VOL.3 (28)

POLICY ISSUE
(Information)

October 31, 1989 SECY-89-339

For: The Commissioners

From: James M. Taylor
Acting Executive Director
for Operations

Subject: REGULATORY STRATEGY FOR THE HIGH-LEVEL WASTE REPOSITORY PROGRAM: DESCRIPTION OF UNCERTAINTIES BEING ADDRESSED BY THE U.S. NUCLEAR REGULATORY COMMISSION STAFF

Purpose: To describe uncertainties in the regulation of the High-Level Waste Repository Program identified to date by the U. S. Nuclear Regulatory Commission (NRC) staff and the Center for Nuclear Waste Regulatory Analyses (CNWRA). Also, to give NRC staff views on the approach for addressing these uncertainties.

Executive Summary: In a staff requirements memorandum dated February 27, 1989, the Commission requested descriptions of uncertainties in the regulation of the High-Level Waste Repository Program that have been identified by the NRC staff and the CNWRA. This paper describes these uncertainties and discusses the staff's approach for addressing uncertainties perceived by the CNWRA. The staff generally agrees with the CNWRA's conclusion that the potential rulemakings and Technical Positions identified in a Commission paper entitled "Regulatory Strategy and Schedules for the High-Level Waste Repository Program" (SECY-88-285, dated October 5, 1988) are related to most of the uncertainties perceived by the CNWRA's systematic analysis to date. These uncertainties will be considered in preparing the scopes for potential rulemakings and Technical Positions identified in SECY-88-285. Furthermore, two or three new activities might be needed to address the uncertainties perceived by the CNWRA that are not related to the potential rulemakings

Contact:
Robert L. Johnson, NMSS
492-0409
Joseph J. Holonich, NMSS
492-3403

8911060151
XA

or Technical Positions in SECY-88-285. The staff will revise SECY-88-285 in February 1990 to update the staff's plans for preparing potential rulemakings and Technical Positions.

Background: In SECY-88-285, the staff described: (1) the existing regulatory framework for licensing a repository; (2) the approaches for identifying uncertainties in the framework; and (3) the strategy and schedules for reducing these uncertainties, using a mix of rulemakings, Technical Positions, and one Regulatory Guide. SECY-88-285 also listed the potential rulemakings and Technical Positions that the staff planned to use to reduce uncertainties identified by the NRC staff at that time.

Based on its systematic analysis of 10 CFR Part 60 to date (referred to in the CNWRA contract as the "program architecture"), the CNWRA has perceived regulatory and institutional uncertainties in addition to those uncertainties identified by the NRC staff in SECY-88-285. The CNWRA evaluated and ranked these uncertainties with respect to importance, timing of resolution, and desired durability of resolution (i.e., how permanent a resolution is appropriate at this time). The staff is using the CNWRA evaluation to assist in deciding what changes might be needed to the strategy and schedules in SECY-88-285. Additional information on the CNWRA's methods for systematic analysis of the regulation and evaluation of uncertainties, together with results of the analysis and evaluation conducted to date, are given in the report entitled "Analysis and Evaluation of Regulatory Uncertainties in 10 CFR Part 60, Subparts B and E" (CNWRA 89-003, dated May 31, 1989). Copies of this report have been given under separate cover to each Commissioner's office.

The Commission has requested, in a staff requirements memorandum dated February 27, 1989 (COMJC-89-2), the following:

> For each of the technical, regulatory, and institutional uncertainties identified in SECY-88-285, as well as for any additional uncertainties identified by the Center for Nuclear Waste Regulatory Analysis (CNWRA), please explain the regulatory requirement or issue involved, the nature of the uncertainty, and the significance of the uncertainty for the HLW regulatory and licensing process.

The staff has prepared this Commission paper to respond to the aforementioned request. Section I describes the uncertainties identified by the staff in SECY-88-285 and the uncertainties perceived by the CNWRA to date and given in CNWRA 89-003. Section II discusses approaches for addressing the uncertainties perceived by the CNWRA. (Approaches for reducing uncertainties that the staff identified are discussed in SECY-88-285.)

Discussion: I. Description of Uncertainties

In SECY-88-285, the NRC staff identified 35 uncertainties (9 regulatory uncertainties, 4 institutional uncertainties, and 22 technical uncertainties). These uncertainties are listed in Enclosure 1, and Enclosure 2 briefly describes each uncertainty including the regulatory requirement(s), nature of the uncertainty, and significance to the regulatory and licensing process. A separate Commission paper further discusses implementation of the EPA Standards and the potential rulemaking on the methodology for proving compliance with the EPA Standards.

