
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	3
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	3
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	3
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	3
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	3
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	3
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	3
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	3
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	3
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	1
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	1
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	1
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	1
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	1
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	1

TABLE IXa. EXPEDITE SITE CHARACTERIZATION (ATTRIBUTE T1)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 8; T1 EXPEDITE SITE CHAR.
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	9
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	9
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	9
1	Site characterization plan	16*, 17*,23	Retrievability/tracers (redone 2/7/89)	7
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	7
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	7
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	7
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	7
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7

TABLE IXb. EXPEDITE SITE CHARACTERIZATION (ATTRIBUTE T1)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 8; T1 EXPEDITE SITE CHAR.
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	7
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	7
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	7
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	7
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	5
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	5
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	5
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	5
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	3
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	1
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	1
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	1
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	1
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	1
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	1
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	1
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	1
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	1
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	1
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	1
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	1
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	1
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	1
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	NA
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	NA
8	License termination	52*	Can license be terminated if DOE has spent fuel?	NA

TABLE Xa. PROCEED WITHOUT REDUCING OTHER UNCERTAINTIES (ATTRIBUTE T3)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 9; T3 PROCEED W/O OTHERS
1	Site characterization plan	16*, 17*,23	Retrievability/tracers (redone 2/7/89)	9
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	9
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	9
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	9
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	9
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	9
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	9
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	9
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	9
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	9
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	9
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	9
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	9
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	9
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	9
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	9
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	9
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	9
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	9
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	9
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	9

TABLE Xb. PROCEED WITHOUT REDUCING OTHER UNCERTAINTIES (ATTRIBUTE T3)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 9; T3 PROCEED W/O OTHERS
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	9
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	9
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	9
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	9
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	9
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	9
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	9
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	9
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	9
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	9
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	7
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	7
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	7
8	License termination	52*	Can license be terminated if DOE has spent fuel?	7
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	7
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	7
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	7
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	7
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	7
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	7
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	7
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	7
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	3

TABLE XIa. DOE NEEDS GUIDANCE (ATTRIBUTE T4)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 10;T4 QUICK REDUCTION
1	Site characterization plan	16*, 17*,23	Retrievability/tracers (redone 2/7/89)	9
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	9
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	9
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	9
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	9
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7

TABLE XIb. DOE NEEDS GUIDANCE (ATTRIBUTE T4)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 10;T4 QUICK REDUCTION
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	7
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	7
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	7
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	7
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	7
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	5
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	5
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	5
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	5
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	5
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	5
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	5
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	5
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	5
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	3
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	3
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	3
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	3
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	1
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	1

TABLE XIIa. LONG TIME NOT NEEDED FOR CLOSURE (ATTRIBUTE T5)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 11;T5 EARLY RESOLUTION
1	Site characterization plan	16*, 17*,23	Retrievability/tracers (redone 2/7/89)	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	9
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	9
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	7
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	7
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	7
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
8	License termination	52*	Can license be terminated if DOE has spent fuel?	7
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	7
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	7
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	7
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	7
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7

TABLE XIIb. LONG TIME NOT NEEDED FOR CLOSURE (ATTRIBUTE T5)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 11;T5 EARLY RESOLUTION
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	7
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	7
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	7
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	7
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	7
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	7
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	7
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	7
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	7
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	5
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	5
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	5
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	5
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	5
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	5
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	5
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	5
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	5
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	5
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	5
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	5
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	5
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	5
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	5
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	5
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	5
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	3
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	3
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	3
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	3

TABLE XIIIa. EXPEDITE LICENSING REVIEW (ATTRIBUTE T6)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 12;T6 EXPEDITE LIC.REV.
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	9
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	7
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	7
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	7
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7

TABLE XIIIb. EXPEDITE LICENSING REVIEW (ATTRIBUTE T6)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 12;T6 EXPEDITE LIC.REV.
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	7
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	7
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	5
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	5
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	5
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	5
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
8	License termination	52*	Can license be terminated if DOE has spent fuel?	3
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	3
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	3
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	3
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	3
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	1
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	1
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	1

TABLE XIVa. STAKEHOLDER INVOLVEMENT (ATTRIBUTE D1)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 17;D1 STAKE HOLDER
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	9
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	9
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	9
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
8	License termination	52*	Can license be terminated if DOE has spent fuel?	7
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	7
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	7
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	7

TABLE XIVb. STAKEHOLDER INVOLVEMENT (ATTRIBUTE D1)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 17;D1 STAKE HOLDER
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	7
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	7
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	7
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	5
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	5
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	5
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	5
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	5
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	5
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	5
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	5
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	5
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	5
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	5
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	5
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	5
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	5
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	5
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	3
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	3
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	3
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	3
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	3
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	3
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	3
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	3
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	3
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	3
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	3
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1

TABLE XVa. STATE OF NEVADA INVOLVEMENT (ATTRIBUTE D2)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 18;D2 NEVADA INVOLVE.
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	9
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	9
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	9
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	9
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	9
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	9
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	9
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	9
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	9
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	9
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9

TABLE XVb. STATE OF NEVADA INVOLVEMENT (ATTRIBUTE D2)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 18;D2 NEVADA INVOLVE.
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	9
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	9
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	9
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	9
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	9
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	7
8	License termination	52*	Can license be terminated if DOE has spent fuel?	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	7
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	7
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	5
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	5
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	5
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	5
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	5
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	5
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	5
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	5
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	5
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	3
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	3

TABLE XVIa. OTHER FEDERAL AGENCY INVOLVEMENT (ATTRIBUTE D3)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 19;D3 AGENCY INVOLVE.
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	9
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	9
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	9
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	9
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	9
8	License termination	52*	Can license be terminated if DOE has spent fuel?	7
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	7
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	7
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	7
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	7
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	7
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	7
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	7
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	7
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	7
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7

TABLE XVIb. OTHER FEDERAL AGENCY INVOLVEMENT (ATTRIBUTE D3)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 19;D3 AGENCY INVOLVE.
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	7
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	7
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	7
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	7
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	7
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	7
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	5
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	5
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	5
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	5
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	5
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	5
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	5
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	5
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	5
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	5
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	5
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	5
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	5
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	5
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	5
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	5
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	5
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	5
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	5
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	5
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	5
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	3
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	3
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	3
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	3
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	1
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	1

TABLE XVIIa. UNCERTAINTY REDUCTION SHOULD BE DURABLE (ATTRIBUTE D4)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 20;D4 DURABILITY DESIRED
2	Environmental report	21(a), 51, 23, 24(a)	How does license app. ER relate to statutory EIS?	9
3	Conditions/construction authorization	32*	Construction auth. conditions for H&S unspecified	9
9	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	Is ALARA properly applicable?	9
10	Radiation exposures/releases	111(a)*, 132(a)*, 132(b)*	What does "at all times" mean here?	9
11	Retrieval of waste	111(b)(1)-(3)	Design to permit or not to preclude retrieval?	9
12	System perf. after permanent closure	112, 113(c), 133(f)	"Anticipated and unanticipated processes/events"	9
13	EBS performance after permanent closure	113(a)(1)(i)(A),(1)(ii)(A)	"Substantially complete containment"	9
14	EBS Radionuclide release/postclosure	113(a)(1)(i)(B),(1)(ii)(B)	Any release of radionuclides must be gradual	9
15	Ownership/control of land	121(a)*	When and how does DOE guarantee "control"of land?	9
16	Favorable conditions	122(a)(1), 122(b)*	How far into the future must projections be?	9
17	Favorable conditions	122(a)(1), 122(b)*	GWTT along "fastest path of radionuclide travel"	9
19	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	Performance objectives not significantly affected	9
20	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	"Taking into account the degree of resolution"	9
21	Adverse cond: human activity/groundwater	122(a)(2)*, 122(c)(2)	Performance objectives not significantly affected	9
22	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	"Taking into account the degree of resolution"	9
23	Adverse cond:nat. phenom. & groundwater	122(a)(2)*, 122(c)(3)	Performance objectives not significantly affected	9
24	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	"Taking into account the degree of resolution"	9
25	Adverse cond: deform. affecting gdwater	122(a)(2)*, 122(c)(4)	Performance objectives not significantly affected	9
26	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	"Taking into account the degree of resolution"	9
27	Adverse cond: changes to hydrology	122(a)(2)*, 122(c)(5)	Performance objectives not significantly affected	9
37	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	Performance objectives not significantly affected	9
38	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	"Taking into account the degree of resolution"	9
39	Adverse condition - earthquakes	122(a)(2)*, 122(c)(12)	Performance objectives not significantly affected	9
40	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	"Taking into account the degree of resolution"	9
41	Adverse cond:earthquakes/tectonic processes	122(a)(2)*, 122(c)(13)	Performance objectives not significantly affected	9
43	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Performance objectives not significantly affected	9
45	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	"Taking into account the degree of resolution"	9
46	Adverse condition - igneous activity	122(a)(2)*, 122(c)(15)	Performance objectives not significantly affected	9
47	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	"Taking into account the degree of resolution"	9
49	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	"Taking into account the degree of resolution"	9
50	Adverse cond:nat. occurring materials	122(a)(2)*, 122(c)(17)	Performance objectives not significantly affected	9
54	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	Performance objectives not significantly affected	9
59	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	"Taking into account the degree of resolution"	9
60	Adverse condition:water table rise	122(a)(2)*, 122(c)(22)	Performance objectives not significantly affected	9
61	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	"Taking into account the degree of resolution"	9
62	Adverse condition:perched water	122(a)(2)*, 122(c)(23)	Performance objectives not significantly affected	9
63	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	"Taking into account the degree of resolution"	9
64	Adverse condition: gaseous radionuclides	122(a)(2)*, 122(c)(24)	Performance objectives not significantly affected	9
65	Imp. to safety:fires/explosions	131(b)(3)*	Does redundancy permit failure of some systems?	9

TABLE XVIIb. UNCERTAINTY REDUCTION SHOULD BE DURABLE (ATTRIBUTE D4)

ID NO.	GENERAL SUBJECT OF REGULATION	PRIMARY 10 CFR 60 CITATION	ABBREVIATED UNCERTAINTY STATEMENT	Old 20;D4 DURABILITY DESIRED
66	Imp. to safety:fires/explosions	131(b)(3)*	Provisions and means of protection unclear	9
67	Imp. to safety:fires/explosions	131(b)(3)*	Should explosion suppression be included?	9
71	Imp. to safety: criticality control	131(b)(7)	Reg provides no methods for criticality control	9
72	Imp. to safety: criticality control	131(b)(7)	Difference in safety margin from 10CFR72 analog	9
73	Imp. to safety: criticality control	131(b)(7)	Reg allows 2-event criticality	9
78	Design - safe undergrd ops/rock movement	133(e)*, 133(i)	Will NRC regulate non-radiological safety?	9
1	Site characterization plan	16*, 17*,23	Retrivability/tracers (redone 2/7/89)	7
4	Conditions/construction authorization	32*	Reg. reads protect H&S, security or env. values	7
5	License amendment/permanent closure	51*	Archives consultation likely/potential intruders	7
6	License amendment/permanent closure	51*	Monuments "as permanent as practicable"	7
7	License amendment/permanent closure	51*	"Substantially increase difficulty of retrieval"	7
8	License termination	52*	Can license be terminated if DOE has spent fuel?	7
18	Adverse condition - flooding	122(a)(2)*, 122(c)(1)	"Taking into account the degree of resolution"	7
29	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	Performance objectives not significantly affected	7
30	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	"Taking into account the degree of resolution"	7
31	Adverse cond:gdwater cond affecting EBS	122(a)(2)*, 122(c)(7)	Performance objectives not significantly affected	7
32	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	"Taking into account the degree of resolution"	7
33	Adverse condition - geochemical	122(a)(2)*, 122(c)(8)	Performance objectives not significantly affected	7
34	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	"Taking into account the degree of resolution"	7
35	Adverse cond: groundwater not reducing	122(a)(2)*, 122(c)(9)	Performance objectives not significantly affected	7
36	Adverse condition:structural deformation	122(a)(2)*, 122(c)(11)	"Taking into account the degree of resolution"	7
42	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	"Taking into account the degree of resolution"	7
44	Adverse condition - higher earthquakes	122(a)(2)*, 122(c)(14)	Meaning of "typical of the area"	7
48	Adverse condition - extreme erosion	122(a)(2)*, 122(c)(16)	Performance objectives not significantly affected	7
52	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	Performance objectives not significantly affected	7
53	Adverse condition - drilling	122(a)(2)*, 122(c)(19)	"Taking into account the degree of resolution"	7
56	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	Performance objectives not significantly affected	7
57	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	"Taking into account the degree of resolution"	7
58	Adverse cond:geomech/undrgrd opening	122(a)(2)*, 122(c)(21)	Performance objectives not significantly affected	7
68	Imp. to safety:emergency capability	131(b)(4)8	Does reg preclude aid in emergency response?	7
69	Imp. to safety: utility services	131(b)(5)*	Design all utility systems for essential function	7
70	Imp. to safety:inspection/testing/maint.	131(b)(6)	"Design to permit periodic inspection"	7
75	Imp. to safety: mining regulations	131(b)(9)	Reg doesn't include procedures, only design	7
77	Imp. to safety: mining regulations	131(b)(9)	NRC jurisdiction vis-a-vis MSHA unclear	7
28	Adverse cond:hydrol.change-climate change	122(a)(2)*, 122(c)(6)	"Taking into account the degree of resolution"	5
51	Adverse cond:mining for resources	122(a)(2)*, 122(c)(18)	"Taking into account the degree of resolution"	3
55	Adverse cond:complex engineering measures	122(a)(2)*, 122(c)(20)	"Taking into account the degree of resolution"	3
74	Imp. to safety: instrumentation/control	131(b)(8)	ID of I&C systems not required by reg	3
76	Imp. to safety: mining regulations	131(b)(9)	Reg references surface mining regs	3

APPENDIX A

PERTINENT DEFINITIONS FROM

"TOP-001-02 PROGRAM ARCHITECTURE RELATIONAL DATABASE WORK INSTRUCTION, ATTACHMENT A," DATED, AUGUST 15, 1988

29. UNCERTAINTY TOPIC

Content - This field contains the general subject and keywords of the UNCERTAINTY in the next field. It is intended as a vehicle for consistent identification and consolidation of items related to a given topic. (See Field 8 content description.)

Format - Field size: TBD characters.

30. UNCERTAINTIES (PAPD Step 4 and part of Steps 11 and 12)

Definitions:

Regulatory Uncertainty - Lack of certitude as to what is meant by the REGULATORY REQUIREMENT or with its ELEMENTS OF PROOF, or the adequacy, completeness, and/or necessity of the requirement itself.

REGULATORY UNCERTAINTY may stem from lack of clarity in the quoted statement, the omission of an essential requirement from the regulation, and/or the inclusion of requirements in the regulation that do not contribute to or detract from the regulatory program.

Technical Uncertainty - Lack of certitude as to how to demonstrate (DOE action) or determine (NRC action) compliance and/or obtain the requisite information.

A TECHNICAL UNCERTAINTY is created by the absence of a defined and accepted means to resolve a technical program need. TECHNICAL UNCERTAINTIES are derivable from DOE COMPLIANCE DEMONSTRATION METHODS, NRC COMPLIANCE DETERMINATION METHODS, NRC UNCERTAINTY QUESTIONS, UNCERTAINTY REDUCTION METHODS and INFORMATION REQUIREMENTS.

Institutional Uncertainty - The lack of certitude regarding the roles, missions, actions, and schedules of agencies with REGULATORY REQUIREMENTS that effect the high-level waste regulatory program, their impacts, or their integration with the NRC regulatory program.

Uncertainty, in all cases, is associated with a perceived insufficiency in a specific item. This may include one or more of several types; e.g., definition, clarity, consistency, technical acceptance, proof. Uncertainties generally act as a constraint on action in some area of interest. However, -- and this is a point that must be carefully considered in selecting and defining uncertainties -- the fact that some work remains to be completed does not, of itself, cause the results of that work to be an uncertainty.

If the method of completing the work is unknown or lacks general acceptance, the method may be the subject of an uncertainty. Or, if the work is completed and the results will not support a useable conclusion, the conclusion may be the subject of an uncertainty.

The UNCERTAINTY statement may be thought of as the definition of a perceived insufficiency and the general type of corrective action. Together, these provide the basis for the identification of detailed corrective methods, information needs and plans in subsequent steps of the Program Architecture process.

Content - This field will contain, in full or in abstract form, the UNCERTAINTIES put forth by the NRC, DOE, States, Tribes and other affected parties. In all cases, such UNCERTAINTIES shall include reference(s) to magnetic or hard copy source(s) of the information.

DOE UNCERTAINTIES will be entered in this field as described above until the LSS becomes operational. From that point, DOE UNCERTAINTIES will be identified by an appropriate reference to the LSS; that is, the field will contain the identifier or code to be used to obtain this information from the LSS.

For each NRC UNCERTAINTY, a brief statement will be provided that identifies what is uncertain (e.g., The regulatory intent...), defines what is needed to correct the uncertainty (e.g., ...needs to be clarified), and identifies why the uncertainty needs to be corrected. These are to be positive statements; i.e., what is needed, rather than what is not now available. Additional examples would include:

a. A term requires further definition to avoid . . .
b. The applicability of a theory needs to be demonstrated to provide the basis for . . .
c. Bounds must be established in order to . . .
d. Jurisdiction must be established so that . . .

Note that these statements imply action but are not in themselves action statements. Action statements will be developed in Field 37, DOE Uncertainty Reduction Methods, and in Field 39, NRC Uncertainty Reduction Methods.

Format - Field size: Variable length up to 32K characters.

31. UNCERTAINTY SOURCE
(PAPD Step 4 and part of Steps 11 and 12)

Content - This field will identify the source(s) of the UNCERTAINTY or set of UNCERTAINTIES in the preceding field. A "source" is an agency that presented or identified the UNCERTAINTY for resolution or reduction. (The agency with action responsibility is identified in Field 34.) Potential sources include the NRC, DOE, States, Tribes and other affected parties.

Format - Field size: TBD characters.

32. UNCERTAINTY TYPE CODE
(PAPD Step 4 and part of Steps 11 and 12)

Content - This field will contain a code that identifies that each UNCERTAINTY is either Regulatory, Technical or Institutional.

Format - Field size: TBD characters.

33. SITE DEPENDENCY (PAPD Step 4 and part of Steps 11 and 12)

Content - This field will contain a code that identifies that each UNCERTAINTY is either Site Constrained, Site Specific or Generic (site independent).

Format - Field size: TBD characters.

34. UNCERTAINTY ACTION AGENCY
(PAPD Step 4 and part of Steps 11 and 12)

Content - This field will identify the government agency(ies) responsible for resolving/reducing each UNCERTAINTY; e.g., DOE, DOT, EPA, NRC, Congress. For REGULATORY UNCERTAINTIES, this is a single agency. For TECHNICAL UNCERTAINTIES, except in rare instances, this is also a single agency. Other agencies may coordinate in or approve certain aspects, but only one agency is responsible for eliminating or reducing the lack of certitude. In the case of INSTITUTIONAL UNCERTAINTIES, two or more agencies may share responsibility.

Format - Field size: TBD characters.

35. NRC UNCERTAINTY QUESTIONS (PAPD Step 10)

Definition - A component of an uncertainty -- An expression of inquiry that calls for a reply.

To resolve a specific TECHNICAL, REGULATORY, or INSTITUTIONAL UNCERTAINTY, one or more questions will arise that require information to obtain an answer or make a reply. The resolution of uncertainty is dependent upon the answer(s) to the question(s) which, in turn, is dependent on the specific information.

Content - UNCERTAINTY QUESTIONS are developed by breaking an UNCERTAINTY into its constituent elements and phrasing each element as a question. If the UNCERTAINTY is not divisible, enter "DNA" (for "Does Not Apply").