The CNWRA's systematic analysis of 10 CFR Part 60, Subparts B ("Licenses") and E ("Technical Criteria") resulted in the 78 uncertainties given in CNWRA 89-003. The CNWRA assembled these uncertainties into 13 groups of similar kinds of uncertainties. Uncertainties within a group are generally drawn from the same section or subsection of 10 CFR Part 60. Of the 13 groups, nine are regulatory uncertainties and four are institutional uncertainties. Enclosure 3 lists the uncertainty groups, the uncertainties that make up each group as given in CNWRA 89-003, and the types of uncertainties. Enclosure 4 gives the CNWRA's description of each of the 13 uncertainty groups, as presented in CNWRA 89-003. Additional information for each of the 78 individual uncertainties is given in Appendix B of CNWRA 89-003.

As mentioned previously, the uncertainties given in CNWRA 89-003 are based on the CNWRA's systematic analysis conducted to date. The analysis considered 10 CFR Part 60, Subparts B and E, which contain the regulatory requirements for the content of the License Application and the Technical Criteria. These subparts are most relevant to repository design and performance and therefore also to the U. S. Department of Energy's (DOE's) site characterization program, which is intended to develop the information to support the repository design and performance assessments. The analysis only identified regulatory and institutional uncertainties

as perceived by the CNWRA. Regulatory elements of proof (i.e., what must be proven in general terms to demonstrate compliance with a requirement) and technical uncertainties are in the process of being identified, but are not included in the report.

II. Approach for Addressing Uncertainties Perceived by the CNWRA

The approach for addressing regulatory, institutional, and technical uncertainties that the NRC staff has identified is given in SECY-88-285. The staff will be deciding how to address the additional uncertainties perceived to date by the CNWRA. The CNWRA has evaluated these additional uncertainties in CNWRA 89-003 to help the NRC staff in making its decision. In summary, the CNWRA concluded that most of the uncertainties in CNWRA 89-003 are related to the potential rulemakings or Technical Positions identified in SECY-88-285 (see Enclosure 5). Of the 13 groups of uncertainties analyzed by the CNWRA, to date, 9 groups are closely related to the potential rulemakings and Technical Positions in SECY-88-285 and thus could be addressed within the scope of the potential rulemakings or Technical Positions. Four groups remain that are either marginally related or not presently related to the potential rulemakings and Technical Positions identified in SECY-88-285. Group I relates to regulatory uncertainties with potential adverse conditions. Group VII relates to the institutional uncertainties about regulating mine safety and other non-radiological safety considerations. Group IX consists of institutional uncertainties pertaining to potential licensing amendments. The remaining group (UN 15) is an institutional uncertainty over land ownership and control.

The staff generally agrees with the CNWRA's conclusion that the potential rulemakings and Technical Positions identified in SECY-88-285 are related to most of the uncertainties perceived by the CNWRA, to date. However, the NRC staff will be evaluating, in detail, the uncertainties and evaluations in CNWRA 89-003 to determine if the uncertainties are valid and, if so, what uncertainty reduction activities (e.g., Technical Position, rulemaking or other activities) are needed. These uncertainties will be considered in preparing the scopes for the potential rulemakings or Technical Positions identified in SECY-88-285.

There might also be a need to initiate one new activity to reduce the Group I uncertainty associated with all potentially adverse conditions. For this activity, it might be appropriate to give generic guidance on an acceptable approach for addressing any of the potentially adverse conditions. The NRC staff recognizes that there is also a technical uncertainty unique to each potentially adverse condition for a given site. The ultimate reduction of these technical uncertainties can best be achieved by site characterization and a combination of preliminary performance assessments, prelicensing review and consultation between NRC and DOE, and in some cases Technical Positions. For the Group VIII uncertainties regarding regulating mine safety, the staff will consider either a new activity or addressing this uncertainty in the Repository Design Technical Position. For the Group IX uncertainties with licensing amendments, the staff will consider expanding the scope of the potential rulemaking on content of the application to also address these uncertainties as needed. Finally, a new activity to address the institutional uncertainty over land ownership and control will be considered.

Conclusions: Based on the previous discussion, the NRC staff concludes that:

1. The staff generally agrees with the conclusion in CNWRA 89-003 that potential rulemakings and Technical Positions identified in SECY-88-285 relate to most of the uncertainties perceived by the CNWRA's analysis to date. These uncertainties will be considered in preparing the scopes for potential rulemakings and Technical Positions identified in SECY-88-285.

2. There might also be a need for two or three new activities of some type (e.g., rulemakings, Technical Positions, or other activities) to address uncertainties not related to the potential rulemakings and Technical Positions given in SECY-88-285 (i.e., potentially adverse conditions, non-radiological safety, and land ownership and control).

3. SECY-88-285 will be revised as needed by the end of February 1990 after the CNWRA completes its systematic analysis of 10 CFR Part 60 (scheduled to be completed in December 1989).

Coordination: The Office of the General Counsel has reviewed this paper and has no legal objection.

James M. Taylor
Acting Executive Director
for Operations

Enclosures:
1. List of Regulatory, Institutional, and Technical Uncertainties Identified in SECY-88-285
2. Descriptions of Uncertainties Identified in SECY-88-285
3. List of Uncertainty Groups Identified in CNWRA 89-003
4. Descriptions of Uncertainties Identified in CNWRA 89-003
5. Relationship of Groups of Uncertainties Identified in CNWRA 89-003 to Potential Rulemakings and Technical Positions Identified in SECY-88-285.

DISTRIBUTION:
Commissioners
OGC
OIG
LSS
GPA
REGIONAL OFFICES
EDO
ACRS
ACNW
ASLBP
ASLAP
SECY

ENCLOSURE 1

Enclosure 1

LIST OF REGULATORY, INSTITUTIONAL, AND TECHNICAL UNCERTAINTIES IDENTIFIED IN SECY-88-285

Rulemakings to Resolve Regulatory Uncertainties

1. Conform Part 60 to the U. S. Environmental Protection Agency (EPA) High-Level Waste (HLW) Standard

2. Methodology for Proving Compliance with EPA HLW Standards

3. Further Amplification of the Meaning of the Phrase "Anticipated Processes and Events and Unanticipated Processes and Events" used in 10 CFR Part 60

*4. Further Amplification of the Meaning of the Phrase the "Disturbed Zone" used in 10 CFR Part 60

5. Further Amplification of the Meaning of the Phrase "Substantially Complete Containment" used in 10 CFR Part 60

*6. Further Amplification of the Meaning of the Phrase "Pre-waste Emplacement Groundwater Travel Time" used in 10 CFR Part 60

7. Establishment of "Criteria for Containment of Greater-than-Class-C" Low-Level Waste When it is Disposed of in a Deep Geologic Repository

8. Definition of "Design Basis Accident Dose Limit" for Repository Operations

9. Establishment of Emergency Planning Criteria under Subpart I of 10 CFR Part 60

Rulemakings to Reduce Institutional Uncertainties

10. Review of the Commission's Findings under its 1984 Waste Confidence Decision

11. Implementation of Nuclear Waste Policy Act (NWPA) Provisions Requiring NRC to Adopt DOE's Environmental Impact Statement

12. Licensing Support System

---

* Potential Rulemakings 4 and 6 have been combined into one potential rulemaking

13. Revisions to Content of Licensing Application and Threshold for Acceptance of the License Application

Technical Positions to Guide DOE's Reduction of Technical Uncertainties*

1. Post-closure Seals in an Unsaturated Medium
2. Extrapolation of Short-term Data to Long-term Results

**3. Waste Retrievability

**4. Retrieval Demonstration during Site Characterization

***5. Repository Design

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

* Many of these potential Technical Positions deal with complicated technical uncertainties for which acceptable uncertainty reduction methods may need to evolve over time. Therefore, the staff will decide in the scoping step for each potential Technical Position if it is more beneficial to develop a Technical Position or use the prelicensing review and consultation process instead.

** Potential Technical Positions 3 and 4 have been combined into one Technical Position

*** Potential Technical Positions 5, 21, and 22 have been combined into one Technical Position

20. Formal Use of Expert Judgment

*21. Applicable Surface Design Regulatory Guides

*22. Applicable Subsurface Design Regulatory Guides

Regulatory Guide to Reduce Regulatory Uncertainty

1. Format and Content of License Application

* Potential Technical Positions 5, 21, and 22 have been combined into one Technical Position