The UNCERTAINTY QUESTIONS may relate to one or more of several factors involved in responding to the UNCERTAINTY. For REGULATORY and INSTITUTIONAL UNCERTAINTIES these factors, in general, are derived directly from the uncertainty. For TECHNICAL UNCERTAINTIES the factors are taken from a variety of applicable technical concerns. Examples include, but are by no means limited to:

a. How well must the parameter of interest be known (i.e., what is the required accuracy/precision or statistical confidence)?
b. Is applicable theory available?
c. What level of acceptance is there in the technical community for the applicability of the theory to the conditions/processes of concern?
d. Can the process/phenomenon be acceptably modeled/ simulated?
e. Can causal factors be identified with acceptable certitude?
f. Can the local environment be acceptably analysed/ simulated?
g. Can the variables of interest (e.g., frequency, duration, limits, properties) be identified and quantitatively described with acceptable accuracy?
h. Can the needed data be obtained with sufficient accuracy?
i. What statistical confidence or safety margin is acceptable?

Format - Field size: Variable length up to 32K characters.

36. DOE UNCERTAINTY REDUCTION METHOD TOPIC (PAPD Step 22)

Content - This field contains the general subject and keywords of the DOE UNCERTAINTY REDUCTION METHOD in the next field. It is intended as a vehicle for consistent identification and consolidation of items related to a given topic. (See Field 8 content description.)

Format - Field size: TBD characters.

37. DOE UNCERTAINTY REDUCTION METHODS (PAPD Step 22)
[NOTE: When the LSS comes on-line, this field may be reduced to the identifier or code to be used to obtain this information from the LSS.]

Content - This field will contain a summary of (and, if published, a reference to) how DOE plans to reduce each REGULATORY, TECHNICAL, and INSTITUTIONAL UNCERTAINTY related to their demonstration of compliance. Contingency, backup or other alternative methods under serious consideration shall also be described.

Format - Field size: Variable length up to 32K characters.

38. NRC UNCERTAINTY REDUCTION METHOD TOPIC (PAPD Step 15)

Content - This field contains the general subject and keywords of the NRC UNCERTAINTY REDUCTION METHOD in the next field. It is intended as a vehicle for consistent identification and consolidation of items related to a given topic. (See Field 8 content description.)

Format - Field size: TBD characters.

39. NRC UNCERTAINTY REDUCTION METHODS (PAPD Step 15)

Definition - How the TECHNICAL, INSTITUTIONAL or NRC REGULATORY UNCERTAINTY will be reduced.

Content - This field contains a summary description of how the NRC plans to reduce each NRC UNCERTAINTY. This abbreviated plan will include:

a. Responsible Organization(s): The organization(s) within the NRC and, as applicable, its contractors assigned to the task of reducing the UNCERTAINTY (the lead organization is to be clearly identified),

b. Summary of Approach: A summary of the approach to be used (for example, staff technical position, NRC counsel legal opinion, rulemaking, memorandum of understanding),

c. Required Tasks: The tasks presently considered necessary for reduction of the UNCERTAINTY to an acceptable level (NOTE: These tasks are above the level of satisfaction of INFORMATION REQUIREMENTS; i.e., INFORMATION REQUIREMENTS will be derived from the identified tasks.),

d. Interactions: The interactions between the above tasks and/or between these tasks and other activities (inputs from, outputs to, coordination with),

e. Schedule Constraints: The project milestones and the key uncertainty reduction method lead times (e.g., 3-year rulemaking) that dictate the schedule for (1) completion of the above tasks and/or (2) interim milestones for reviews, deliverables and interactions. The rationale behind the Field 47 schedule and network for the subject NRC UNCERTAINTY REDUCTION METHOD is to be summarized here.

f. CPM Code: The reference code to the top-level CPM network of the NRC UNCERTAINTY REDUCTION METHOD,

g. Uncertainty Reduction Method Reference(s): Reference(s) to more complete presentation of the NRC UNCERTAINTY REDUCTION METHOD,

h. Postulated Elements of Proof: In cases where INSTITUTIONAL and/or REGULATORY UNCERTAINTY exists, the ELEMENTS OF PROOF for the REGULATORY REQUIREMENT as they are presumed to be after the subject UNCERTAINTY is resolved. Those Postulated ELEMENTS OF PROOF whose wording may be affected by (i.e., is sensitive to) the resolution of the subject UNCERTAINTY are to be entered in upper case (all-cap) letters. In the Uncertainty Reduction Method Notes an explanation will be provided of all such verbal dependencies and any logical dependencies that may exist. If the logical and verbal construction of the ELEMENTS OF PROOF is insensitive to the UNCERTAINTY, an explanation will be provided in the Uncertainty Reduction Method Notes. The Postulated ELEMENTS OF PROOF are to be provided in this field in the text hierarchical format. A hard-copy of the graphic ELEMENTS OF PROOF hierarchical format will be retained in the permanent hard-copy file for the subject UNCERTAINTY REDUCTION METHOD. (See Field 15, Attachment B and TOP-001-03.)

Contingency, backup or other alternative methods under serious consideration for reduction of the subject UNCERTAINTY shall also be summarized in this field.

Format - Field size: Variable length up to 32K characters.

40. NRC UNCERTAINTY REDUCTION METHOD CODE (PAPD Step 15)

Content - This field will contain a code that, based on the description in the preceding field, identifies the basic method to be used to reduce the NRC UNCERTAINTY. The available codes for each type of UNCERTAINTY are as follows:

REGULATORY

INT	NRC to provide an interpretation
DEF	NRC to provide a definition
RG-R	NRC to issue a Regulatory Guide (Regulatory)
MOU-R	Memorandum of Understanding (Regulatory)
CLA	NRC to clarify regulatory intent
OGC	NRC OGC to provide legal opinion
RUL-R	Rulemaking (Regulatory)

TECHNICAL

RES-D	DOE to conduct research
SDY-D	DOE to conduct study(ies)
MTD-D	DOE to develop and demonstrate method
RES-N	NRC to conduct research
SDY-N	NRC to conduct study(ies)
DAA-N	NRC to define acceptable approach(es)
RG-T	NRC to issue a Regulatory Guide (Technical)
GTP	NRC to write a Generic Technical Position

INSTITUTIONAL

MOU-I	Memorandum of Understanding (Institutional)
RUL-I	Rulemaking (Institutional)

Format - Field size: TBD characters.

APPENDIX B

REGULATORY UNCERTAINTIES

>>>UNCERTAINTY_NUMBER:

1

>>>IDENTIFICATION_NUMBER:

RR52/UN1

>>>PRIMARY_CITATION:

10CFR60.16*
10CFR60.17*
10CFR60.23

>>>UNCERTAINTY_TEXT:

The nature of the uncertainty is that the regulation does not specify whether, or what criteria, testing with radioactive materials is or is not necessary. Until this determination is made, the Regulatory Requirement is incomplete, since neither site characterization planning that involves the use of radioactive material nor the related site characterization is complete and meets statutory requirements given in 42USC10133(c)(2).

10CFR60 only includes the requirement that DOE demonstrate the need to use radioactive materials in testing, and that the NRC rule on that justification.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

A Regulatory Uncertainty exists because 10CFR60 does not specify whether, or by what criteria, the Commission will determine that testing with radioactive materials is or is not necessary, nor does it specify limits and restrictions for use of radioactive material. 10CFR60.17(a)(2)(ii) requires only that plans for testing with radioactive materials be included in the site characterization plan. 10CFR60.18(e) is related to 17(a)(2)(ii) in that it reflects the requirement for a Commission determination of need for testing with radioactive materials. Until this determination is made, the Regulatory Requirement is incomplete, since statutorily neither site characterization planning nor the site characterization program itself is fully compliant.

>>>FILE_NAME:

R52UN1.1

>>>UNCERTAINTY_NUMBER:

2

>>>IDENTIFICATION_NUMBER:

RR74/UN1

>>>PRIMARY_CITATION:

10CFR60.21(a)
10CFR60.51
10CFR60.23
10CFR60.24(a)

>>>UNCERTAINTY_TEXT:

There is currently uncertainty stemming from the language in 10 CFR 60.21(a) which requires the preparation of an environmental report which "shall accompany" the license application and the juxtaposition of that language contained in 42 USC 10134(f)(4) of the Nuclear Waste Policy Act, as amended, which states "(4) Any environmental impact statement prepared in connection with a repository proposed to be constructed by the Secretary under this subtitle shall, to the extent practicable, be adopted by the Commission in connection with the issuance by the Commission of a construction authorization and license for such repository. To the extent such statement is adopted by the Commission, such adoption shall be deemed to also satisfy the responsibilities of the Commission under the National Environmental Policy Act of 1969 (42 U.S.C. 4321, et seq." What is required (environmental report or environmental impact statement) and its role in the licensing process needs clarification. Clearly, the law (statute) must control the regulation. 10 CFR 60.21 and related sections are currently the subject of a rulemaking.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

Inconsistency (or at least the potential thereof) between the regulation and NWPA.

>>>FILE_NAME:

R74UN1.2

>>>UNCERTAINTY_NUMBER:

3

>>>IDENTIFICATION_NUMBER:

RR62/UN1

>>>PRIMARY_CITATION:

10CFR60.32*

>>>UNCERTAINTY_TEXT:

10CFR60.32(a) states that "A construction authorization shall include such conditions as the Commission finds to be necessary to protect the health and safety of the public, the common defense and security, or environmental values." There are two uncertainties here. The first uncertainty, RR62/UN1, is the use of the word "or" in "...or environmental values." A literal interpretation of the subsection is that the construction authorization needs to include either conditions necessary to protect health and safety or conditions necessary to protect the common defense and security or conditions necessary to protect the environment, but not all three, or even two of the three.

This represents an insufficiency in the regulation. It is doubtful that the regulation means, for example, that a construction authorization needs to include only environmental protection, and that, if it concerns itself with environmental protection, health and safety are of no concern.

The uncertainty can be removed by changing the word "or" in "or environmental values" to "and".

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

10CFR60.32(a) states that "A construction authorization shall include such conditions as the Commission finds to be necessary to protect the health and safety of the public, the common defense and security, or environmental values." There are two uncertainties here. The first uncertainty, RR62/UN1, is the use of the word "or" in "...or environmental values." A literal interpretation of the subsection is that the construction authorization needs to include either conditions necessary to protect health and safety or conditions necessary to protect the common defense and security or conditions necessary to protect the environment, but not all three, or even two of the three.

This represents an insufficiency in the regulation. It is doubtful that the regulation means, for example, that a construction authorization needs to include only environmental protection, and that, if it concerns itself with environmental protection, health and safety are of no concern, yet this is clearly the meaning of the regulation as it is written.

>>>FILE_NAME:

R62UN1.3

>>>UNCERTAINTY_NUMBER:

4

>>>IDENTIFICATION_NUMBER:

RR62/UN2

>>>PRIMARY_CITATION:

10CFR60.32*

>>>UNCERTAINTY_TEXT:

10CFR60.32(a) states that "A construction authorization shall include such conditions as the Commission finds to be necessary to protect the health and safety of the public, the common defense and security, or environmental values." There are two uncertainties here. The second uncertainty, RR62/UN2, lies in the lack of definition of "such conditions". Although the regulation clearly assigns the responsibility of defining the necessary conditions to the Commission, they must be defined before DOE can proceed with an application for construction authorization.

This vagueness is an insufficiency in the regulation. The uncertainty can be removed by defining parameters for the conditions necessary to protect health and safety, common defense and security, and environmental values while still leaving the Commission some discretion in the definition.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

10CFR60.32(a) states that "A construction authorization shall include such conditions as the Commission finds to be necessary to protect the health and safety of the public, the common defense and security, or environmental values." There are two uncertainties here. The second uncertainty, RR62/UN2, lies in the lack of definition of "such conditions". Although the regulation clearly assigns the responsibility of defining the necessary conditions to the Commission, they must be defined before DOE can proceed with an application for construction authorization.

This vagueness is an insufficiency in the regulation. The uncertainty can be removed by defining parameters for the conditions necessary to protect health and safety, common defense and security, and environmental values while still leaving the Commission some discretion in the definition. Until this is done, however, DOE cannot know how to proceed to meet the regulations governing application for a license and for construction authorization.

>>>FILE_NAME:

R62UN2.4

>>>UNCERTAINTY_NUMBER:

5

>>>IDENTIFICATION_NUMBER:

RR71/UN3

>>>PRIMARY_CITATION:

10CFR60.51*

>>>UNCERTAINTY_TEXT:

The uncertainty text in question is embodied in 10CFR60.52(a)(2)(ii), which requires placement of records in archives "... that would be likely to be consulted by potential human intruders..."

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

There is no way of identifying "potential human intruders" nor of projecting the likelihood of "potential human intruders" consulting an archive in the United States or anywhere in the world in the future after permanent closure.

>>>FILE_NAME:

R71UN3.5

>>>UNCERTAINTY_NUMBER:

6

>>>IDENTIFICATION_NUMBER:

RR71/UN2

>>>PRIMARY_CITATION:

10CFR60.51*

>>>UNCERTAINTY_TEXT:

The uncertainty text in question is embodied in 10CFR60.51(a)(2)(i), which requires monuments marking the repository after closure to be "as permanent as practicable".

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The rationale for the uncertainty is that the phrase "as permanent as practicable" is meaningless. If the instruction is to erect a permanent monument, than the builders will make it permanent inasmuch as they are able to judge its permanence - or, in other words, as permanent as they can. Is anything less warranted or desirable?

>>>FILE_NAME:

R71UN2.6

>>>UNCERTAINTY_NUMBER:

7

>>>IDENTIFICATION_NUMBER:

RR71/UN1

>>>PRIMARY_CITATION:

10CFR60.51*

>>>UNCERTAINTY_TEXT:

The uncertainty text in question is embodied in 10CFR60.46(a)(1), which states that a licnse amendment shall be required with respect to any action which "...would substantially increase the difficulty of retrieving..emplaced waste".

10CFR60.111(b) includes a related uncertainty - "...to preserve the option of waste retrieval..." which drives the uncertainty in 10CFR60.46(a)(1), since it is not clear whether "preserve the option" means to permit waste retrieval or not to preclude waste retrieval. If the latter were to be the final interpretation, the phrase "subtantially increase the difficulty of retrieving..." is meaningless. Thus, increasing the difficulty of waste retrieval can be characterized only after the uncertainty in 60.111(b) is resolved.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The rationale for the uncertainty is given in the uncertainty text. If retaining the retrieval option means only not precluding it and the repository is designed accordingly, there is no way to determine what would "substantially increase" its "difficulty". If retaining the retrieval option means designing the repository to permit retrieval, the word "substantially" needs definition, so the regulation is uncertain in either case.

>>>FILE_NAME:

R71UN1.7

>>>UNCERTAINTY_NUMBER:

8

>>>IDENTIFICATION_NUMBER:

RR72/UN1

>>>PRIMARY_CITATION:

10CFR60.52*

>>>UNCERTAINTY_TEXT:

10 CFR 60.52 provided in pertinent part:

> Section 60.52 Termination of License.
> (a) Following permanent closure and the decontamination or dismantlement of surface facilities, DOE may apply for an amendment to terminate the license.
>
> ....
>
> (c) A license shall be terminated only when the Commission finds with respect to the geologic repository:
>
> ....
>
> (3) That the termination of the license is authorized by law, including sections 57, 62, and 81 of the Atomic Energy Act, as amended. (emphasis added)

Section 57 of the Atomic Energy Act (42 USC 2078) provides, in pertinent part:

> Sec. 57. Prohibition. --
> a. Unless authorized by a general or specific license issued by the Commission, which the Commission is authorized to issue pursuant to section 53, no person, (including a government agency) may transfer or receive in interstate commerce, transfer, deliver, acquire, own, possess, receive possession of or title to, or import into or export from the United States any special nuclear materials. (42 USC 2077)

"special nuclear material" is defined by sec.11(aa) of the Atomic Energy Act (42 USC):

> aa. The term "special nuclear material" means (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51, determines to be special nuclear material, but does not include source material; or (2) any material artificially (sic) enriched by any of the foregoing, but does not include source material.

Section 123 of the Nuclear Waste Policy Act (42 USC 10143) as amended, provides:

> Delivery, and acceptance by the Secretary, of any high-level radioactive waste or spent nuclear fuel for a repository constructed under this part shall constitute a transfer to the Secretary of title to such waste or spent fuel.

The combination of these provisions raise, in this analysts mind, the question whether a "termination of license" may ever "be authorized by law" (as the law is presently constituted) so as to satisfy 10 CFR 60.52 (c)(3). Simply put: (1) Spent Fuel contains "special nuclear" material. (2) Possession or transfer requires a license. and, (3) DOE will have title (possession) at closure and therefore will either retain title and possession or transfer title and possession. Either would seem to require a license pursuant to section 57 (42 USC 2078) with respect to "special nuclear material."

Similar considerations are present with respect to "byproduct material" and "source material" contained in spent nuclear fuel and possession or transfer of which requires a license pursuant to section 62 (42 USC 2092) and section 81 (42 USC 42111) of the Atomic Energy Act.

The uncertainty could be resolved through either legislation or perhaps some Commission action related to the following language

> ....The Commission is authorized to establish classes of material and to exempt certain classes or quantities of material or kinds of uses or users from the requirements for a license set forth in this section when it makes a finding that the exemption of such classes or quantities of such material or such kinds of uses or users will not constitute an unreasonable risk to the common defense and security and to the health and safety of the public.

This language occurs in sections 51, 62 and 81.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

None

>>>FILE_NAME:

R72UN1.8

>>>UNCERTAINTY_NUMBER:

9

>>>IDENTIFICATION_NUMBER:

RR4/UN1

>>>PRIMARY_CITATION:

10CFR60.111(a)*
10CFR60.132(a)*
10CFR60.132(b)*

>>>UNCERTAINTY_TEXT:

10CFR60.111(a) does not have a reference to ALARA such as 10CFR72.67(b) has. This omission should be resolved.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The absence of ALARA in RR4 and the presence of it in 10CFR72.67(b) should be evaluated by the NRC, since it could pose problems during the licensing process.

>>>FILE_NAME:

R4UN1.9

>>>UNCERTAINTY_NUMBER:

10

>>>IDENTIFICATION_NUMBER:

RR4/UN2

>>>PRIMARY_CITATION:

10CFR60.111(a)*
10CFR60.132(a)*
10CFR60.132(b)*

>>>UNCERTAINTY_TEXT:

An uncertainty exists in the phrase "at all times" found in 10CFR60.111(a). The intent could refer to (1) normal operations during all preclosure times, such as operations, storage, performance testing, retrieval, decontamination and decommissioning or (2) during times of normal operation, off normal operation, and times of accidents. The second interpretation would force EPA limits on releases during and after an accident, which may not be the intent of the NRC.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The phrase "at all times" in 10CFR60.111(a) could be interpreted in two ways.

>>>FILE_NAME:

R4UN2.10

>>>UNCERTAINTY_NUMBER:

11

>>>IDENTIFICATION_NUMBER:

RR2/UN1

>>>PRIMARY_CITATION:

10CFR60.111(b)(1)
10CFR60.111(b)(2)
10CFR60.111(b)(3)

>>>UNCERTAINTY_TEXT:

The perceived insufficiency in the text of the Regulatory Requirement, covered in 10CFR60.111(b), 132(a), 133(c), and 133(e) (1), is that the intent of the Regulatory Requirement requires clarification as to whether the Geologic Repository Operations Area, surface facilities, underground facility, and underground openings must be designed specifically to permit waste retrieval or only that the design of these items does not preclude waste retrieval.