ENCLOSURE 2

DESCRIPTIONS OF UNCERTAINTIES IDENTIFIED IN SECY-88-285*

Uncertainty Title:	Conform Part 60 to the U. S. Environmental Protection Agency (EPA) High-Level Waste (HLW) Standard
SECY-88-285 Number:	Potential Rulemaking 1
Regulatory Requirements:	The Nuclear Waste Policy Act requires that the U. S. Nuclear Regulatory Commission's (NRC's) requirements and criteria be consistent with any comparable standards promulgated by EPA. Once the final EPA Standard is issued, certain amendments to 10 CFR Part 60 will be needed to achieve the consistency directed by the Act. The principal changes will be made to 10 CFR 60.111(a) and 10 CFR 60.112, where the present rule refers to but does not further specify the standards established by EPA.
Nature of Uncertainty:	Although the existing rule recognizes the need to incorporate the forthcoming EPA Standard, there is some uncertainty as to what changes will be needed to conform 10 CFR Part 60 to the EPA Standard.

Significance to Regulatory and Licensing Process:

In discharging its statutory responsibility, NRC must amend 10 CFR Part 60 to conform it to the EPA Standard. It is also necessary to establish consistent terminology between the two regulations, which did not exist with EPA's previously proposed standard. Provided EPA does not make any significant changes in areas of the standard that were not questioned by the court, on remanding the standard to EPA, this rulemaking is not expected to have any significant impact on the U. S. Department of Energy's (DOE's) site characterization program.

* Three of the potential rulemakings identified in Enclosure 1 are not discussed in this enclosure. The rulemakings on the Licensing Support System and adopting DOE's Environmental Impact Statement are complete. The waste confidence rulemaking was issued for public comment on September 28, 1989 (54 FR 39765). (These potential rulemakings are numbered 10, 11, and 12, respectively, in Enclosure 1.)

Uncertainty Title:	Methodology for Proving Compliance with the EPA HLW Standard*
SECY-88-285 Number:	Potential Rulemaking 2
Regulatory Requirements:	This rulemaking will amend 10 CFR 60.112 to incorporate methodologies for determining compliance with the post-closure aspects of the EPA Standard.
Nature of Uncertainty:	Because of the long-time period, 10,000 years, over which compliance must be determined and the uncertainties inherent in such a determination, there are currently no recognized methodologies for determining compliance with the EPA Standard. The use of a quantitative, probabilistic standard such as the EPA Standard could lead to debate about compliance because of the uncertainties.

Significance to Regulatory and Licensing Process:

Reduction of this uncertainty would result in revising 10 CFR Part 60 to incorporate acceptable methods for determining compliance with the EPA Standard. The staff is proposing to resolve uncertainties with the methodologies to demonstrate compliance now rather than wait until the licensing hearing, since the focus of the licensing hearing should be on the site data and the acceptability of the site, not unique methodologies for determining compliance. Also, as discussed in a separate Commission paper on the implementation of the EPA Standards, development of this rulemaking will aid the staff in evaluating and commenting on the probabilistic EPA Standards as they are being revised.

* A separate Commission paper (SECY-89-319) further discusses implementation of the EPA Standards and this potential rulemaking.

Uncertainty Title:	Further Amplification of the Meaning of the Phrase "Anticipated Processes and Events and Unanticipated Processes and Events" used in 10 CFR Part 60
SECY-88-285 Number:	Potential Rulemaking 3
Regulatory Requirements:	As defined within 10 CFR 60.2, "Anticipated Processes and Events" (APEs) and "Unanticipated Processes and Events" (UPEs) are two categories of processes and events which could occur within the geologic setting during the period after permanent closure of the repository. Determination of these categories of processes and events is required because: (1) APEs are the primary design basis processes and events for the design of the waste package and the engineered barrier; and (2) APEs together with UPEs are to provide the basis for analysis to determine compliance with the overall system performance objective of 10 CFR 60.112 (implementation of the environmental standard promulgated by EPA in 40 CFR Part 191).
Nature of Uncertainty:	The definition of APEs and UPEs includes non-specific terms such as "reasonably likely" and "sufficiently credible to warrant consideration," which have been interpreted in a number of different ways.

Significance to Regulatory and Licensing Process:

Absent a consistent understanding of how APEs and UPEs are to be applied in the licensing process, there is a high potential for significant redirection of DOE's site characterization activities that could affect DOE's ability to obtain the information necessary for licensing. Until these terms are clarified, it cannot be determined if the natural barriers, waste package, or engineered barrier system are sufficient to comply with the required performance objectives of 10 CFR Part 60.