This perceived insufficiency needs to be corrected so that DOE understands what design action is required by the intent of this regulation and so that NRC can effectively evaluate DOE's compliance demonstration.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The current Regulations 10CFR60.111(b), 132(a), 133(c), and 133(e)(1) leave the intent of the Regulatory Requirement open to various interpretations, some of which may not satisfy the intent of the Regulatory Requirement. It is necessary to clarify the meaning of the Regulatory Requirement so that uniform interpretation and compliance can be achieved.

There is a difference between "To permit waste retrieval" versus that "The Geologic Repository Operations Area be designed for waste retrieval", but the Regulation as it is currently written presents the impression that the Geologic Repository Operations area shall be designed for waste retrieval. Therefore there is a regulatory uncertainty that should be resolved.

One interpretation would allow compliance with the Regulatory Requirement intent by making sure that the Geologic Repository Operations Area does not prohibit the retrieval of waste, if necessary (10CFR60.111(b)(1) and 133(e)(1) retrievability option maintained).

Another interpretation of the requirement would allow compliance only if the design of the Geologic Repository Operations Area included provisions specifically for the retrieval of waste (10CFR60.111(b)(2) and 133(c), design for retrievability). The range of interpretations possible can greatly impact the cost of the Geologic Repository Operations Area design and construction.

The intent of the waste retrieval Regulatory Requirement is discussed and clarified in NUREG 0804, 1983. In NUREG 0804, NRC adheres to its original position that retrievability is an important design consideration, but rephrases the requirement in functional terms. NRC recognizes that any actual retrieval would be an unusual event and may be expensive. The idea is that it should not be made impossible or impractical to retrieve the waste if such retrieval turns out to be necessary to protect the public health and safety, but does not require the repository to be designed specifically for waste retrieval.

One Postulated Elements of Proof Hierarchy (Chart 1), presented in the uncertainty reduction methodology (RR2/UN1/QU1/NR1), illustrates those elements that can be derived when the text is conservatively interpreted. The Postulated Elements of Proof Hierarchy (Chart 2), presented in the same uncertainty reduction methodology, for this Regulatory Requirement consider that the repository design does not preclude (make impossible) the option to retrieve waste.

>>>FILE_NAME:

R2UN1.11

>>>UNCERTAINTY_NUMBER:

12

>>>IDENTIFICATION_NUMBER:

RR1001/UN1

>>>PRIMARY_CITATION:

10CFR60.112
10CFR60.113(c)
10CFR60.133(f)

>>>UNCERTAINTY_TEXT:

The terms "anticipated processes and events" and "unanticipated processes and events" require further definition to permit uniform interpretation of the regulatory requirement. In the definition in 10CFR60.2, the distinction between anticipated and unanticipated processes and events is differentiated by whether or not it is "...reasonably likely to occur...". In NUREG-0804, December 1983, p. 19, it is noted that "...the distinction between anticipated and unanticipated processes and events relates solely to natural processes and events affecting the geologic setting...." From the same reference, unanticipated processes and events are those which "..include processes and events which are not evidenced during the Quaternary Period or which, though evidenced during the Quaternary, are not likely to occur during the relevant time frame...." Without clarification, disagreement will likely develop concerning which events or processes are "reasonably likely to occur", and it will not be possible to clearly identify which processes and events are anticipated and which are unanticipated.

A draft generic technical position, "Guidance for Determination of Anticipated Processes and Events and Unanticipated Processes and Events", February 1988, has been reviewed but does not completely clarify the required definition.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

In NUREG-0804, further discussion of this subject notes "...that the distinction between anticipated and unanticipated processes and events relates solely to natural processes and events affecting the geologic setting...." It further states that "...Such processes or events would not be anticipated unless they were reasonably likely, assuming that processes operating in the geologic setting during the Quaternary Period were to continue to operate but with the perturbations caused by the

presence of emplaced waste superimposed thereon. Unanticipated processes and events would include those that are judged not to be reasonably likely to occur during the period the intended performance objective must be achieved, but which nevertheless are sufficiently credible to warrant consideration...." Although this discussion expounds on the subject, the determination of what is "reasonably likely" (as a criterion for an anticipated process or event) is not clear.

The DRAFT GENERIC TECHNICAL POSITION-GUIDANCE FOR DETERMINATION OF ANTICIPATED PROCESSES AND EVENTS AND UNANTICIPATED PROCESSES AND EVENTS provides the guidance and methodologies that NRC considers necessary to evaluate both anticipated and unanticipated processes and events. NRC requested public comment on the draft GTP, and the comments NRC received indicated that, while they were proceeding in the right direction, several questions in the draft GTP remain to be addressed.

Without clarification, disagreement will likely develop concerning which events or processes are "reasonably likely to occur", and it will not be possible to clearly identify which processes and events are anticipated and which are unanticipated.

>>>FILE_NAME:

R1001UN1.12

>>>UNCERTAINTY_NUMBER:

13

>>>IDENTIFICATION_NUMBER:

RR1002/UN1

>>>PRIMARY_CITATION:

10CFR60.113(a)(1)(i)(A)
10CFR60.113(a)(1)(ii)(A)

>>>UNCERTAINTY_TEXT:

The term "substantially complete" used in 10CFR60 E 113 (a) (1) (i) (A) and 10CFR60 E 113 (a) (1) (ii) (A) requires further definition. The NRC needs to define what is meant by "substantially complete" as related to containment of radionuclides. This term needs to be defined so that designers of containers will have a quantitative specification, or the basis for developing a quantitative specification, for container design, and so that the NRC will have criteria by which to determine if the design is acceptable.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The term "substantially complete" is not adequately defined. In NUREG 0804, the Commission recognized the statistical probability of some percentage of containers failing, and so revised the original wording "containing all radionuclides" to "substantially complete" containment.

>>>FILE_NAME:

R1002UN1.13

>>>UNCERTAINTY_NUMBER:

14

>>>IDENTIFICATION_NUMBER:

RR1003/UN3

>>>PRIMARY_CITATION:

10CFR60.113(a)(1)(i)(B)
10CFR60.113(a)(1)(ii)(B)

>>>UNCERTAINTY_TEXT:

10CFR60.135 (c) (1) states that "all such radioactive wastes shall be in solid form".The regulatory intent of 10CFR60.135 (c) (1) needs to be clarified relative to fission product gases contained in spent fuel rods.

It is necessary to clarify the meaning of the regulatory requirement so that uniform interpretation and compliance can be achieved.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

From the current wording of 10CFR60.135 (c) (1), it could be concluded that spent fuel rods, which contain radioactive gases, must be processed or treated so that no radioactive gases are left. If processing or treatment is required, consideration must be given to the containment of such radioactive gases during processing or treatment. This may be more difficult than proving that gases will be contained within the fuel rod, the waste container, and the engineered barrier system. If the interpretation requires processing or treatment, the maximum allowable limit of radioactive gases must be determined, since radioacitive gases may permeate even a "solid" waste form. (E. Tschoepe, 4 November 1988, 16 December 1988)

A second interpretation might be that spent fuel rods meet the requirement as a solid waste form, since radioactive gases are contained within the solid boundary of each fuel rod. This shows that the current wording allows a broad range of interpretation so that completely opposite meanings can be derived from the same text. (R. Wilbur, 1 December 1988)

>>>FILE_NAME:

R1003UN3.14

>>>UNCERTAINTY_NUMBER:

15

>>>IDENTIFICATION_NUMBER:

RR55/UN1

>>>PRIMARY_CITATION:

10CFR60.121(a)*

>>>UNCERTAINTY_TEXT:

The requirement for ownership and control should contain a milestone reference by which the requirement is to have been met. The only opportunity for NRC review of compliance with this requirement is during evaluation of DOE's license application. Control must be established (or assured) prior to license application and DOE must exercise some control during site characterization. The exact nature and extent of the control needed prior to actual operation at the repository site is not clear.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The only indication of the time at which control must be established that currently exists is implied by the term "location". This implies that the lands where the repository and controlled area are to be located must be owned or controlled and unencumbered prior to construction authority.

>>>FILE_NAME:

R55UN1.15

>>>UNCERTAINTY_NUMBER:

16

>>>IDENTIFICATION_NUMBER:

RR2001/UN1

>>>PRIMARY_CITATION:

10CFR60.122(a)(1)
10CFR60.122(b)*

>>>UNCERTAINTY_TEXT:

The intended meaning of the phrase "when projected" found in 10CFR60.122(b)(1), Favorable Conditions, is uncertain.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The period of time into the future in which the geologic processes are to be predicted can affect the expected conditions at the repository site. The few million years in the Quaternary is too long a period to project in to the future, for example, since the site is to be deemed secure for only 10,000 years. If a one-in-a-million year earthquake is "projected", its probability of affecting the repository is quite small, however, the damage associated with such an earthquake would be expected to be catastrophic to the geologic repository. The timing to be considered proper is a crucial element of the effects analysis, and subsequent design, and, thus, needs to be clarified and justified for each of the elements to be considered.

>>>FILE_NAME:

R2001UN1.16

>>>UNCERTAINTY_NUMBER:

17

>>>IDENTIFICATION_NUMBER:

RR2001/UN2

>>>PRIMARY_CITATION:

10CFR60.122(a)(1)
10CFR60.122(b)*

>>>UNCERTAINTY_TEXT:

Contradiction in terms between 10CFR60.122 (b)(7) and 10CFR60.113(a)(2).

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

In 10CFR60.122(b)(7) the ground water travel time is discussed and the statement "substantially exceeds 1000 years" is used to describe the travel time "fastest path." This statement is in contradiction with the statement in 10CFR60.113(a)(2) that the time of travel along the fastest path is to be at least 1000 years or such other travel time as may be approved by the Commission. One thousand and one years would qualify under 113(a)(2) while it is probable that some considerably longer period would be described as "substantially exceed(ing)" 1000 years. This inconsistency in definition should be resolved; and the term "substantially exceeds 1000 years" should be clarified as to what number (per cent) of 1000 years is deemed substantial.

>>>FILE_NAME:

R2001UN2.17

>>>NOTES ON UNCERTAINTIES 18 THROUGH 64 (EXCLUDING 44)

NOTE: The following uncertainties, RR2002/UN1 (Uncertainty #18) and RR2002/UN2 (Uncertainty #19) are representative of UN1 and UN2 in RR2002 through RR2025. The subject of these uncertainties is the need for clarification of the statements "take into account the degree of resolution" for the UN1s, and "not to affect significantly" for the UN2s. The only differences being the different Regulatory Requirements which are addressed. These Regulatory Requirements are listed in a table following RR2002/UN2 (Uncertainty #19).

The uncertain language for UN18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 45, 47, 49, 53, 52, 55, 57, 59, 61, and 63 is contained in the phrase "taking into account the degree of resolution" in 10CFR60.122(a)(2).

The uncertain language for UN19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 46, 48, 50, 52, 54, 56, 58, 60, 62, and 64 is contained in the phrase "not to affect significantly the ability of the repository to isolate the waste" in 10CFR60.122(a)(2).

The complete uncertainty notes for UN18 and UN19, which discuss the application of these two phrases to the potentially adverse condition of 10CFR60.122(c)(1), are discussed on the following five pages. In the interest of brevity, the application of these two phrases to the particulars of the potentially adverse conditions of 10CFR60.122(c)(2) through 10CFR60.122.(c)(24) are not discussed in detail, but are listed. The discussions of UN18 and UN19 are given to provide an example for all of these discussions.

>>>UNCERTAINTY_NUMBER:

18

>>>IDENTIFICATION_NUMBER:

RR2002/UN1

>>>PRIMARY_CITATION:

10CFR60.122(a)(2)*
10CFR60.122(c)(1)

>>>UNCERTAINTY_TEXT:

The intended meaning of the phrase "take into account the degree of resolution" needs to be clarified in order to allow the DOE to adequately investigate the potentially adverse human activity or natural conditions. An adequate investigation is one that provides reasonable assurance that the potentially adverse human activities or natural conditions have been thoroughly and correctly studied.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

In 60.122(a)(2)(i) "take into account" could imply that some evaluatory weight be placed upon the possibility of undetected adverse conditions and the probability of their occurrence and possible effect on the performance expectations. It could also mean that a safety margin (large allowance for uncertainty) or high statistical confidence be applied to the evaluation of the adverse condition during the consideration process.

The "degree of resolution" could mean that some scale of numerical assessment of resolution be accomplished such that the relative importance of differing types of evaluations can be assessed and the relative correctness of each determined so that potentially adverse conditions might be rated. Or, it could mean, the evaluations recognize the uncertainties in any geologic investigations. A third interpretation, might be that the means of measurement of the adverse factor be used to assess the relative importance of the values attained and their implications to the overall assessment.

The following paragraphs are a compilation of the discussion of other aspects of the regulation which were considered during the process of identifying uncertainty. The items found below were considered not to produce regulatory or institutional uncertainty.

10CFR60.122(a)(2) states the following: "If any of the potentially adverse conditions specified in paragraph (c) of this section is present, it may compromise the ability of the geologic repository to meet the performance objectives relating to isolation of the waste. In order to show that a potentially adverse condition does not so compromise the performance of the geologic repository the following must be demonstrated:"

The wording of this portion of the siting criteria is not ambiguous. The following parts of the regulation define the way in which a given potentially adverse condition must be considered in order to satisfy the requirement that the performance of the repository not be compromised.

10CFR60.122(a)(2)(ii) is as follows: "The effect of the potentially adverse human activity or natural condition on the site has been adequately evaluated, using analyses which are sensitive to the potentially adverse human activity or natural condition and assumptions which are not likely to underestimate its effect; and"

There is no uncertainty in this requirement. The analyses are to use techniques which are judged to have a sensitivity appropriate to the evaluation task, and the evaluations are to be conservative in order to not underestimate a given effect.

If both conditions have been met then the adverse condition is deemed to have been adequately considered.

10CFR60.122(a)(2)(iii)(C) is as follows: "The potentially adverse human activity or natural condition can be remedied."

This portion of the regulation is straightforward. It implies that "if it can be fixed", or its adverse effects corrected in some other way, then, the potentially adverse condition will be treated as a benign operator.

10CFR60.122(a)(2)(iii)(B) is as follows: "The effect of the potentially adverse human activity or natural condition is compensated by the presence of a combination of the favorable characteristics so that the performance objectives relating to isolation of the waste are met, or..."

The term "compensated by the presence of a combination of the favorable characteristics" is understandable. The acceptable "combination" which can be considered compensatory is defined on the basis of the performance objectives. If unfavorable and adverse conditions are present, they may be negated or their adversity reduced by favorable conditions which cause the overall performance evaluation of the repository to remain within the numerical bounds established by the performance objectives.

>>>FILE_NAME:

R2002UN1.18

>>>UNCERTAINTY_NUMBER:

19

>>>IDENTIFICATION_NUMBER:

RR2002/UN2

>>>PRIMARY_CITATION:

10CFR60.122(a)(2)*
10CFR60.122(c)(1)

>>>UNCERTAINTY_TEXT:

The meaning of the phrase "not to affect significantly" in 60.122(a)(2)(iii)(A) needs to be clarified, in order for the DOE to determine what level of effect is to be considered not important to the ability of a geologic repository to meet the performance objectives. For additional information look at NUREG-0804, page 56.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The term "not to affect significantly", see 60.122(a)(2)(iii)(A), needs to be clarified because it could be interpreted in several ways. Relative to the performance objectives, the term could be applied such that the effect of a given adverse condition was termed significant only when it caused the performance objectives to be breached. Or an adverse condition could be termed significant when some to-be-decided level of effect was attained which was less than that required to breach the performance objectives but did represent a seeming threat to the objectives. Similarly, an adverse condition effect could be considered a significant threat based on a probable change in ambient conditions to some to-be-identified alarm level of the adverse condition itself and/or its components.

60.112 defines postclosure performance objectives for the system. These objectives inherently limit the aggregate effects of whatever combination of favorable and adverse conditions exists. That is, given a set of favorable conditions that permit the system to satisfy 60.112, the net effect of all adverse conditions may not cause the system to exceed 60.112 release rates.

In contrast, 60.122(a)(2)(iii)(A) requires examination of the effect of individual adverse conditions on system performance and requires that each condition is "not to affect significantly the ability of the geologic repository to meet the performance objectives relating to the isolation of the waste" (ie. 60.112). Clearly, if the effects of one or more of the individual conditions each cause system performance to even approach 60.112 limits, the aggregate effects are likely to breach those limits. (This apparent inconsistency needs to be clarified to provide the basis for a uniform approach to the analysis of the effects of adverse conditions on system performance.)

The following paragraphs are a compilation of the discussion of other aspects of the regulation which were considered during the process of identifying uncertainty. The items found below were considered not to produce regulatory uncertainty.

10CFR60.122(a)(2) states the following: "If any of the potentially adverse conditions specified in paragraph (c) of this section is present, it may compromise the ability of the geologic repository to meet the performance objectives relating to isolation of the waste. In order to show that a potentially adverse condition does not so compromise the performance of the geologic repository the following must be demonstrated:"

The wording of this portion of the siting criteria is not ambiguous. The following parts of the regulation define the way in which a given potentially adverse condition must be considered in order to satisfy the requirement that the performance of the repository not be compromised.

10CFR60.122(a)(2)(ii) is as follows: "The effect of the potentially adverse human activity or natural condition on the site has been adequately evaluated, using analyses which are sensitive to the potentially adverse human activity or natural condition and assumptions which are not likely to underestimate its effect; and"

There is no uncertainty in this requirement. The analyses are to use techniques which are judged to have a sensitivity appropriate to the evaluation task, and the evaluations are to be conservative in order to not underestimate a given effect.

If both conditions have been met then the adverse condition is deemed to have been adequately considered.

10CFR60.122(a)(2)(iii)(C) is as follows: "The potentially adverse human activity or natural condition can be remedied."

This portion of the regulation is straightforward. It implies that "if it can be fixed", or its adverse effects corrected in some other way, then, the potentially adverse condition will be treated as a benign operator.

10CFR60.122(a)(2)(iii)(B) is as follows: "The effect of the potentially adverse human activity or natural condition is compensated by the presence of a combination of the favorable characteristics so that the performance objectives relating to isolation of the waste are met, or..."

The term "compensated by the presence of a combination of the favorable characteristics" is understandable. The acceptable "combination" which can be considered compensatory is defined on the basis of the performance objectives. If unfavorable and adverse conditions are present, they may be negated or their adversity reduced by favorable conditions which cause the overall performance evaluation of the repository to remain within the numerical bounds established by the performance objectives.

>>>FILE_NAME:

R2002UN2.19

REGULATORY REQUIREMENT # - RRxxxxx	REGULATORY TEXT IDENTIFIERS
RR2002	10CFR60.122(a)(2) * 10CFR60.122(c) 10CFR60.122(c)(1)
RR2003	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(2)
RR2004	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(3)
RR2005	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(4)
RR2006	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(5)
RR2007	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(6)
RR2008	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(7)
RR2009	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(8)

RR2010	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(9)
RR2011	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(10)
RR2012	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(11)
RR2013	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(12)
RR2014	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(13)
RR2015	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(14)
RR2016	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(15)
RR2017	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(16)
RR2018	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) R60.122(c)(17)

RR2019	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(18)
RR2020	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(19)
RR2021	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(20)
RR2022	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(21)
RR2023	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(22)
RR2024	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(23)
RR2025	10CFR60.122(a)(2) * 10CFR60.122(b) * 10CFR60.122(c) 10CFR60.122(c)(24)

>>>UNCERTAINTY_NUMBER:

65

>>>IDENTIFICATION_NUMBER:

RR88/UN1

>>>PRIMARY_CITATION:

10CFR60.131(b)(9)

>>>UNCERTAINTY_TEXT:

One perceived insufficiency is the text of the Regulatory Requirement - RR88, covered in 10CFR60.131(b)(3). This text gives the impression that the Regulatory Requirement requires that **all** the structures, systems, and components important to safety should perform their safety functions during and after credible fires or explosions. Could some of the structures, systems, and components important to safety **fail** but the safety of the geologic repository operations area still be maintained by, for example, making some systems and/or components redundant.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The current Regulation Requirement - RR88, 10CFR60.131(b)(3) as it is written presents the impression that all the structures, systems and components important to safety should perform their safety functions regardless of the location and severity of a credible fire or explosion. It is conceivable and credible that a fire could break out in a system due to, say, an electrical fire, and could cause the failure of a component or even a system. Making all the structures, systems, and components important to safety 100% fire- and explosion-proof may not be practicable. Adequate compliance with the subject Requirement - RR88, may be very difficult to achieve.

>>>FILE_NAME:

R88UN1.65

>>>UNCERTAINTY_NUMBER:

66

>>>IDENTIFICATION_NUMBER:

RR88/UN3

>>>PRIMARY_CITATION:

10CFR60.131(b)(3)

>>>UNCERTAINTY_TEXT:

In 72.72(c), "the design of ISFSI shall include provisions to protect" versus "the GROA area shall be designed to include means to protect", in the 60.131(b)3(iv). Although the meaning of the two above regulatory texts is basically the same, neither one identifies the provisions or means to protect against adverse effects.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

It is uncertain in both 60.131(b03(iv) and 72.72(c) what the means or provisions against adverse effects are.

>>>FILE_NAME:

R88UN3.66

>>>UNCERTAINTY_NUMBER:

67

>>>IDENTIFICATION_NUMBER:

RR88/UN2

>>>PRIMARY_CITATION:

10CFR60.131(b)(3)*

>>>UNCERTAINTY_TEXT:

The item that may be insufficient in 10CFR60.131(b)(3)(iv) is whether the omission of the protection requirement from the adverse effects of either the operation or failure of an explosion suppression systems is intentional.

This needs to be clarified so that RR88 covered in 10CFR60.131(b)(3), is complete and self-consistent and so that DOE clearly understands the intent of the subject regulations.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

10CFR60.131(b)(3)(iii) requires that the geologic repository operations areas be designed to include appropriate suppression systems to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety.

10CFR60.131(b)(3)(iv) deals with means of protecting structures, systems, and components important to safety against adverse effects of either the operation or failure of the fire suppression systems only. No mention is made on the adverse effects of either the operation or failure of the explosion suppression systems.

>>>FILE_NUMBER:

R88UN2.67

>>>UNCERTAINTY_NUMBER:

68

>>>IDENTIFICATION_NUMBER:

RR89/UN3

>>>PRIMARY_CITATION:

10CFR60.131(b)(4)*

>>>UNCERTAINTY_TEXT:

The item that is deficient is the text of the Regulatory Requirement covered in 10CFR60131(b)(4)(ii). The deficiency in the text of the regulatory requirement is that the use of "available offsite services (such as fire, police, medical and ambulance service)" is restricted to "aid in recovery from emergencies". This appears to preclude their use to aid in responding to emergencies. If the use of available offsite services is restricted in this manner, then the GROA should include sufficient onsite resources to not require the use of those offsite services during an emergency.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The wording of 10CFR60.131(b)(4)(ii) directly links the use of available offsite services only to the purpose of aiding in recovery from emergencies. It would appear that such services, if available, could also be used to respond to emergencies for which they have been trained and are allowed access to.

>>>FILE_NAME:

R89UN3.68

>>>UNCERTAINTY_NUMBER:

69

>>>IDENTIFICATION_NUMBER:

RR90/UN3

>>>PRIMARY_CITATION:

10CFR60.131(b)(5)*

>>>UNCERTAINTY_TEXT:

The deficiency is that the text of the Regulatory Requirement covered in 10CFR60.131(b)(5) does not require that the emergency utility services be designed to permit testing of the service system in order to ensure functionality. The deficiency in the text of the regulatory requirement was found through a comparison to text contained in 10CFR72.72(k)(2). There is no similar text contained in 10CFR60.131(b)(5).

This deficiency needs to be corrected so that no argument can be presented claiming that the GROA was not designed adequately (to the same standards as a similar facility with similar functions and activities).

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The text of 10CFR60.131(b)(5) is inadequate because it does not require a design feature which is important to the geologic repository operations area's safety function.

>>>FILE_NAME:

R90UN3.69

>>>UNCERTAINTY_NUMBER:

70

>>>IDENTIFICATION_NUMBER:

RR91/UN1

>>>PRIMARY_CITATION:

10CFR60.131(b)(5)*

>>>UNCERTAINTY_TEXT:

The 10CFR60.131(b)(6) text includes the term "periodic" and a phrase "as necessary, to ensure their continued functioning and readiness" which may improve or decrease the clarity, inclusiveness, or conservativeness of the regulatory requirement.

Therefore, this requirement does not require designing for testing and maintenance that is non-periodic, which may be essential for safety. Also preventative testing and maintenance and other testing and maintenance is not required either.

By eliminating this potential uncertainty, clearer guidance could be provided to DOE as to the specific actions required in the design of structures, systems and components important to safety.

Except for the authorizing statute, only items in the Regulatory Requirement can be involved in a Regulatory or Institutional Uncertainty. 10CFR72 is not a part of this Regulatory Requirement and is not applicable to a repository. While it might be desirable to have identical requirements in the two regulations, if these regulations serve different purposes, it is neither necessary nor, in all cases, practical. In the case of these two sections, 60.131(b)(6) is more specific than 72.72(f) but it is not clear that there is any inconsistency in terms of regulatory intent or the design responses necessary to satisfy the requirements.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

Comparison of the text in 60.131(b)(6) to 72.72(f) raised the question of regulatory insufficiencies for facilities which could have very similar functions and activities. This leads to the argument that 10CFR60.131(b)(6) is not inclusive enough in its requirement.

>>>FILE_NAME:

R91UN1.70

>>>UNCERTAINTY_NUMBER:

71

>>>IDENTIFICATION_NUMBER:

RR92/UN3

>>>PRIMARY_CITATION:

10CFR60.131(b)(7)

>>>UNCERTAINTY_TEXT:

Regulatory requirements defining methods of criticality control:

-10CFR60.131(b)7 provides no regulatory requirements for methods of criticality control.

-10CFR72.73(b) provides regulatory requirements for methods of criticality control.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

72.73(b) specifies methods of criticality control, versus, nothing in 60.131(b)7.

>>>FILE_NAME:

R92UN3.71

>>>UNCERTAINTY_NUMBER:

72

>>>IDENTIFICATION_NUMBER:

RR92/UN2

>>>PRIMARY_CITATION:

10CFR60.131(b)(7)

>>>UNCERTAINTY_TEXT:

Regulatory requirement for margin of safety value, calculation conditions and operational applicability.

10CFR60.131(b)(7) provides an explicit margin of safety value (Keff must be sufficiently below unity to show at least a 5% margin) and requires a condition specifying allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation. It further states that each system shall be designed for criticality safety under normal and accident conditions.

10CFR72.73(a) does not specify an explicit margin of safety value but requires a condition for the nuclear criticality parameters to be commensurate with the uncertainties in the handling, transfer and storage conditions, in the data and methods used in calculations and in the nature of the immediate environment under accident conditions (no reference to normal conditions is included).

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

It appears that different margin of safety values and calculation considerations are presented in 60.131(b)7 and 72.73. This may possibly reflect specific differences between ISFSI and repository facilities, functions, and activities.

Both the repository and ISFSI facilities should be designed for criticality safety under normal, off-normal, and accident conditions.

>>>FILE_NAME:

R92UN2.72

>>>UNCERTAINTY_NUMBER:

73

>>>IDENTIFICATION_NUMBER:

RR92/UN1

>>>PRIMARY_CITATION:

10CFR60.131(b)(7)

>>>UNCERTAINTY_TEXT:

10CFR60.131(b)(7) states that the previously referenced systems shall be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety.

10CFR72.73 (a) states that the previously referenced systems shall be designed to be maintained subcritical and to prevent a nuclear criticality accident.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The 10CFR72.73 (a) regulatory requirement appears to be more stringent in two ways. First, a requirement is specified which requires the systems to be maintained subcritical [no corresponding requirement in 10CFR60.131(b)(7)]. Secondly, no "unless" condition is specified regarding the requirement to design systems so that a nuclear criticality accident is not possible. The 10CFR60.131(b)(7) regulatory requirement specifies an "unless" condition implying that under the stated conditions a nuclear criticality accident is possible. This further implies that it is acceptable to design systems complying with this regulatory requirement which could/would cause a nuclear criticality accident under the stated conditions. In effect, the 10CFR60.131(b)(7) regulatory requirement appears to define conditions under which a nuclear criticality accident is possible, and (should such an event occur) is acceptable.

>>>FILE_NAME:

R92UN1.73

>>>UNCERTAINTY_NUMBER:

74

>>>IDENTIFICATION_NUMBER:

RR93/UN3

>>>PRIMARY_CITATION:

10CFR60.131(b)(8)

>>UNCERTAINTY_TEXT:

Those instrument and control systems that must remain operational under accident conditions shall be identified in the Safety Analysis Report [10CFR72.72(i)], versus, nothing in 10CFR60.131(b)(8).

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

Since the same or similar activities will/could be conducted at a repository, an MRS, or an ISFSI, the regulatory text of the corresponding regulations should have the same context. In 10CFR72.72(i), the instrument and control systems that must remain operational under accident conditions are required to be identified in the Safety Analysis Report, while there is no such requirement in 10CFR60.131(b)(8).

>>>FILE_NAME:

R93UN3.74

>>>UNCERTAINTY_NUMBER:

75

>>>IDENTIFICATION_NUMBER:

RR80/UN3

>>>PRIMARY_CITATION:

10CFR60.131(b)(9)

>>>UNCERTAINTY_TEXT:

The text of the regulation implies that only **design requirements** in 30CFR57, as they apply to worker protection, need to be considered in the design of the underground facility. This requirement is incomplete, since 30CFR57 also includes **procedures** regarding activities in the underground facility, which were developed specifically to protect workers.

The regulation needs to make reference to the procedures as well as the design requirements of 30CFR57 that may apply to protect the workers in the underground facility.

The potential insufficiency in the regulation needs to be corrected because, as it stands, the regulation appears to be incomplete in its requirement for worker protection, and may fail in its intent to provide reasonable assurance that all structures, systems, and components important to safety can perform their intended functions.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The regulatory text is specific in its requirement to consider the **design requirements** of 30CFR57 as they apply to worker protection, in order to assure that structures, systems, and components important to safety can perform their intended functions. However, 30CFR57 also addresses **procedures** regarding activities in the underground facility. The procedures are developed specifically to assure the protection of workers. It is conceivable that by not following procedures in the performance of an underground activity, an accident could occur that would adversely affect the intended functions of structures, systems and components important to safety. Since it is the intent of the regulation to assure that structures, systems, and components important to safety can perform their intended functions, the regulation appears to be incomplete in its requirement, without also specifying that the regulations for procedures in 30CFR57 should be considered as part of the requirements for the underground facility.

>>>FILE_NAME:

R80UN3.75

>>>UNCERTAINTY_NUMBER:

76

>>>IDENTIFICATION_NUMBER:

R80/UN2

>>>PRIMARY_CITATION:

10CFR60.131(b)(9)

>>>UNCERTAINTY_TEXT:

The second perceived insufficiency in 10CFR60.131(b)(9) is the need to clarify the reference to 30CFR57, and not to reference Chapter I, Subchapter D,E,and N, which includes 30CFR56 and two reserved subchapters (D & E). Specifically, 10CFR60.131(b)(9) references Chapter I, Subchapter N which invokes 30CFR56, "Surface Mining Regulations". This is redundant with but not as inclusive as 30CFR57, "Deep Surface Mining Regulations".

By eliminating this perceived insufficiency, guidance is provided to DOE as to the jurisdiction of regulations dealing with worker protection, and to the design requirements and procedures in 30CFR57, which must be applied to the geologic repository operations area design, construction, and operation.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

The uncertainty is that 10CFR60.131(b)(9) makes reference to Subchapter N and thus invokes 30CFR56, "Surface Mining Regulations" which is not as inclusive as 30CFR57, "Deep Surface Mining Regulations".

>>>FILE_NAME:

R80UN2.76

>>>UNCERTAINTY_NUMBER:

77

>>>IDENTIFICATION_NUMBER:

RR80/UN1

>>>PRIMARY_CITATION:

10CFR60.131(b)(9)

>>>UNCERTAINTY_TEXT:

The first perceived insufficiency in 10CFR60.131(b)(9) is that since DOE is not subject to MSHA regulatory jurisdiction, and the wording in 10CFR60.131(b)(9), uncertainty arises in the determination of the regulatory role of NRC in enforcement of the worker protection provisions of 30CFR57.

By eliminating this perceived insufficiency guidance is provided to DOE as to the jurisdiction of regulations dealing with worker protection, and to the design requirements and procedures in 30CFR57, which should be applied to the geologic repository operations area design, construction, and operation.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

There seems to be some uncertainty over NRC's role in regulating worker safety covered by 30CFR57.

>>>FILE_NAME:

R80UN1.77

>>>UNCERTAINTY_NUMBER:

78

>>>IDENTIFICATION_NUMBER:

RR3/UN1

>>>PRIMARY_CITATION:

10CFR60.133(e)*
10CFR60.133(i)

>>>UNCERTAINTY_TEXT:

The perceived insufficiency is the intent of the term "safely" in the regulatory text of RR3. [10CFR60.133(e)(1)]

The requirement for safe operations in the design of the underground opening includes aspects related to mine worker safety and mining safety, exclusive of radiation safety. The Mine Safety and Health Administration (MSHA) has provided 30CFR57 for regulating safety of metal and non-metal underground mines and mine workers. The uncertainty in 10CFR60.133(e)(1), is whether NRC will regulate worker safety totally unrelated to radiological safety. By eliminating this uncertainty, guidance is provided to DOE as to the intent and thus the specific actions required in the design of the underground facility, in order to comply with RR3.

>>>UNCERTAINTY_NOTES:

1. UNCERTAINTY NOTES:

1.1 RATIONALE FOR THE PRESENCE OF AN UNCERTAINTY:

10CFR60.133(e)(1) addresses specifically the design of the underground openings. The design is directly related to the aspect of safety in the underground operation. "Safety" in design and underground operations includes mine worker safety, which is covered in 30CFR57. The reference to "safety" in the current Regulation (10CFR60.133(e)(1)) may bring confusion to the process of complying with the regulation, as well as to the process of compliance determination.

>>>FILE_NAME:

R3UN1.78

APPENDIX C

ATTRIBUTES USED FOR RANKING UNCERTAINTIES

>>>ATTRIBUTES RELATED TO IMPORTANCE OF AN UNCERTAINTY:

I1. It appears that technology for testing and analytical methods for obtaining information and/or data needed to reduce the uncertainty will not be obtainable in a timely manner, so that data needed to reduce the uncertainty cannot be collected.

I2. Reducing this uncertainty has a pervasive effect on the repository program, in that more than one phase of the program will be affectd.

I3. Reducing the uncertainty displays a high potential for avoiding or mitigating adverse non-radiological health and safety effects in the operational phase.

I4. Reducing the uncertainty displays a high potential for avoiding or mitigating adverse effects on radiological safety and/or waste isolation.

I5. Reducing the uncertainty displays a high potential for avoiding or mitigating chemical contamination problems.

I6. Reducing the uncertainty displays a high potential for avoiding or /mitigating irreversible environmental disturbance.

I7. Reduction of other uncertainties is highly dependent on reduction of this one: i.e., when this one is reduced, others will either be reduced more easily or will no longer exist.

I8. Reducing the uncertainty has a significant impact on the waste confidence decision.

>>>THE FOLLOWING ATTRIBUTES IDENTIFY POSSIBLE SCP OBJECTIONS

I9. There is a high potential for significant and irreversible adverse effects on repository performance (radiological safety and/or waste isolation) if this uncertainty is not reduced before site characterization proceeds.

I10. There is a high potential for significant and irreversible/unmitigable effects on characterization that would physically preclude obtaining the information necessary for licensing if this uncertainty is not reduced before site characterization proceeds.

>>>THE FOLLOWING ATTRIBUTES IDENTIFY POSSIBLE ESF COMMENTS

I11. There is a high potential for misinterpretation or misapplication of the pertinent 10CFR60 standards regarding radiological safety and/or waste isolation during

Exploratory Shaft Facility (ESF) design, construction, and/or construction testing if this uncertainty is not reduced.

I12. There is a high potential for misinterpretation or misapplication of the pertinent 10CFR60 standards other than those concerning radiological safety and/or waste isolation during Exploratory Shaft Facility (ESF) design, construction, and/or construction testing if this uncertainty is not reduced.

>>>STATEMENTS RELATED TO TIME CONSTRAINTS AND DESIRED TIMING OF AN UNCERTAINTY REDUCTION:

T1. Reducing the uncertainty will enable site characterization to be performed expeditiously.

T2. If the uncertainty is not resolved there is potential for expansion of the scope of DOE's site characterization activities.

T3. Reduction of this uncertainty can proceed without prior reduction of other uncertainties or prior NRC rulemaking.

T4. It is desirable to reduce this uncertainty relatively quickly because DOE needs guidance with respect to the uncertainty.

T5. A long time will not be needed to come to closure on reduction of the uncertainty.

T6. The statutory licensing review will be expedited in the course of reducing the uncertainty because the potential for protracted litigation will have been avoided.

>>>THE FOLLOWING ATTRIBUTES IDENTIFY POSSIBLE SCP OBJECTIONS

T7. There is a high potential for significant redirection of DOE's studies that would result in disruption to characterization schedules and sequencing of studies and would interfere with DOE's ability to obtain the information necessary for licensing if this uncertainty is not reduced before site characterization proceeds.

T8. There is a high potential for inadequacies to arise in the QA program which must be resolved prior to commencement of site characterization if this uncertainty is not reduced before site characterization proceeds.

>>>THE FOLLOWING ATTRIBUTES IDENTIFY POSSIBLE SCP COMMENTS

T9. There is high potential for significant adverse effects on the repository licensing process (but not for irreparable

damage to repository performance) if the uncertainty is not reduced before site characterization proceeds.

T10. There is high potential for significant but correctable or mitigable disruption to characterization schedules and sequencing of studies that would interfere with and/or delay DOE's schedule for obtaining the information necessary for licensing if the uncertainty is not reduced before site characterization proceeds.

>>>STATEMENTS RELATED TO DURABILITY OF AN UNCERTAINTY REDUCTION:

D1. A high level of stakeholder involvement is desirable in reducing this uncertainty - it is the sort of uncertainty in which the stakeholders are judged to be appropriately involved. (Stakeholders include the public, utilities, interest groups, Tribes.)

D2. A high level of State of Nevada involvement is desirable in reducing this uncertainty - it is the sort of uncertainty in which the the State of Nevada is judged to be appropriately involved.

D3. A high level of Federal agency involvement is desirable in reducing this uncertainty.

D4. It is desirable that the reduction of this uncertainty be durable, that the reduction would stand the test of time well, and would not be likely to be countermanded by subsequent events, such as advances in technology or new siting information.

APPENDIX D

REPRINT OF 10CFR PART 60

DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE IN GEOLOGIC REPOSITORIES

PART 60—DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN GEOLOGIC REPOSITORIES

Subpart A—General Provisions

Subpart B—Licenses

Preapplication Review

License Applications

Construction Authorization

License Issuance and Amendment

Permanent Closure

Authority: Secs. 51, 53, 62, 63, 65, 81, 161, 182, 183, 68 Stat. 929, 930, 932, 933, 935, 948, 953, 954, as amended (42 U.S.C. 2071, 2073, 2092, 2093, 2095, 2111, 2201, 2232, 2233), secs. 202, 206, 88 Stat. 1244, 1246 (42 U.S.C. 5842, 5846); secs. 10 and 14, Pub. L. 95-601, 92 Stat. 2951 (42 U.S.C. 2021a and 5851); sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332); sec. 121, Pub. L. 97-425, 96 Stat. 2228 (42 U.S.C. 10141).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); §§ 60.10, 60.71 to 60.75 are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

Source: 46 FR 13980, Feb. 25, 1981, unless otherwise noted.