Uncertainty Title:	Further Clarification of the Meaning of the Phrases "Groundwater Travel Time/Disturbed Zone" used in 10 CFR Part 60
SECY-88-285 Number:	Potential Rulemakings 4 and 6
Regulatory Requirements:	The performance objective for the HLW repository geologic setting is stated in 10 CFR 60.113(a)(2) as: "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 1000 years or such other time as may be approved or specified by the Commission." The term "disturbed zone" is identified in the requirements of 10 CFR 60.113(a)(2) and is defined in 10 CFR 60.2 as: "...that portion of the controlled area the physical or chemical properties of which have changed as a result of underground facility construction or as the 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."
Nature of Uncertainty:	The rulemaking record is clear about the overall intended meaning and purpose of the groundwater travel time performance objective. However, considerable uncertainty exists in implementing the requirement. For example, it is not certain that the "fastest path of likely radionuclide travel" can be delineated with reasonable assurance in heterogeneous geologic materials present at real repository sites. A second uncertainty relates to the disturbed zone concept. The intent of the disturbed zone concept is to establish an inner boundary from which the pre-waste-emplacement groundwater travel time is determined. However, the uncertainty develops from the intent to establish a boundary that excludes a zone around the repository where very complicated processes related to waste generated heat and construction occur, and the need to understand these same processes to determine the disturbed zone boundary as well as make a determination on waste package and total system performance.

Significance to Regulatory and Licensing Process:

Because of the possible inability of implementing the groundwater travel time requirements of 10 CFR 60.113, and the impracticality of determining the extent of the disturbed zone consistent with the definition, it may be unreasonably difficult for DOE to demonstrate compliance with the post-closure performance objective for the natural barrier. Reduction of this uncertainty will enable DOE to better characterize the site so as to collect the necessary data to demonstrate compliance with the regulations.

Uncertainty Title:	Further Amplification of the Meaning of the Phrase "Substantially Complete Containment" Used in 10 CFR Part 60
SECY-88-285 Number:	Potential Rulemaking 5
Regulatory Requirements:	As part of the performance requirements of the engineered barrier system, 10 CFR 60.113(a)(1)(i) states: "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...."
Nature of Uncertainty:	This is a regulatory uncertainty because the term "substantially complete containment" as used in 10 CFR 60.113(a)(1)(i)(A) may not be sufficiently specific to adequately convey to DOE and its designers, or to NRC's technical reviewers, what is meant by substantially complete and what must be done in order to demonstrate compliance with the regulation. Thus, further definition may be required to minimize the potential for significant technical misunderstandings.

Significance to Regulatory and Licensing Process:

Further amplification of the meaning of "substantially complete containment" and what needs to be done in order to demonstrate compliance may serve in the near term to help ensure DOE designs a waste package containment system that NRC can find acceptable.

Uncertainty Title:	Establishment of "Criteria for Containment of Greater-Than-Class-C" Low-Level Waste When It is Disposed of in a Geologic Repository
SECY-88-285 Number:	Potential Rulemaking 7
Regulatory Requirements:	10 CFR 60.135(d) requires that the "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." In addition, the release rate limits of 10 CFR 60.113 would apply to greater-than-class-C waste; however, the containment requirement of 10 CFR 60.113 applies to only high-level waste.
Nature of Uncertainty:	Wastes that are greater-than-Class-C (GTCC) low-level wastes are generally unsuitable for near-surface disposal, and those wastes may be disposed of in a high-level waste repository. If DOE chooses to exercise the option to dispose of greater-than-Class-C waste in the HLW repository, the NRC must establish design criteria for greater-than-Class-C, low-level wastes in accordance with 10 CFR 60.135(d). The staff must also establish the containment requirements for GTCC waste and the method of analyzing their impact on the repository release rate.

Significance to Regulatory and Licensing Process:

If DOE chooses to dispose of GTCC waste in the repository, criteria for containment of greater-than-class-C wastes in the HLW repository need to be established so that DOE can design containers for disposal. In addition, DOE may need to modify the models it uses to analyze certain design aspects of the site. In general, it will not affect the majority of waste being disposed of in the repository, nor will it have a significant impact on the repository design.

Uncertainty Title:	Definition of "Design Basis Accident Dose Limit" for Repository Operations
SECY-88-285 Number:	Potential Rulemaking 8
Regulatory Requirements:	10 CFR Part 60 does not contain a Design Basis Accident (DBA) Dose Limit.
Nature of Uncertainty:	This regulatory uncertainty arises because 10 CFR Part 60 does not contain a specific DBA dose limit. In addition, uncertainty has developed as to whether the value of 0.5 rem in 10 CFR 60.2's, definition of items important to safety, should be construed as a design basis accident dose limit. According to 10 CFR 60.2: "...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" are defined as important to safety.