Subpart A—General Provisions

§ 60.1 Purpose and scope.

This part prescribes rules governing the licensing of the U.S. Department of Energy to receive and possess source, special nuclear, and byproduct material at a geologic repository operations area sited, constructed, or operated in accordance with the Nuclear Waste Policy Act of 1982. This part does not apply to any activity licensed under another part of this chapter.

[51 FR 27162, July 30, 1986]

§ 60.2 Definitions.

As used in this part:

"Accessible environment" means: (1) The atmosphere, (2) the land surface, (3) surface water, (4) oceans, and (5) the portion of the lithosphere that is outside the controlled area.

"Affected Indian Tribe" means any Indian Tribe (1) within whose reservation boundaries a repository for high-level radioactive waste or spent fuel is proposed to be located; or (2) whose Federally defined possessory or usage rights to other lands outside of the reservation's boundaries arising out of Congressionally ratified treaties or other Federal law may be substantially and adversely affected by the locating of such a facility; *Provided,* That the Secretary of the Interior finds, upon the petition of the appropriate governmental officials of the Tribe, that such effects are both substantial and adverse to the Tribe.

"Anticipated processes and events" means those natural processes and events that are reasonably likely to occur during the period the intended performance objective must be achieved. To the extent reasonable in the light of the geologic record, it shall be assumed that those processes operating in the geologic setting during the Quaternary Period continue to operate but with the perturbations caused by the presence of emplaced radioactive waste superimposed thereon.

"Barrier" means any material or structure that prevents or substantially delays movement of water or radionuclides.

"Candidate area" means a geologic and hydrologic system within which a geologic repository may be located.

"Commencement of construction" means clearing of land, surface or subsurface excavation, or other substantial action that would adversely affect the environment of a site, but does not include changes desirable for the temporary use of the land for public recreational uses, site characterization activities, other preconstruction monitoring and investigation necessary to establish background information related to the suitability of a site or to the protection of environmental values, or procurement or manufacture of components of the geologic repository operations area.

"Commission" means the Nuclear Regulatory Commission or its duly authorized representatives.

"Containment" means the confinement of radioactive waste within a designated boundary.

"Controlled area" means a surface location, to be marked by suitable monuments, extending horizontally no more than 10 kilometers in any direction from the outer boundary of the underground facility, and the underlying subsurface, which area has been committed to use as a geologic repository and from which incompatible activities would be restricted following permanent closure.

"Director" means the Director of the Nuclear Regulatory Commission's Office of Nuclear Material Safety and Safeguards.

"Disposal" means the isolation of radioactive wastes from the accessible environment.

"Disturbed zone" means that portion of the controlled area the physical or chemical properties of which have changed as a result of underground facility construction or as a result of heat generated by the emplaced radioactive wastes such that the resultant change of properties may have a significant effect on the performance of the geologic repository.

"DOE" means the U.S. Department of Energy or its duly authorized representatives.

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

"Geologic repository" means a system which is intended to be used for, or may be used for, the disposal of radioactive wastes in excavated geologic media. A geologic repository includes: (1) The geologic repository operations area, and (2) the portion of the geologic setting that provides isolation of the radioactive waste.

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

"Geologic setting" means the geologic, hydrologic, and geochemical systems of the region in which a geologic repository operations area is or may be located.

"Groundwater" means all water which occurs below the land surface.

"High-level radioactive waste" or "HLW" means: (1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted.

"HLW facility" means a facility subject to the licensing and related regulatory authority of the Commission pursuant to Sections 202(3) and 202(4) of the Energy Reorganization Act of 1974 (88 Stat 1244).[1]

"Host rock" means the geologic medium in which the waste is emplaced.

"Important to safety," with reference to structures, systems, and components means those engineered structures, systems, and components essential to the prevention or mitigation of an accident that could result in a radiation dose to the whole body, or any organ, of 0.5 rem or greater at or beyond the nearest boundary of the unrestricted area at any time until the completion of permanent closure.

"Isolation" means inhibiting the transport of radioactive material so that amounts and concentrations of this material entering the accessible environment will be kept within prescribed limits.

"Permanent closure" means final backfilling of the underground facility and the sealing of shafts and boreholes.

"Performance confirmation" means the program of tests, experiments, and analyses which is conducted to evaluate the accuracy and adequacy of the information used to determine with reasonable assurance that the performance objectives for the period after permanent closure will be met.

"Public Document Room" means the place at 1717 H Street N.W., Washington, D.C., at which records of the Commission will ordinarily be made available for public inspection and any other place, the location of which has been published in the FEDERAL REGISTER, at which public records of the Commission pertaining to a particular geologic repository are made available for public inspection.

"Radioactive waste" or "waste" means HLW and other radioactive materials other than HLW that are received for emplacement in a geologic repository.

"Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

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

"Saturated zone" means that part of the earth's crust beneath the regional water table in which all voids, large and small, are ideally filled with water under pressure greater than atmospheric.

"Site" means the location of the controlled area.

"Site characterization" means the program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a particular site relevant to the procedures under this part. Site characterization includes borings, surface excavations, excavation of exploratory shafts, limited subsurface lateral excavations and borings, and in situ testing at depth needed to determine the suitability of the site for a geologic repository, but does not include preliminary borings and geophysical testing needed to decide whether site

[1] These are DOE "facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed under such Act [the Atomic Energy Act]" and "Retrievable Surface Storage Facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive wastes generated by [DOE], which are not used for, or are part of, research and development activities."

characterization should be undertaken.

"Unanticipated processes and events" means those processes and events affecting the geologic setting that are judged not to be reasonably likely to occur during the period the intended performance objective must be achieved, but which are nevertheless sufficiently credible to warrant consideration. Unanticipated processes and events may be either natural processes or events or processes and events initiated by human activities other than those activities licensed under this part. Processes and events initiated by human activities may only be found to be sufficiently credible to warrant consideration if it is assumed that: (1) The monuments provided for by this part are sufficiently permanent to serve their intended purpose; (2) the value to future generations of potential resources within the site can be assessed adequately under the applicable provisions of this part; (3) an understanding of the nature of radioactivity, and an appreciation of its hazards, have been retained in some functioning institutions; (4) institutions are able to assess risk and to take remedial action at a level of social organization and technological competence equivalent to, or superior to, that which was applied in initiating the processes or events concerned; and (5) relevant records are preserved, and remain accessible, for several hundred years after permanent closure.

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

"Unrestricted area" means any area, access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

"Unsaturated zone" means the zone between the land surface and the regional water table. Generally, fluid pressure in this zone is less than atmospheric pressure, and some of the voids may contain air or other gases at atmospheric pressure. Beneath flooded areas or in perched water bodies the fluid pressure locally may be greater than atmospheric.

"Waste form"means the radioactive waste materials and any encapsulating or stabilizing matrix.

"Waste package" means the waste form and any containers, shielding, packing and other absorbent materials immediately surrounding an individual waste container.

"Water table" means that surface in a groundwater body at which the water pressure is atmospheric.

[48 FR 28217, June 21, 1983, as amended at 50 FR 29647, July 22, 1985; 51 FR 27162, July 30, 1986]

§ 60.3 License required.

(a) DOE shall not receive or possess source, special nuclear, or byproduct material at a geologic repository operations area except as authorized by a license issued by the Commission pursuant to this part.

(b) DOE shall not commence construction of a geologic repository operations area unless it has filed an application with the Commission and has obtained construction authorization as provided in this part. Failure to comply with this requirement shall be grounds for denial of a license.

§ 60.4 Communications.

Except where otherwise specified, all communications and reports concerning the regulations in this part and applications filed under them should be addressed to the Director of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 1717 H Street NW, Washington, D.C., or 7915 Eastern Avenue, Silver Spring, Maryland.

§ 60.5 Interpretations.

Except as specifically authorized by the Commission, in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be considered binding upon the Commission.

§ 60.6 Exemptions.

The Commission may, upon application by DOE, any interested person, or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest.

§ 60.7 License not required for certain preliminary activities.

The requirement for a license set forth in § 60.3(a) of this part is not applicable to the extent that DOE receives and possesses source, special nuclear, and byproduct material at a geologic repository:

(a) For purposes of site characterization; or

(b) For use, during site characterization or construction, as components of radiographic, radiation monitoring, or similar equipment or instrumentation.

§ 60.8 Reporting, recordkeeping, and application requirements: OMB approval not required.

The information collection requirements contained in this part affect fewer than ten persons. Therefore, under section 3506(c)(5) of the Paperwork Reduction Act of 1980 (Pub. L. 96-511), OMB clearance is not required for these information collection requirements.

[47 FR 13774, Apr. 1, 1982]

§ 60.9 Employee protection.

(a) Discrimination by a Commission licensee, an applicant for a Commission license, or a contractor or subcontractor of a Commission licensee or applicant against an employee for engaging in certain protected activities is prohibited. Discrimination includes discharge and other actions that relate to compensation, terms, conditions, and privileges of employment. The protected activities are established in section 210 of the Energy Reorganization Act of 1974, as amended, and in general are related to the administration or enforcement of a requirement imposed under the Atomic Energy Act or the Energy Reorganization Act.

(1) The protected activities include but are not limited to:

(i) Providing the Commission information about possible violations of requirements imposed under either of the above statutes;

(ii) Requesting the Commission to institute action against his or her employer for the administration or enforcement of these requirements; or

(iii) Testifying in any Commission proceeding.

(2) These activities are protected even if no formal proceeding is actually initiated as a result of the employee assistance or participation.

(3) This section has no applicaton to any employee alleging discrimination prohibited by this section who, acting without direction from his or her employer (or the employer's agent), deliberately causes a violation of any requirement of the Energy Reorganization Act of 1974, as amended, or the Atomic Energy Act of 1954, as amended.

(b) Any employee who believes that he or she has been discharged or otherwise discriminated against by any person for engaging in the protected activities specified in paragraph (a)(1) of this section may seek a remedy for the discharge or discrimination through an administrative proceeding in the Department of Labor. The administrative proceeding must be initiated within 30 days after an alleged violation occurs by filing a complaint alleging the violation with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor may order reinstatement, back pay, and compensatory damages.

(c) A violation of paragraph (a) of this section by a Commission licensee, an applicant for a Commission license, or a contractor or subcontractor of a Commission licensee or applicant may be grounds for:

(1) Denial, revocation, or suspension of the license.

(2) Imposition of a civil penalty on the licensee or applicant.

(3) Other enforcement action.

(d) Actions taken by an employer, or others, which adversely affect an employee may be predicated upon nondiscriminatory grounds. The prohibition

applies when the adverse action occurs because the employee has engaged in protected activities. An employee's engagement in protected activities does not automatically render him or her immune from discharge or discipline for legitimate reasons or from adverse action dictated by nonprohibited considerations.

(e) Each licensee and each applicant shall post Form NRC-3, "Notice to Employees," on its premises. Posting must be at locations sufficient to permit employees protected by this section to observe a copy on the way to or from their place of work. Premises must be posted not later than 30 days after an application is docketed and remain posted while the application is pending before the Commission, during the term of the license, and for 30 days following license termination.

NOTE: Copies of Form NRC-3 may be obtained by writing to the Regional Administrator of the appropriate U.S. Nuclear Regulatory Commission Regional Office listed in Appendix D, Part 20 of this chapter.

[47 FR 30456, July 14, 1982, as amended at 52 FR 31612, Aug. 21, 1987]

§ 60.10 Completeness and accuracy of information.

(a) Information provided to the Commission by an applicant for a license or by a licensee or information required by statute or by the Commission's regulations, orders, or license conditions to be maintained by the applicant or the licensee shall be complete and accurate in all material respects.

(b) Each applicant or licensee shall notify the Commission of information identified by the applicant or licensee as having for the regulated activity a significant implication for public health and safety or common defense and security. An applicant or licensee violates this paragraph only if the applicant or licensee fails to notify the Commission of information that the applicant or licensee has identified as having a significant implication for public health and safety or common defense and security. Notification shall be provided to the Administrator of the appropriate Regional Office within two working days of identifying the information. This requirement is not applicable to information which is already required to be provided to the Commission by other reporting or updating requirements.

[52 FR 49372, Dec. 31, 1987]

EFFECTIVE DATE NOTE: Section 60.10 was added at 52 FR 49372, Dec. 31, 1987, effective February 1, 1988.

Subpart B—Licenses

PREAPPLICATION REVIEW

§ 60.15 Site characterization.

(a) Prior to submittal or an application for a license to be issued under this part DOE shall conduct a program of site characterization with respect to the site to be described in such application.

(b) Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced.

(c) As provided by Sec. 113 of the Nuclear Waste Policy Act (42 U.S.C. 10133), DOE is also required to conduct a program of site characterization, including in situ testing at depth, with respect to alternate sites.

(d) The program of site characterization shall be conducted in accordance with the following:

(1) Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical.

(2) The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization.

(3) To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned.

(4) Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be

planned and coordinated with geologic repository operations area design and construction.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28219, June 21, 1983. Redesignated and amended at 51 FR 27162, July 30, 1986]

§ 60.16 Site characterization plan required.

Before proceeding to sink shafts at any area which has been approved by the President for site characterization, DOE shall submit to the Director, for review and comment, a site characterization plan for such area. DOE shall defer the sinking of such shafts until such time as there has been an opportunity for Commission comments thereon to have been solicited and considered by DOE.

[51 FR 27162, July 30, 1986]

§ 60.17 Contents of site characterization plan.

The site characterization plan shall contain—

(a) A general plan for site characterization activities to be conducted at the area to be characterized, which general plan shall include:

(1) A description of such area, including information on quality assurance programs that have been applied to the collection, recording, and retention of information used in preparing such description.

(2) A description of such site characterization activities, including the following—

(i) The extent of planned excavations;

(ii) Plans for any onsite testing with radioactive material, including radioactive tracers, or nonradioactive material;

(iii) Plans for any investigation activities that may affect the capability of such area to isolate high-level radioactive waste;

(iv) Plans to control any adverse impacts from such site characterization activities that are important to safety or that are important to waste isolation; and

(v) Plans to apply quality assurance to data collection, recording, and retention.

(3) Plans for the decontamination and decommissioning of such area, and for the mitigation of any significant adverse environmental impacts caused by site characterization activities, if such area is determined unsuitable for application for a construction authorization for a geologic repository operations area;

(4) Criteria, developed pursuant to section 112(a) of the Nuclear Waste Policy Act of 1982, to be used to determine the suitability of such area for the location of a geologic repository; and

(5) Any other information which the Commission, by rule or order, requires.

(b) A description of the possible waste form or waste package for the high-level radioactive waste to be emplaced in such geologic repository, a description (to the extent practicable) of the relationship between such waste form or waste package and the host rock at such area, and a description of the activities being conducted by DOE with respect to such possible waste form or waste package or their relationship; and

(c) A conceptual design for the geologic repository operations area that takes into account likely site-specific requirements.

[51 FR 27163, July 30, 1986]

§ 60.18 Review of site characterization activities.[2]

(a) The Director shall cause to be published in the FEDERAL REGISTER a notice that a site characterization plan has been received from DOE and that a staff review of such plan has begun. The notice shall identify the area to be characterized and the NRC staff

[2] In addition to the review of site characterization activities specified in this section, the Commission contemplates an ongoing review of other information on site investigation and site characterization, in order to allow early identification of potential licensing issues for timely resolution. This activity will include, for example, a review of the environmental assessments prepared by DOE at the time of site nomination, and review of issues related to long lead time exploratory shaft planning and procurement actions by DOE prior to issuance of site characterization plans.

members to be consulted for further information.

(b) The Director shall make a copy of the site characterization plan available at the Public Document Room. The Director shall also transmit copies of the published notice of receipt to the Governor and legislature of the State in which the area to be characterized is located and to the governing body of any affected Indian Tribe. The Director shall provide an opportunity, with respect to any area to be characterized, for the State in which such area is located and for affected Indian Tribes to present their views on the site characterization plan and their suggestions with respect to comments thereon which may be made by NRC. In addition, the Director shall make NRC staff available to consult with States and affected Indian Tribes as provided in Subpart C of this part.

(c) The Director shall review the site characterization plan and prepare a site characterization analysis with respect to such plan. In the preparation of such site characterization analysis, the Director may invite and consider the views of interested persons on DOE's site characterization plan and may review and consider comments made in connection with public hearings held by DOE.

(d) The Director shall provide to DOE the site characterization analysis together with such additional comments as may be warranted. These comments shall include either a statement that the Director has no objection to the DOE's site characterization program, if such a statement is appropriate, or specific objections with respect to DOE's program for characterization of the area concerned. In addition, the Director may make specific recommendations pertinent to DOE's site characterization program.

(e) If DOE's planned site characterization activities include onsite testing with radioactive material, including radioactive tracers, the Director's comments shall include a determination regarding whether or not the Commission concurs that the proposed use of such radioactive material is necessary to provide data for the preparation of the environmental reports required by law and for an application to be submitted under § 60.22 of this part.

(f) The Director shall publish in the FEDERAL REGISTER a notice of availability of the site characterization anaylsis and a request for public comment. A reasonable period, not less than 90 days, shall be allowed for comment. Copies of the site characterization analysis and of the comments received shall be made available at the Public Document Room.

(g) During the conduct of site characterization activities, DOE shall report not less than once every six months to the Commission on the nature and extent of such activities and the information that has been developed, and on the progress of waste form and waste package research and development. The semiannual reports shall include the results of site characterization studies, the identification of new issues, plans for additional studies to resolve new issues, elimination of planned studies no longer necessary, identification of decision points reached and modifications to schedules where appropriate. DOE shall also report its progress in developing the design of a geologic repository operations area appropriate for the area being characterized, noting when key design parameters or features which depend upon the results of site characterization will be established. Other topics related to site characterization shall also be covered if requested by the Director.

(h) During the conduct of site characterization activities, NRC staff shall be permitted to visit and inspect the locations at which such activities are carried out and to observe excavations, borings, and in situ tests as they are done.

(i) The Director may comment at any time in writing to DOE, expressing current views on any aspect of site characterization. In particular, such comments shall be made whenever the Director, upon review of comments invited on the site characterization analysis or upon review of DOE's semiannual reports, determines that there are substantial new grounds for making recommendations or stating objections to DOE's site characterization program. The Director shall

invite public comment on any comments which the Director makes to DOE upon review of the DOE semiannual reports or on any other comments which the Director makes to DOE on site characterization.

(j) The Director shall transmit copies of the site characterization analysis and all comments to DOE made by the Director under this section to the Governor and legislature of the State in which the area to be characterized is located and to the governing body of any affected Indian Tribe. When transmitting the site characterization analysis under this paragraph, the Director shall invite the addressees to review and comment thereon.

(k) All correspondence between DOE and the NRC under this section, including the reports described in paragraph (g), shall be placed in the Public Document Room.

(l) The activities described in paragraphs (a) through (k) of this section constitute informal conference between a prospective applicant and the staff, as described in § 2.101(a)(1) of this chapter, and are not part of a proceeding under the Atomic Energy Act of 1954, as amended. Accordingly, neither the issuance of a site characterization analysis nor any other comments of the Director made under this section constitutes a commitment to issue any authorization or license or in any way affect the authority of the Commission, the Atomic Safety and Licensing Appeal Board, Atomic Safety and Licensing Boards, other presiding officers, or the Director, in any such proceeding.

[51 FR 27163, July 30, 1986]

License Applications

§ 60.21 Content of application.

(a) An application shall consist of general information and a Safety Analysis Report. An environmental report shall be prepared in accordance with Part 51 of this chapter and shall accompany the application. Any Restricted Data or National Security Information shall be separated from unclassified information.

(b) The general information shall include:

(1) A general description of the proposed geologic repository identifying the location of the geologic repository operations area, the general character of the proposed activities, and the basis for the exercise of licensing authority by the Commission.

(2) Proposed schedules for construction, receipt of waste, and emplacement of wastes at the proposed geologic repository operations area.

(3) A certification that DOE will provide at the geologic repository operations area such safeguards as it requires at comparable surface facilities (of DOE) to promote the common defense and security.

(4) A description of the physical security plan for protection against radiological sabotage. Since the radiation hazards associated with high-level wastes make them inherently unattractive as a target for theft or diversion, no detailed information need be submitted on protection against theft or diversion.

(5) A description of site characterization work actually conducted by DOE at all sites considered in the application and, as appropriate, explanations of why such work differed from the description of the site characterization program described in the Site Characterization Report for each site.

(c) The Safety Analysis Report shall include:

(1) A description and assessment of the site at which the proposed geologic repository operations area is to be located with appropriate attention to those features of the site that might affect geologic repository operations area design and performance. The description of the site shall identify the location of the geologic repository operations area with respect to the boundary of the accessible environment.

(i) The description of the site shall also include the following information regarding subsurface conditions. This description shall, in all cases, include such information with respect to the controlled area. In addition, where subsurface conditions outside the controlled area may affect isolation within the controlled area, the description shall include such information with respect to subsurface condi-

tions outside the controlled area to the extent such information is relevant and material. The detailed information referred to in this paragraph shall include:

(A) The orientation, distribution, aperture in-filling and origin of fractures, discontinuities, and heterogeneities;

(B) The presence and characteristics of other potential pathways such as solution features, breccia pipes, or other potentially permeable features;

(C) The geomechanical properties and conditions, including pore pressure and ambient stress conditions;

(D) The hydrogeologic properties and conditions;

(E) The geochemical properties; and

(F) The anticipated response of the geomechanical, hydrogeologic, and geochemical systems to the maximum design thermal loading, given the pattern of fractures and other discontinuities and the heat transfer properties of the rock mass and groundwater.

(ii) The assessment shall contain:

(A) An analysis of the geology, geophysics, hydrogeology, geochemistry, climatology, and meteorology of the site,

(B) Analyses to determine the degree to which each of the favorable and potentially adverse conditions, if present, has been characterized, and the extent to which it contributes to or detracts from isolation. For the purpose of determining the presence of the potentially adverse conditions, investigations shall extend from the surface to a depth sufficient to determine critical pathways for radionuclide migration from the underground facility to the accessible environment. Potentially adverse conditions shall be investigated outside of the controlled area if they affect isolation within the controlled area.

(C) An evaluation of the performance of the proposed geologic repository for the period after permanent closure, assuming anticipated processes and events, giving the rates and quantities of releases of radionuclides to the accessible environment as a function of time; and a similar evaluation which assumes the occurrence of unanticipated processes and events.

(D) The effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features that are important to waste isolation, with particular attention to the alternatives that would provide longer radionuclide containment and isolation.

(E) An analysis of the performance of the major design structures, systems, and components, both surface and subsurface, to identify those that are important to safety. For the purposes of this analysis, it shall be assumed that operations at the geologic repository operations area will be carried out at the maximum capacity and rate of receipt of radioactive waste stated in the application.

(F) An explanation of measures used to support the models used to perform the assessments required in paragraphs (A) through (D). Analyses and models that will be used to predict future conditions and changes in the geologic setting shall be supported by using an appropriate combination of such methods as field tests, in situ tests, laboratory tests which are representative of field conditions, monitoring data, and natural analog studies.

(2) A description and discussion of the design, both surface and subsurface, of the geologic repository operations area including: (i) the principal design criteria and their relationship to any general performance objectives promulgated by the Commission, (ii) the design bases and the relation of the design bases to the principal design criteria, (iii) information relative to materials of construction (including geologic media, general arrangement, and approximate dimensions), and (iv) codes and standards that DOE proposes to apply to the design and construction of the geologic repository operations area.

(3) A description and analysis of the design and performance requirements for structures, systems, and components of the geologic repository which are important to safety. This analysis shall consider—(i) The margins of

safety under normal conditions and under conditions that may result from anticipated operational occurrences, including those of natural origin; and (ii) the adequacy of structures, systems, and components provided for the prevention of accidents and mitigation of the consequences of accidents, including those caused by natural phenomena.

(4) A description of the quality assurance program to be applied to the structures, systems, and components important to safety and to the engineered and natural barriers important to waste isolation.

(5) A description of the kind, amount, and specifications of the radioactive material proposed to be received and possessed at the geologic repository operations area.

(6) An identification and justification for the selection of those variables, conditions, or other items which are determined to be probable subjects of license specifications. Special attention shall be given to those items that may significantly influence the final design.

(7) A description of the program for control and monitoring of radioactive effluents and occupational radiation exposures to maintain such effluents and exposures in accordance with the requirements of Part 20 of this chapter.

(8) A description of the controls that the applicant will apply to restrict access and to regulate land use at the site and adjacent areas, including a conceptual design of monuments which would be used to identify the controlled area after permanent closure.

(9) Plans for coping with radiological emergencies at any time prior to permanent closure and decontamination or dismantlement of surface facilities.

(10) A description of the nuclear material control and accounting program.

(11) A description of design considerations that are intended to facilitate permanent closure and decontamination or dismantlement of surface facilities.

(12) A description of plans for retrieval and alternate storage of the radioactive wastes should the geologic repository prove to be unsuitable for disposal of radioactive wastes.

(13) An identification and evaluation of the natural resources of the geologic setting, including estimates as to undiscovered deposits, the exploitation of which could affect the ability of the geologic repository to isolate radioactive wastes. Undiscovered deposits of resources characteristic of the area shall be estimated by reasonable inference based on geological and geophysical evidence. This evaluation of resources, including undiscoverd deposits, shall be conducted for the site and for areas of similar size that are representative of and are within the geologic setting. For natural resources with current markets the resources shall be assessed, with estimates provided of both gross and net value. The estimate of net value shall take into account current development, extraction and marketing costs. For natural resources without current markets, but which would be marketable given credible projected changes in economic or technological factors, the resources shall be described by physical factors such as tonnage or other amount, grade, and quality.

(14) An identification of those structures, systems, and components of the geologic repository, both surface and subsurface, which require research and development to confirm the adequacy of design. For structures, systems, and components important to safety and for the engineered and natural barriers important to waste isolation, DOE shall provide a detailed description of the programs designed to resolve safety questions, including a schedule indicating when these questions would be resolved.

(15) The following information concerning activities at the geologic repository operations area:

(i) The organizational structure of DOE as it pertains to construction and operation of the geologic repository operations area including a description of any delegations of authority and assignments of responsibilities, whether in the form of regulations, administrative directives, contract provisions, or otherwise.

(ii) Identification of key positions which are assigned responsibility for

safety at and operation of the geologic repository operations area.

(iii) Personnel qualifications and training requirements.

(iv) Plans for startup activities and startup testing.

(v) Plans for conduct of normal activities, including maintenance, surveillance, and periodic testing of structures, systems, and components of the geologic repository operation area.

(vi) Plans for permanent closure and plans for the decontamination or dismantlement of surface facilities.

(vii) Plans for any uses of the geologic repository operations area for purposes other than disposal of radioactive wastes, with an analysis of the effects, if any, that such uses may have upon the operation of the structures, systems, and components important to safety and the engineered and natural barriers important to waste isolation.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28219, June 21, 1983]

§ 60.22 Filing and distribution of application.

(a) An application for a license to receive and possess source, special nuclear, or byproduct material at a geologic repository operations area at a site which has been characterized, and an accompanying environmental report, and any amendments thereto, shall be filed in triplicate with the Director and shall be signed by the Secretary of Energy or the Secretary's authorized representative.

(b) Each portion of such application and environmental report and any amendments shall be accompanied by 30 additional copies. Another 120 copies shall be retained by DOE for distribution in accordance with written instructions from the Director or the Director's designee.

(c) DOE shall, upon notification of the appointment of an Atomic Safety and Licensing Board, update the application and environmental report, eliminating all superseded information, and serve them as directed by the board. In addition, at that time DOE shall serve one such copy on the Atomic Safety and Licensing Appeal Panel. Any subsequent amendments to the application or environmental report shall be served in the same manner.

(d) At the time of filing of an application and environmental report, and any amendments thereto, one copy shall be made available in an appropriate location near the proposed geologic repository operations area (which shall be a public document room, if one has been established) for inspection by the public and updated as amendments to the application or environmental report are made. An updated copy shall be produced at any public hearing on the application for use by any parties to the proceedings.

(e) The DOE shall certify that the updated copies of the application and environmental report, as referred to in paragraphs (c) and (d), contain the current contents of such documents submitted in accordance with the requirements of this part.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28220, June 21, 1983]

§ 60.23 Elimination of repetition.

In its application, environmental report, or Site Characterization Report, the DOE may incorporate by reference information contained in previous applications, statements, or reports filed with the Commission: *Provided,* That such references are clear and specific and that copies of the information so incorporated are available in the public document room located near the site of the proposed geologic repository.

§ 60.24 Updating of application and environmental report.

(a) The application and environmental report shall be as complete as possible in the light of information that is reasonably available at the time of docketing.

(b) The DOE shall update its application in a timely manner so as to permit the Commission to review, prior to issuance of a license:

(1) Additional geologic, geophysical, geochemical, hydrologic, meteorologic and other data obtained during construction.

(2) Conformance of construction of structures, systems, and components with the design.

(3) Results of research programs carried out to confirm the adequacy of designs.

(4) Other information bearing on the Commission's issuance of a license that was not available at the time a construction authorization was issued.

(c) The DOE shall update its environmental report in a timely manner so as to permit the Commission to review, prior to issuance of a license, the environmental impacts of any substantial changes in the activities proposed to be carried out or any significant new information regarding the environmental impacts of activities previously proposed.

Construction Authorization

§ 60.31 Construction authorization.

Upon review and consideration of an application and environmental report submitted under this part, the Commission may authorize construction if it determines:

(a) *Safety.* That there is reasonable assurance that the types and amounts of radioactive materials described in the application can be received, possessed, and disposed of in a geologic repository operations area of the design proposed without unreasonable risk to the health and safety of the public. In arriving at this determination, the Commission shall consider whether:

(1) DOE has described the proposed geologic repository including but not limited to: (i) The geologic, geophysical, geochemical and hydrologic characteristics of the site; (ii) the kinds and quantities of radioactive waste to be received, possessed, stored, and disposed of in the geologic repository operations area; (iii) the principal architectural and engineering criteria for the design of the geologic repository operations area; (iv) construction procedures which may affect the capability of the geologic repository to serve its intended function; and (v) features or components incorporated in the design for the protection of the health and safety of the public.

(2) The site and design comply with the performance objectives and criteria contained in Subpart E of this part.

(3) The DOE's quality assurance program complies with the requirements of Subpart G of this part.

(4) The DOE's personnel training program complies with the criteria contained in Subpart H of this part.

(5) The DOE's emergency plan complies with the criteria contained in Subpart I of this part.

(6) The DOE's proposed operating procedures to protect health and to minimize danger to life or property are adequate.

(b) *Common defense and security.* That there is reasonable assurance that the activities proposed in the application will not be inimical to the common defense and security. A DOE certification that it will provide at the geologic repository operations area such safeguards as it requires at comparable DOE surface facilities to promote the common defense and security will constitute a rebuttable presumption of noninimicality to the common defense and security.

(c) *Environmental.* That, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, the action called for is issuance of the construction authorization, with any appropriate conditions to protect environmental values.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28220, June 21, 1983]

§ 60.32 Conditions of construction authorization.

(a) A construction authorization shall include such conditions as the Commission finds to be necessary to protect the health and safety of the public, the common defense and security, or environmental values.

(b) The Commission will incorporate in the construction authorization provisions requiring DOE to furnish periodic or special reports regarding: (1) Progress of construction, (2) any data about the site obtained during construction which are not within the predicted limits upon which the facility design was based, (3) any deficiencies in design and construction which, if uncorrected, could adversely affect safety at any future time, and (4) re-

sults of research and development programs being conducted to resolve safety questions.

(c) The construction authorization will include restrictions on subsequent changes to the features of the geologic repository and the procedures authorized. The restrictions that may be imposed under this paragraph can include measures to prevent adverse effects on the geologic setting as well as measures related to the design and construction of the geologic repository operations area. These restrictions will fall into three categories of descending importance to public health and safety as follows: (1) Those features and procedures which may not be changed without: (i) 60 days prior notice to the Commission (ii) 30 days notice of opportunity for a prior hearing, and (iii) prior Commission approval; (2) those features and procedures which may not be changed without (i) 60 days prior notice to the Commission, and (ii) prior Commission approval; and (3) those features and procedures which may not be changed without 60 days notice to the Commission. Features and procedures falling in paragraph (c)(3) of this section may not be changed without prior Commission approval if the Commission, after having received the required notice, so orders.

(d) A construction authorization shall be subject to the limitation that a license to receive and possess source, special nuclear, or byproduct material at the geologic repository operations area shall not be issued by the Commission until (1) the DOE has updated its application as specified in § 60.24, and (2) the Commission has made the findings stated in § 60.41.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28221, June 21, 1983]

§ 60.33 Amendment of construction authorization.

(a) An application for amendment of a construction authorization shall be filed with the Commission fully describing any changes desired and following as far as applicable the format prescribed in § 60.21.

(b) In determining whether an amendment of a construction authorization will be approved, the Commission will be guided by the considerations which govern the issuance of the initial construction authorization, to the extent applicable.

License Issuance and Amendment

§ 60.41 Standards for issuance of a license.

A license to receive and possess source, special nuclear, or byproduct material at a geologic repository operations area may be issued by the Commission upon finding that:

(a) Construction of the geologic repository operations area has been substantially completed in conformity with the application as amended, the provisions of the Atomic Energy Act, and the rules and regulations of the Commission. Construction may be deemed to be substantially complete for the purposes of this paragraph if the construction of (1) surface and interconnecting structures, systems, and components, and (2) any underground storage space required for initial operation are substantially complete.

(b) The activities to be conducted at the geologic repository operations area will be in conformity with the application as amended, the provisions of the Atomic Energy Act and the Energy Reorganization Act, and the rules and regulations of the Commission.

(c) The issuance of the license will not be inimical to the common defense and security and will not constitute an unreasonable risk to the health and safety of the public. A DOE certification that it will provide at the geologic repository operations area such safeguards as it requires at comparable DOE facilities to promote the common defense and security, will constitute a rebuttable presumption of non-inimicality to the common defense and security.

(d) All applicable requirements of Part 51 have been satisfied.

§ 60.42 Conditions of license.

(a) A license issued pursuant to this part shall include such conditions, including license specifications, as the Commission finds to be necessary to protect the health and safety of the public, the common defense and security, and environmental values.

(b) Whether stated therein or not, the following shall be deemed conditions in every license issued:

(1) The license shall be subject to revocation, suspension, modification, or amendment for cause as provided by the Atomic Energy Act and the Commission's regulations.

(2) The DOE shall at any time while the license is in effect, upon written request of the Commission, submit written statements to enable the Commission to determine whether or not the license should be modified, suspended or revoked.

(3) The license shall be subject to the provisions of the Atomic Energy Act now or hereafter in effect and to all rules, regulations, and orders of the Commission. The terms and conditions of the license shall be subject to amendment, revision, or modification, by reason of amendments to or by reason of rules, regulations, and orders issued in accordance with the terms of the Atomic Energy Act.

(c) Each license shall be deemed to contain the provisions set forth in Section 183 b-d, inclusive, of the Atomic Energy Act, whether or not these provisions are expressly set forth in the license.

§ 60.43 License specification.

(a) A license issued under this part shall include license conditions derived from the analyses and evaluations included in the application, including amendments made before a license is issued, together with such additional conditions as the Commission finds appropriate.

(b) License conditions shall include items in the following categories:

(1) Restrictions as to the physical and chemical form and radioisotopic content of radioactive waste.

(2) Restrictions as to size, shape, and materials and methods of construction of radioactive waste packaging.

(3) Restrictions as to the amount of waste permitted per unit volume of storage space considering the physical characteristics of both the waste and the host rock.

(4) Requirements relating to test, calibration, or inspection to assure that the foregoing restrictions are observed.

(5) Controls to be applied to restricted access and to avoid disturbance to the controlled area and to areas outside the controlled area where conditions may affect isolation within the controlled area.

(6) Administrative controls, which are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure that activities at the facility are conducted in a safe manner and in conformity with the other license specifications.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28221, June 21, 1983]

§ 60.44 Changes, tests, and experiments.

(a)(1) Following authorization to receive and possess source, special nuclear, or byproduct material at a geologic repository operations area, the DOE may (i) make changes in the geologic repository operations area as described in the application, (ii) make changes in the procedures as described in the application, and (iii) conduct tests or experiments not described in the application, without prior Commission approval, provided the change, test, or experiment involves neither a change in the license conditions incorporated in the license nor an unreviewed safety question.

(2) A proposed change, test, or experiment shall be deemed to involve an unreviewed safety question if (i) the likelihood of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the application is increased, (ii) the possibility of an accident or malfunction of a different type than any previously evaluated in the application is created, or (iii) the margin of safety as defined in the basis for any license condition is reduced.

(b) The DOE shall maintain records of changes in the geologic repository operations area and of changes in procedures made pursuant to this section, to the extent that such changes constitute changes in the geologic repository operations area or procedures as described in the application. Records of tests and experiments carried out pursuant to paragraph (a) of this sec-

tion shall also be maintained. These records shall include a written safety evaluation which provides the basis for the determination that the change, test, or experiment does not involve an unreviewed safety question. The DOE shall prepare annually, or at such shorter intervals as may be specified in the license, a report containing a brief description of such changes, tests, and experiments, including a summary of the safety evaluation of each. The DOE shall furnish the report to the appropriate NRC Regional Office shown in Appendix D of Part 20 of this chapter with a copy to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Any report submitted pursuant to this paragraph shall be made a part of the public record of the licensing proceedings.

[46 FR 13980, Feb. 25, 1981, as amended at 52 FR 31612, Aug. 21, 1987]

§ 60.45 Amendment of license.

(a) An application for amendment of a license may be filed with the Commission fully describing the changes desired and following as far as applicable the format prescribed for license applications.

(b) In determining whether an amendment of a license will be approved, the Commission will be guided by the considerations that govern the issuance of the initial license, to the extent applicable.

§ 60.46 Particular activities requiring license amendment.

(a) Unless expressly authorized in the license, an amendment of the license shall be required with respect to any of the following activities:

(1) Any action which would make emplaced high-level radioactive waste irretrievable or which would substantially increase the difficulty of retrieving such emplaced waste.

(2) Dismantling of structures.

(3) Removal or reduction of controls applied to restrict access to or avoid disturbance of the controlled area and to areas outside the controlled area where conditions may affect isolation within the controlled area.

(4) Destruction or disposal of records required to be maintained under the provisions of this part.

(5) Any substantial change to the design or operating procedures from that specified in the license.

(6) Permanent closure.

(7) Any other activity involving an unreviewed safety question.

(b) An application for such an amendment shall be filed, and shall be reviewed, in accordance with the provisions of § 60.45.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28221, June 21, 1983]

Permanent Closure

§ 60.51 License amendment for permanent closure.

(a) The DOE shall submit an application to amend the license prior to permanent closure. The application shall consist of an update of the license application and environmental report submitted under §§ 60.21 and 60.22, including:

(1) A description of the program for post-permanent closure monitoring of the geologic repository.

(2) A detailed description of the measures to be employed—such as land use controls, construction of monuments, and preservation of records—to regulate or prevent activities that could impair the long-term isolation of emplaced waste within the geologic repository and to assure that relevant information will be preserved for the use of future generations. As a minimum, such measures shall include:

(i) Identification of the controlled area and geologic repository operations area by monuments that have been designed, fabricated, and emplaced to be as permanent as is practicable; and

(ii) Placement of records in the archives and land record systems of local State, and Federal government agencies, and archives elsewhere in the world, that would be likely to be consulted by potential human intruders—such records to identify the location of the geologic repository operations area, including the underground facility, boreholes and shafts, and the

boundaries of the controlled area, and the nature and hazard of the waste.

(3) Geologic, geophysical, geochemical, hydrologic, and other site data that are obtained during the operational period pertinent to the long-term isolation of emplaced radioactive wastes.

(4) The results of tests, experiments, and any other analyses relating to backfill of excavated areas, shaft sealing, waste interaction with the host rock, and any other tests, experiments, or analyses pertinent to the long-term isolation of emplaced wastes within the geologic repository.

(5) Any substantial revision of plans for permanent closure.

(6) Other information bearing upon permanent closure that was not available at the time a license was issued.

(b) DOE shall update its environmental report in a timely manner so as to permit the Commission to review, prior to issuance of an amendment, substantial changes in the permanent closure activities proposed to be carried out or significant new information regarding the environmental impacts of such permanent closure.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28221, June 21, 1983]

§ 60.52 Termination of license.

(a) Following permanent closure and the decontamination or dismantlement of surface facilities, DOE may apply for an amendment to terminate the license.

(b) Such application shall be filed, and will be reviewed, in accordance with the provisions of § 60.45 and this section.

(c) A license shall be terminated only when the Commission finds with respect to the geologic repository:

(1) That the final disposition of radioactive wastes has been made in conformance with the DOE's plan, as amended and approved as part of the license.

(2) That the final state of the geologic repository operations area conforms to DOE's plans for permanent closure and DOE's plans for the decontamination or dismantlement of surface facilities, as amended and approved as part of the license.

(3) That the termination of the license is authorized by law, including sections 57, 62, and 81 of the Atomic Energy Act, as amended.

[46 FR 13980, Feb. 25, 1981, as amended at 48 FR 28222, June 21, 1983]

Subpart C—Participation by State Governments and Affected Indian Tribes

SOURCE: 51 FR 27164, July 30, 1986, unless otherwise noted.

§ 60.61 Provision of information.

(a) The Director shall provide to the Governor and legislature of any State in which a geologic repository operations area is or may be located, and to the governing body of any affected Indian Tribe, timely and complete information regarding determinations or plans made by the Commission with respect to the site characterization, siting, development, design, licensing, construction, operation, regulation, permanent closure, or decontamination and dismantlement of surface facilities, of such geologic repository operations area.

(b) For purposes of this section, a geologic repository operations area shall be considered to be one which "may be located" in a State if the location thereof in such State has been described in a site characterization plan submitted to the Commission under this part.

(c) Notwithstanding paragraph (a) of this section, the Director is not required to distribute any document to any entity if, with respect to such document, that entity or its counsel is included on a service list prepared pursuant to Part 2 of this chapter.

(d) Copies of all communications by the Director under this section shall be placed in the Public Document Room, and copies thereof shall be furnished to DOE.

§ 60.62 Site review.

(a) Whenever an area has been approved by the President for site characterization, and upon request of a State or an affected Indian Tribe, the Director shall make NRC staff avail-

able to consult with representatives of such States and Tribes.

(b) Requests for consultation shall be made in writing to the Director.

(c) Consultation under this section may include:

(1) Keeping the parties informed of the Director's views on the progress of site characterization.

(2) Review of applicable NRC regulations, licensing procedures, schedules, and opportunities for State and Tribe participation in the Commission's regulatory activities.

(3) Cooperation in development of proposals for State and Tribe participation in license reviews.

§ 60.63 Participation in license reviews.

(a) State and local governments and affected Indian Tribes may participate in license reviews as provided in Subpart G of Part 2 of this chapter. A State in which a repository for high-level radioactive waste is proposed to be located and any affected Indian Tribe shall have an unquestionable legal right to participate as a party in such proceedings.

(b) In addition, whenever an area has been approved by the President for site characterization, a State or an affected Indian Tribe may submit to the Director a proposal to facilitate its participation in the review of a site characterization plan and/or license application. The proposal may be submitted at any time and shall contain a description and schedule of how the State or affected Indian Tribe wishes to participate in the review, or what services or activities the State or affected Indian Tribe wishes NRC to carry out, and how the services or activities proposed to be carried out by NRC would contribute to such participation. The proposal may include educational or information services (seminars, public meetings) or other actions on the part of NRC, such as establishing additional public document rooms or employment or exchange of State personnel under the Intergovernmental Personnel Act.

(c) The Director shall arrange for a meeting between the representatives of the State or affected Indian Tribe and the NRC staff to discuss any proposal submitted under paragraph (b) of this section, with a view to identifying any modifications that may contribute to the effective participation by such State or Tribe.

(d) Subject to the availability of funds, the Director shall approve all or any part of a proposal, as it may be modified through the meeting described above, if it is determined that:

(1) The proposed activities are suitable in light of the type and magnitude of impacts which the State or affected Indian Tribe may bear;

(2) The proposed activities:

(i) Will enhance communications between NRC and the State or affected Indian Tribe;

(ii) Will make a productive and timely contribution to the review; and

(iii) Are authorized by law.

(e) The Director will advise the State or affected Indian Tribe whether its proposal has been accepted or denied, and if all or any part of proposal is denied, the Director shall state the reason for the denial.

(f) Proposals submitted under this section, and responses thereto, shall be made available at the Public Document Room.

§ 60.64 Notice to States.

If the Governor and legislature of a State have jointly designated on their behalf a single person or entity to receive notice and information from the Commission under this part, the Commission will provide such notice and information to the jointly designated person or entity instead of the Governor and legislature separately.

§ 60.65 Representation.

Any person who acts under this subpart as a representative for a State (or for the Governor or legislature thereof) or for an affected Indian Tribe shall include in the request or other submission, or at the request of the Commission, a statement of the basis of his or her authority to act in such representative capacity.

Subpart D—Records, Reports, Tests, and Inspections

SOURCE: 48 FR 28222, June 21, 1983, unless otherwise noted.

§ 60.71 General recordkeeping and reporting requirements.

(a) DOE shall maintain such records and make such reports in connection with the licensed activity as may be required by the conditions of the license or by rules, regulations, and orders of the Commission as authorized by the Atomic Energy Act and the Energy Reorganization Act.

(b) Records of the receipt, handling, and disposition of radioactive waste at a geologic repository operations area shall contain sufficient information to provide a complete history of the movement of the waste from the shipper through all phases of storage and disposal.

§ 60.72 Construction records.

(a) DOE shall maintain records of construction of the geologic repository operations area.

(b) The records required under paragraph (a) shall include at least the following:

(1) Surveys of the underground facility excavations, shafts, and boreholes referenced to readily identifiable surface features or monuments;

(2) A description of the materials encountered;

(3) Geologic maps and geologic cross sections;

(4) Locations and amount of seepage;

(5) Details of equipment, methods, progress, and sequence of work;

(6) Construction problems;

(7) Anomalous conditions encountered;

(8) Instrument locations, readings, and analysis;

(9) Location and description of structural support systems;

(10) Location and description of dewatering systems; and

(11) Details, methods of emplacement, and location of seals used.

§ 60.73 Reports of deficiencies.

DOE shall promptly notify the Commission of each deficiency found in the characteristics of the site, and design and construction of the geologic repository operations area which, were it to remain uncorrected, could: (a) Be a substantial safety hazard, (b) represent a significant deviation from the design criteria and design bases stated in the application, or (c) represent a deviation from the conditions stated in the terms of a construction authorization or the license, including license specifications. The notification shall be in the form of a written report, copies of which shall be sent to the Director and to the appropriate Nuclear Regulatory Commission Regional Office listed in Appendix D of Part 20 of this chapter.

§ 60.74 Tests.

(a) DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part. These may include tests of:

(1) Radioactive waste,

(2) The geologic repository including its structures, systems, and components,

(3) Radiation detection and monitoring instruments, and

(4) Other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste.

(b) The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part.

§ 60.75 Inspections.

(a) DOE shall allow the Commission to inspect the premises of the geologic repository operations area and adjacent areas to which DOE has rights of access.

(b) DOE shall make available to the Commission for inspection, upon reasonable notice, records kept by DOE pertaining to activities under this part.

(c)(1) DOE shall upon requests by the Director, Office of Nuclear Material Safety and Safeguards, provide rent-free office space for the exclusive use of the Commission inspection personnel. Heat, air-conditioning, light, electrical outlets and janitorial services shall be furnished by DOE. The office shall be convenient to and have full access to the facility and shall provide the inspector both visual and acoustic privacy.

(2) The space provided shall be adequate to accommodate a full-time inspector, a part-time secretary and transient NRC personnel and will be generally commensurate with other office facilities at the geologic repository operations area. A space of 250 square feet either within the geologic repository operations area's office complex or in an office trailer or other onsite space at the geologic repository operations area is suggested as a guide. For locations at which activities are carried out under licenses issued under other parts of this chapter, additional space may be requested to accomodate additional full-time inspectors. The Office space that is provided shall be subject to the approval of the Director, Office of Nuclear Material Safety and Safeguards. All furniture, supplies and communication equipment will be furnished by the Commission.

(3) DOE shall afford any NRC resident inspector assigned to that location, or other NRC inspectors identified by the Regional Administrator as likely to inspect the facility, immediate unfettered access, equivalent to access provided regular employees, following proper identification and compliance with applicable access control measures for security, radiological protection and personal safety.

[48 FR 28222, June 21, 1983, as amended at 52 FR 31612, Aug. 21, 1987]

Subpart E—Technical Criteria

SOURCE: 48 FR 28222, June 21, 1983, unless otherwise noted.

§ 60.101 Purpose and nature of findings.

(a)(1) Subpart B of this part prescribes the standards for issuance of a license to receive and possess source, special nuclear, or byproduct material at a geologic repository operations area. In particular, § 60.41(c) requires a finding that the issuance of a license will not constitute an unreasonable risk to the health and safety of the public. The purpose of this subpart is to set out performance objectives and site and design criteria which, if satisfied, will support such a finding of no unreasonable risk.

(2) While these performance objectives and criteria are generally stated in unqualified terms, it is not expected that complete assurance that they will be met can be presented. A reasonable assurance, on the basis of the record before the Commission, that the objectives and criteria will be met is the general standard that is required. For § 60.112, and other portions of this subpart that impose objectives and criteria for repository performance over long times into the future, there will inevitably be greater uncertainties. Proof of the future performance of engineered barrier systems and the geologic setting over time periods of many hundreds or many thousands of years is not to be had in the ordinary sense of the word. For such long-term objectives and criteria, what is required is reasonable assurance, making allowance for the time period, hazards, and uncertainties involved, that the outcome will be in conformance with those objectives and criteria. Demonstration of compliance with such objectives and criteria will involve the use of data from accelerated tests and predictive models that are supported by such measures as field and laboratory tests, monitoring data and natural analog studies.

(b) Subpart B of this part also lists findings that must be made in support of an authorization to construct a geologic repository operations area. In particular, § 60.31(a) requires a finding that there is reasonable assurance that the types and amounts of radioactive materials described in the application can be received, possessed, and disposed of in a geologic repository operations area of the design proposed without unreasonable risk to the health and safety of the public. As stated in that paragraph, in arriving at this determination, the Commission will consider whether the site and design comply with the criteria contained in this subpart. Once again, while the criteria may be written in unqualified terms, the demonstration of compliance may take uncertainties and gaps in knowledge into account, provided that the Commission can make the specified finding of reasonable assurance as specified in paragraph (a) of this section.

§ 60.102 Concepts.

This section provides a functional overview of Subpart E. In the event of any inconsistency with definitions found in § 60.2, those definitions shall prevail.

(a) *The HLW facility.* NRC exercises licensing and related regulatory authority over those facilities described in section 202 (3) and (4) of the Energy Reorganization Act of 1974. Any of these facilities is designated a *HLW facility.*

(b) *The geologic repository operations area.* (1) This part deals with the exercise of authority with respect to a particular class of HLW facility—namely a *geologic repository operations area.*

(2) *A geologic repository operations area* consists of those surface and subsurface areas that are part of a geologic repository where radioactive waste handling activities are conducted. The underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals, is designated the *underground facility.*

(3) The exercise of Commission authority requires that the geologic repository operations area be used for *storage* (which includes *disposal*) of *high-level radioactive wastes (HLW).*

(4) HLW includes irradiated reactor fuel as well as reprocessing wastes. However, if DOE proposes to use the geologic repository operations area for storage of *radioactive waste* other than HLW, the storage of this radioactive waste is subject to the requirements of this part.

(c) *Areas related to isolation.* Although the activities subject to regulation under this part are those to be carried out at the geologic repository operations area, the licensing process also considers characteristics of adjacent areas that are defined in other ways. There is to be an area surrounding the underground facility referred to above, which is designated the *controlled area,* within which DOE is to exercise specified controls to prevent adverse human actions following permanent closure. The location of the controlled area is the *site.* The *accessible environment* is the atmosphere, land surface, surface water, oceans, and the portion of the lithosphere that is outside the controlled area. There is an area, designated the *geologic setting,* which includes the geologic, hydrologic, and geochemical systems of the region in which a geologic repository operations area is or may be located. The geologic repository operations area plus the portion of the geologic setting that provides isolation of the radioactive waste make up the *geologic repository.*

(d) *Stages in the licensing process.* There are several stages in the licensing process. The *site characterization* stage, though begun before submission of a license application, may result in consequences requiring evaluation in the license review. The *construction stage* would follow, after issuance of a construction authorization. A *period of operations* follows the issuance of a license by the Commission. The period of operations includes the time during which *emplacement* of wastes occurs; any subsequent period before permanent closure during which the emplaced wastes are *retrievable;* and *permanent closure,* which includes sealing of shafts. Permanent closure represents the end of active human intervention with respect to the engineered barrier system.

(e) *Isolation of waste.* (1) During the first several hundred years following permanent closure of a geologic repository, when radiation and thermal levels are high and the uncertainties in assessing repository performance are large, special emphasis is placed upon the ability to contain the wastes by waste packages within an *engineered barrier system.* This is known as the *containment period.* The *engineered barrier system* includes the waste packages and the underground facility. A *waste package* is composed of the waste form and any containers, shielding, packing, and absorbent materials immediately surrounding an individual waste container. The *underground facility* means the underground structure, including openings and backfill materials, but excluding, shafts, boreholes, and their seals.

(2) Following the containment period special emphasis is placed upon the ability to achieve isolation of the wastes by virtue of the characteristics

of the geologic repository. The engineered barrier system works to control the release of radioactive material to the geologic setting and the geologic setting works to control the release of radioactive material to the accessible environment. *Isolation* means inhibiting the transport of radioactive material so that amounts and concentrations of the materials entering the accessible environment will be kept within prescribed limits.

PERFORMANCE OBJECTIVES

§ 60.111 Performance of the geologic repository operations area through permanent closure.

(a) *Protection against radiation exposures and releases of radioactive material.* The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in Part 20 of this chapter and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.

(b) *Retrievability of waste.* (1) The geologic repository operations area shall be designed to preserve the option of waste retrieval throughout the period during which wastes are being emplaced and, thereafter, until the completion of a preformance confirmation program and Commission review of the information obtained from such a program. To satisfy this objective, the geologic repository operations area shall be designed so that any or all of the emplaced waste could be retrieved on a reasonable schedule starting at any time up to 50 years after waste emplacement operations are initiated, unless a different time period is approved or specified by the Commission. This different time period may be established on a case-by-case basis consistent with the emplacement schedule and the planned performance confirmation program.

(2) This requirement shall not preclude decisions by the Commission to allow backfilling part or all of, or permanent closure of, the geologic repository operations area prior to the end of the period of design for retrievability.

(3) For purposes of this paragraph, a reasonable schedule for retrieval is one that would permit retrieval in about the same time as that devoted to construction of the geologic repository operations area and the emplacement of wastes.

§ 60.112 Overall system performance objective for the geologic repository after permanent closure.

The geologic setting shall be selected and the engineered barrier system and the shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events.

§ 60.113 Performance of particular barriers after permanent closure.

(a) *General provisions*—(1) *Engineered barrier system.* (i) The engineered barrier system shall be designed so that assuming anticipated processes and events: (A) Containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay; and (B) any release of radionuclides from the engineered barrier system shall be a gradual process which results in small fractional releases to the geologic setting over long times. For disposal in the saturated zone, both the partial and complete filling with groundwater of available void spaces in the underground facility shall be appropriately considered and analysed among the anticipated processes and events in designing the engineered barrier system.

(ii) In satisfying the preceding requirement, the engineered barrier system shall be designed, assuming anticipated processes and events, so that:

(A) Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in § 60.113(b) provided, that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository; and

(B) The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.

(2) *Geologic setting.* The geologic repository shall be located so that pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment shall be at least 1,000 years or such other travel time as may be approved or specified by the Commission.

(b) On a case-by-case basis, the Commission may approve or specify some other radionuclide release rate, designed containment period or pre-waste-emplacement groundwater travel time, provided that the overall system performance objective, as it relates to anticipated processes and events, is satisfied. Among the factors that the Commission may take into account are:

(1) Any generally applicable environmental standard for radioactivity established by the Environmental Protection Agency;

(2) The age and nature of the waste, and the design of the underground facility, particularly as these factors bear upon the time during which the thermal pulse is dominated by the decay heat from the fission products;

(3) The geochemical characteristics of the host rock, surrounding strata and groundwater; and

(4) Particular sources of uncertainty in predicting the performance of the geologic repository.

(c) Additional requirements may be found to be necessary to satisfy the overall system performance objective as it relates to unanticipated processes and events.

Land Ownership and Control

§ 60.121 Requirements for ownership and control of interests in land.

(a) *Ownership of land.* (1) Both the geologic repository operations area and the controlled area shall be located in and on lands that are either acquired lands under the jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use.

(2) These lands shall be held free and clear of all encumbrances, if significant, such as: (i) Rights arising under the general mining laws; (ii) easements for right-of-way; and (iii) all other rights arising under lease, rights of entry, deed, patent, mortgage, appropriation, prescription, or otherwise.

(b) *Additional controls.* Appropriate controls shall be established outside of the controlled area. DOE shall exercise any jurisdiction and control over surface and subsurface estates necessary to prevent adverse human actions that could significantly reduce the geologic repository's ability to achieve isolation. The rights of DOE may take the form of appropriate possessory interests, servitudes, or withdrawals from location or patent under the general mining laws.

(c) *Water rights.* (1) DOE shall also have obtained such water rights as may be needed to accomplish the purpose of the geologic repository operations area.

(2) Water rights are included in the additional controls to be established under paragraph (b) of this section.

SITING CRITERIA

§ 60.122 Siting criteria.

(a)(1) A geologic setting shall exhibit an appropriate combination of the conditions specified in paragraph (b) of this section so that, together with the engineered barriers system, the favorable conditions present are sufficient to provide reasonable assurance that the performance objectives relating to isolation of the waste will be met.

(2) If any of the potentially adverse conditions specified in paragraph (c) of this section is present, it may compromise the ability of the geologic repository to meet the performance objectives relating to isolation of the waste. In order to show that a potentially adverse condition does not so compromise the performance of the geologic repository the following must be demonstrated:

(i) The potentially adverse human activity or natural condition has been adequately investigated, including the extent to which the condition may be present and still be undetected taking into account the degree of resolution achieved by the investigations; and

(ii) The effect of the potentially adverse human activity or natural condition on the site has been adequately evaluated using analyses which are sensitive to the potentially adverse human activity or natural condition and assumptions which are not likely to underestimate its effect; and

(iii)(A) The potentially adverse human activity or natural condition is shown by analysis pursuant to paragraph (a)(2)(ii) of this section not to affect significantly the ability of the geologic repository to meet the performance objectives relating to isolation of the waste, or

(B) The effect of the potentially adverse human activity or natural condition is compensated by the presence of a combination of the favorable characteristics so that the performance objectives relating to isolation of the waste are met, or

(C) The potentially adverse human activity or natural condition can be remedied.

(b) *Favorable conditions.* (1) The nature and rates of tectonic, hydrogeologic, geochemical, and geomorphic processes (or any of such processes) operating within the geologic setting during the Quaternary Period, when projected, would not affect or would favorably affect the ability of the geologic repository to isolate the waste.

(2) For disposal in the saturated zone, hydrogeologic conditions that provide:

(i) A host rock with low horizontal and vertical permeability;

(ii) Downward or dominantly horizontal hydraulic gradient in the host rock and immediately surrounding hydrogeologic units; and

(iii) Low vertical permeability and low hydraulic gradient between the host rock and the surrounding hydrogeologic units.

(3) Geochemical conditions that:

(i) Promote precipitation or sorption of radionuclides;

(ii) Inhibit the formation of particulates, colloids, and inorganic and organic complexes that increase the mobility of radionuclides; or

(iii) Inhibit the transport of radionuclides by particulates, colloids, and complexes.

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

(5) Conditions that permit the emplacement of waste at a minimum depth of 300 meters from the ground surface. (The ground surface shall be deemed to be the elevation of the lowest point on the surface above the disturbed zone.)

(6) A low population density within the geologic setting and a controlled area that is remote from population centers.

(7) Pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment that substantially exceeds 1,000 years.

(8) For disposal in the unsaturated zone, hydrogeologic conditions that provide—

(i) Low moisture flux in the host rock and in the overlying and underlying hydrogeologic units;

(ii) A water table sufficiently below the underground facility such that fully saturated voids contiguous with the water table do not encounter the underground facility;

(iii) A laterally extensive low-permeability hydrogeologic unit above the host rock that would inhibit the downward movement of water or divert downward moving water to a location beyond the limits of the underground facility;

(iv) A host rock that provides for free drainage; or

(v) A climatic regime in which the average annual historic precipitation is a small percentage of the average annual potential evapotranspiration.

(c) *Potentially adverse conditions.* The following conditions are potentially adverse conditions if they are characteristic of the controlled area or may affect isolation within the controlled area.

(1) Potential for flooding of the underground facility, whether resulting from the occupancy and modification of floodplains or from the failure of existing or planned man-made surface water impoundments.

(2) Potential for foreseeable human activity to adversely affect the groundwater flow system, such as groundwater withdrawal, extensive irrigation, subsurface injection of fluids, underground pumped storage, military activity or construction of large scale surface water impoundments.

(3) Potential for natural phenomena such as landslides, subsidence, or volcanic activity of such a magnitude that large-scale surface water impoundments could be created that could change the regional groundwater flow system and thereby adversely affect the performance of the geologic repository.

(4) Structural deformation, such as uplift, subsidence, folding, or faulting that may adversely affect the regional groundwater flow system.

(5) Potential for changes in hydrologic conditions that would affect the migration of radionuclides to the accessible environment, such as changes in hydraulic gradient, average interstitial velocity, storage coefficient, hydraulic conductivity, natural recharge, potentiometric levels, and discharge points.

(6) Potential for changes in hydrologic conditions resulting from reasonably foreseeable climatic changes.

(7) Groundwater conditions in the host rock, including chemical composition, high ionic strength or ranges of Eh-pH, that could increase the solubility or chemical reactivity of the engineered barrier system.

(8) Geochemical processes that would reduce sorption of radionuclides, result in degradation of the rock strength, or adversely affect the performance of the engineered barrier system.

(9) Groundwater conditions in the host rock that are not reducing.

(10) Evidence of dissolutioning such as breccia pipes, dissolution cavities, or brine pockets.

(11) Structural deformation such as uplift, subsidence, folding, and faulting during the Quaternary Period.

(12) Earthquakes which have occurred historically that if they were to be repeated could affect the site significantly.

(13) Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or magnitude of earthquakes may increase.

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

(15) Evidence of igneous activity since the start of the Quaternary Period.

(16) Evidence of extreme erosion during the Quaternary Period.

(17) The presence of naturally occurring materials, whether identified or undiscovered, within the site, in such form that:

(i) Economic extraction is currently feasible or potentially feasible during the foreseeable future; or

(ii) Such materials have greater gross value or net value than the average for other areas of similar size that are representative of and located within the geologic setting.

(18) Evidence of subsurface mining for resources within the site.

(19) Evidence of drilling for any purpose within the site.

(20) Rock or groundwater conditions that would require complex engineering measures in the design and construction of the underground facility or in the sealing of boreholes and shafts.

(21) Geomechanical properties that do not permit design of underground opening that will remain stable through permanent closure.

(22) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located in the unsaturated zone.

(23) Potential for existing or future perched water bodies that may saturate portions of the underground facility or provide a faster flow path from an underground facility located in the unsaturated zone to the accessible environment.

(24) Potential for the movement of radionuclides in a gaseous state through air-filled pore spaces of an unsaturated geologic medium to the accessible environment.

[48 FR 28222, June 21, 1983, as amended at 50 FR 29647, July 22, 1985]

Design Criteria for the Geologic Repository Operations Area

§ 60.130 Scope of design criteria for the geologic repository operations area.

Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in §§ 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities.

§ 60.131 General design criteria for the geologic repository operations area.

(a) *Radiological protection.* The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall include:

(1) Means to limit concentrations of radioactive material in air;

(2) Means to limit the time required to perform work in the vicinity of radioactive materials, including, as appropriate, designing equipment for ease of repair and replacement and providing adequate space for ease of operation;

(3) Suitable shielding;

(4) Means to monitor and control the dispersal of radioactive contamination;

(5) Means to control access to high radiation areas or airborne radioactivity areas; and

(6) A radiation alarm system to warn of significant increases in radiation levels, concentrations of radioactive material in air, and of increased radioactivity released in effluents. The alarm system shall be designed with provisions for calibration and for testing its operability.

(b) *Structures, systems, and components important to safety*—(1) *Protection against natural phenomena and environmental conditions.* The structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions anticipated at the geologic repository operations area will not interfere with necessary safety functions.

(2) *Protection against dynamic effects of equipment failure and similar events.* The structures, systems, and components important to safety shall be designed to withstand dynamic effects such as missile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions.

(3) *Protection against fires and explosions.* (i) The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area.

(ii) To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials.

(iii) The geologic repository operations area shall be designed to in-

clude explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety.

(iv) The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems.

(4) *Emergency capability.* (i) The structures, systems, and components important to safety shall be designed to maintain control of radioactive waste and radioactive effluents, and permit prompt termination of operations and evacuation of personnel during an emergency.

(ii) The geologic repository operations area shall be designed to include onsite facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available offsite services (such as fire, police, medical and ambulance service) that may aid in recovery from emergencies.

(5) *Utility services.* (i) Each utility service system that is important to safety shall be designed so that essential safety functions can be performed under both normal and accident conditions.

(ii) The utility services important to safety shall include redundant systems to the extent necessary to maintain, with adequate capacity, the ability to perform their safety functions.

(iii) Provisions shall be made so that, if there is a loss of the primary electric power source or circuit, reliable and timely emergency power can be provided to instruments, utility service systems, and operating systems, including alarm systems, important to safety.

(6) *Inspection, testing, and maintenance.* The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness.

(7) *Criticality control.* All systems for processing, transporting, handling, storage, retrieval, emplacement, and isolation of radioactive waste shall be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Each system shall be designed for criticality safety under normal and accident conditions. The calculated effective multiplication factor (k_{eff}) must be sufficiently below unity to show at least a 5% margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation.

(8) *Instrumentation and control systems.* The design shall include provisions for instrumentation and control systems to monitor and control the behavior of systems important to safety over anticipated ranges for normal operation and for accident conditions.

(9) *Compliance with mining regulations.* To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977, as to the construction and operation of the geologic repository operations area, the design of the geologic repository operations area shall nevertheless include such provisions for worker protection as may be necessary to provide reasonable assurance that all structures, systems, and components important to safety can perform their intended functions. Any deviation from relevant design requirements in 30 CFR, Chapter I, Subchapters D, E, and N will give rise to a rebuttable presumption that this requirement has not been met.

(10) *Shaft conveyances used in radioactive waste handling.* (i) Hoists important to safety shall be designed to preclude cage free fall.

(ii) Hoists important to safety shall be designed with a reliable cage location system.

(iii) Loading and unloading systems for hoists important to safety shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

(iv) Hoists important to safety shall be designed to include two independent indicators to indicate when waste

packages are in place and ready for transfer.

§ 60.132 Additional design criteria for surface facilities in the geologic repository operations area.

(a) *Facilities for receipt and retrieval of waste.* Surface facilities in the geologic repository operations area shall be designed to allow safe handling and storage of wastes at the geologic repository operations area, whether these wastes are on the surface before emplacement or as a result of retrieval from the underground facility.

(b) *Surface facility ventilation.* Surface facility ventilation systems supporting waste transfer, inspection, decontamination, processing, or packaging shall be designed to provide protection against radiation exposures and offsite releases as provided in § 60.111(a).

(c) *Radiation control and monitoring*—(1) *Effluent control.* The surface facilities shall be designed to control the release of radioactive materials in effluents during normal operations so as to meet the performance objections of § 60.111(a).

(2) *Effluent monitoring.* The effluent monitoring systems shall be designed to measure the amount and concentration of radionuclides in any effluent with sufficient precision to determine whether releases conform to the design requirement for effluent control. The monitoring systems shall be designed to include alarms that can be periodically tested.

(d) *Waste treatment.* Radioactive waste treatment facilities shall be designed to process any radioactive wastes generated at the geologic repository operations area into a form suitable to permit safe disposal at the geologic repository operations area or to permit safe transportation and conversion to a form suitable for disposal at an alternative site in accordance with any regulations that are applicable.

(e) *Consideration of decommissioning.* The surface facility shall be designed to facilitate decontamination or dismantlement to the same extent as would be required, under other parts of this chapter, with respect to equivalent activities licensed thereunder.

§ 60.133 Additional design criteria for the underground facility.

(a) *General criteria for the underground facility.* (1) The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides.

(2) The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility.

(b) *Flexibility of design.* The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

(c) *Retrieval of waste.* The underground facility shall be designed to permit retrieval of waste in accordance with the performance objectives of § 60.111.

(d) *Control of water and gas.* The design of the underground facility shall provide for control of water or gas intrusion.

(e) *Underground openings.* (1) Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained.

(2) Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock.

(f) *Rock excavation.* The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment.

(g) *Underground facility ventilation.* The ventilation system shall be designed to:

(1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a),

(2) Assure continued function during normal operations and under accident conditions; and

(3) Separate the ventilation of excavation and waste emplacement areas.

(h) *Engineered barriers.* Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure.

(i) *Thermal loads.* The underground facility shall be designed so that the performance objectives will be met taking into account the predicted thermal and thermomechanical response of the host rock, and surrounding strata, groundwater system.

[48 FR 28222, June 21, 1983, as amended at 50 FR 29648, July 22, 1985]

§ 60.134 Design of seals for shafts and boreholes.

(a) *General design criterion.* Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives or the period following permanent closure.

(b) *Selection of materials and placement methods.* Materials and placement methods for seals shall be selected to reduce, to the extent practicable:

(1) The potential for creating a preferential pathway for groundwater to contact the waste packages or

(2) For radionuclide migration through existing pathways.

[48 FR 28222, June 21, 1983, as amended at 50 FR 29648, July 22, 1985]

Design Criteria for the Waste Package

§ 60.135 Criteria for the waste package and its components.

(a) *High-level-waste package design in general.* (1) Packages for HLW shall be designed so that the in situ chemical, physical, and nuclear properties of the waste package and its interactions with the emplacement environment do not compromise the function of the waste packages or the performance of the underground facility or the geologic setting.

(2) The design shall include but not be limited to consideration of the following factors: solubility, oxidation/reduction reactions, corrosion, hydriding, gas generation, thermal effects, mechanical strength, mechanical stress, radiolysis, radiation damage, radionuclide retardation, leaching, fire and explosion hazards, thermal loads, and synergistic interactions.

(b) *Specific criteria for HLW package design*—(1) *Explosive, pyrophoric, and chemically reactive materials.* The waste package shall not contain explosive or pyrophoric materials or chemically reactive materials in an amount that could compromise the ability of the underground facility to contribute to waste isolation or the ability of the geologic repository to satisfy the performance objectives.

(2) *Free liquids.* The waste package shall not contain free liquids in an amount that could compromise the ability of the waste packages to achieve the performance objectives relating to containment of HLW (because of chemical interactions or formation of pressurized vapor) or result in spillage and spread of contamination in the event of waste package perforation during the period through permanent closure.

(3) *Handling.* Waste packages shall be designed to maintain waste containment during transportation, emplacement, and retrieval.

(4) *Unique identification.* A label or other means of identification shall be provided for each waste package. The identification shall not impair the integrity of the waste package and shall be applied in such a way that the information shall be legible at least to the end of the period of retrievability. Each waste package identification shall be consistent with the waste package's permanent written records.

(c) Waste form criteria for HLW. High-level radioactive waste that is emplaced in the underground facility shall be designed to meet the following criteria:

(1) *Solidification.* All such radioactive wastes shall be in solid form and placed in sealed containers.

(2) *Consolidation.* Particulate waste forms shall be consolidated (for example, by incorporation into an encapsulating matrix) to limit the availability and generation of particulates.

(3) *Combustibles.* All combustible radioactive wastes shall be reduced to a noncombustible form unless it can be demonstrated that a fire involving the waste packages containing combustibles will not compromise the integrity of other waste packages, adversely affect any structures, systems, or components important to safety, or compromise the ability of the underground facility to contribute to waste isolation.

(d) *Design criteria for other radioactive wastes.* Design criteria for waste types other than HLW will be addressed on an individual basis if and when they are proposed for disposal in a geologic repository.

PERFORMANCE CONFIRMATION REQUIREMENTS

§ 60.137 General requirements for performance confirmation.

The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part.

Subpart F—Performance Confirmation Program

SOURCE: 48 FR 28228, June 21, 1983, unless otherwise noted.

§ 60.140 General requirements.

(a) The performance confirmation program shall provide data which indicates, where practicable, whether:

(1) Actual subsurface conditions encountered and changes in those conditions during construction and waste emplacement operations are within the limits assumed in the licensing review; and

(2) Natural and engineered systems and components required for repository operation, or which are designed or assumed to operate as barriers after permanent closure, are functioning as intended and anticipated.

(b) The program shall have been started during site characterization and it will continue until permanent closure.

(c) The program shall include in situ monitoring, laboratory and field testing, and in situ experiments, as may be appropriate to accomplish the objective as stated above.

(d) The program shall be implemented so that:

(1) It does not adversely affect the ability of the natural and engineered elements of the geologic repository to meet the performance objectives.

(2) It provides baseline information and analysis of that information on those parameters and natural processes pertaining to the geologic setting that may be changed by site characterization, construction, and operational activities.

(3) It monitors and analyzes changes from the baseline condition of parameters that could affect the performance of a geologic repository.

(4) It provides an established plan for feedback and analysis of data, and implementation of appropriate action.

§ 60.141 Confirmation of geotechnical and design parameters.

(a) During repository construction and operation, a continuing program of surveillance, measurement, testing, and geologic mapping shall be conducted to ensure that geotechnical and design parameters are confirmed and to ensure that appropriate action is taken to inform the Commission of changes needed in design to accommodate actual field conditions encountered.

(b) Subsurface conditions shall be monitored and evaluated against design assumptions.

(c) As a minimum, measurements shall be made of rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into subsurface areas, changes in groundwater conditions, rock pore water pressures including those along fractures and joints, and the thermal and thermomechanical response of the rock mass as a result of development and operations of the geologic repository.

(d) These measurements and observations shall be compared with the original design bases and assumptions. If significant differences exist between the measurements and observations and the original design bases and assumptions, the need for modifications

to the design or in construction methods shall be determined and these differences and the recommended changes reported to the Commission.

(e) In situ monitoring of the thermomechanical response of the underground facility shall be conducted until permanent closure to ensure that the performance of the natural and engineering features are within design limits.

§ 60.142 Design testing.

(a) During the early or developmental stages of construction, a program for in situ testing of such features as borehole and shaft seals, backfill, and the thermal interaction effects of the waste packages, backfill, rock, and groundwater shall be conducted.

(b) The testing shall be initiated as early as is practicable.

(c) A backfill test section shall be constructed to test the effectiveness of backfill placement and compaction procedures against design requirements before permanent backfill placement is begun.

(d) Test sections shall be established to test the effectiveness of borehole and shaft seals before full-scale operation proceeds to seal boreholes and shafts.

§ 60.143 Monitoring and testing waste packages.

(a) A program shall be established at the geologic repository operations area for monitoring the condition of the waste packages. Waste packages chosen for the program shall be representative of those to be emplaced in the underground facility.

(b) Consistent with safe operation at the geologic repository operations area, the environment of the waste packages selected for the waste package monitoring program shall be representative of the environment in which the wastes are to be emplaced.

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

(d) The waste package monitoring program shall continue as long as practical up to the time of permanent closure.

Subpart G—Quality Assurance

SOURCE: 48 FR 28228, June 21, 1983, unless otherwise noted.

§ 60.150 Scope.

As used in this part, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that the geologic repository and its subsystems or components will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.

§ 60.151 Applicability.

The quality assurance program applies to all systems, structures and components important to safety, to design and characterization of barriers important to waste isolation and to activities related thereto. These activities include: site characterization, facility and equipment construction, facility operation, performance confirmation, permanent closure, and decontamination and dismantling of surface facilities.

§ 60.152 Implementation.

DOE shall implement a quality assurance program based on the criteria of Appendix B of 10 CFR Part 50 as applicable, and appropriately supplemented by additional criteria as required by § 60.151.

Subpart H—Training and Certification of Personnel

SOURCE: 48 FR 28229, June 21, 1983, unless otherwise noted.

§ 60.160 General requirements.

Operations of systems and components that have been identified as important to safety in the Safety Analysis Report and in the license shall be performed only by trained and certified personnel or by personnel under the direct visual supervision of an individual with training and certification in such operation. Supervisory personnel who direct operations that are important to safety must also be certified in such operations.

§ 60.161 Training and certification program.

DOE shall establish a program for training, proficiency testing, certification and requalification of operating and supervisory personnel.

§ 60.162 Physical requirements.

The physical condition and the general health of personnel certified for operations that are important to safety shall not be such as might cause operational errors that could endanger the public health and safety. Any condition which might cause impaired judgment or motor coordination must be considered in the selection of personnel for activities that are important to safety. These conditions need not categorically disqualify a person, so long as appropriate provisions are made to accommodate such conditions.

Subpart I—Emergency Planning Criteria [Reserved]

PART 61—LICENSING REQUIREMENTS FOR LAND DISPOSAL OF RADIOACTIVE WASTE

Subpart A—General Provisions

Subpart B—Licenses

Subpart C—Performance Objectives

Subpart D—Technical Requirements for Land Disposal Facilities

Subpart E—Financial Assurances