Significance to Regulatory and Licensing Process:

NRC needs to remove any ambiguity regarding the DBA Dose Limit if accidental releases occur in the repository operations area. DOE needs to know what, if any, DBA Dose Limit will apply and for what purpose the DBA Dose Limit will be used.

Uncertainty Title:	Establishment of Emergency Planning Criteria under Subpart I of 10 CFR Part 60
SECY-88-285 Number:	Potential Rulemaking 9
Regulatory Requirements:	10 CFR Part 60, Subpart I, "Emergency Planning Criteria," is currently reserved.
Nature of the Uncertainty:	There are no existing criteria for emergency planning.

Significance to Regulatory and Licensing Process:

Because 10 CFR 60.31(a)(5) requires DOE's emergency plan to be in compliance with 10 CFR Part 60, Subpart I, at the time a Construction Authorization is issued, DOE must know NRC's "Emergency Planning Criteria," to prepare the License Application.

Uncertainty Title:	Revisions to Content of License Application and Criteria for Acceptance of License Application
SECY-88-285 Number:	Potential Rulemaking 13
Regulatory Requirement:	The content of the License Application is given in 10 CFR 60.21.
Nature of Uncertainty:	Although 10 CFR 60.21 describes general requirements for what should be included in the general information and the Safety Analysis Report, in the License Application, this section may not be sufficiently detailed for DOE to know what is needed in order to submit a complete and high-quality License Application. Furthermore, no specific criteria are given for accepting the License Application for docketing.

Significance to Regulatory and Licensing Process:

Refining the content requirements of the License Application will help DOE to determine what information needs to be developed or collected to support the License Application and will help assure that DOE submits a complete and high-quality License Application.

Developing criteria for acceptance of the License Application will provide a documented basis on which to accept or reject the License Application. Acceptance criteria might also improve the effectiveness of prelicensing consultation and the Site Characterization Plan (SCP) Progress Report review process by encouraging DOE to resolve NRC staff concerns before the License Application is submitted.

Uncertainty Title:	Post-Closure Seals in Unsaturated Media
SECY-88-285:	Potential Technical Position 1
Regulatory Requirements:	The applicable 10 CFR Part 60 regulations are: (1) 10 CFR 60.134, which covers the design of seals for shafts and boreholes; (2) 10 CFR 60.15, which addresses the site characterization requirements; (3) 10 CFR 60.140, 60.141, and 60.142, which address the performance confirmation program requirements; and (4) 10 CFR 60.112, which addresses the requirements for selection of the geologic setting and design of the engineered barrier system and the shafts, boreholes and their seals to meet the overall system performance objective for the geologic repository after permanent closure.
Nature of Uncertainty:	The specific design requirements given in 10 CFR 60.134 for site sealing are generic and intended for use in any type of medium. The technical uncertainty arises because there are no criteria for site sealing in an unsaturated medium that DOE can use to demonstrate compliance with the regulations.

Significance to Regulatory and Licensing Process:

Data collected during site characterization and DOE's performance confirmation program, which is required to start during site characterization, must support and provide input to seal design. Therefore, reduction of this uncertainty will help DOE confirm the adequacy of its current seal design and that site characterization and performance confirmation programs support the design.

Uncertainty Title:	Extrapolation of Short-Term Data to Long-Term Results
SECY-88-285 Number:	Potential Technical Position 2
Regulatory Requirements:	DOE must demonstrate how the overall repository system and its components comply with the technical criteria given in 10 CFR Part 60, Subpart E, which require performance over hundreds to thousands of years.
Nature of Uncertainty:	Many analyses of the repository and its various engineered and natural components used to demonstrate compliance with the applicable sections of 10 CFR Part 60 will be based on short-duration tests performed by DOE. This compliance demonstration involves the use of data from accelerated tests and predictive models supported by field and laboratory tests, monitoring data, and natural analog studies. These tests can involve waste package performance, rock/water interactions, hydrologic system and radionuclide transport analysis, and tectonic and volcanic activity at Yucca Mountain. In all cases, the tests will be run over a period of a few days to a few years, while the time frames in the regulation are 300 to 1000 years for the waste package and 10,000 years for the overall repository. A technical uncertainty exists with how to extrapolate short-term test results to performance objectives for long time periods (i.e., 100 to 10,000 years).

Significance to Regulatory and Licensing Process:

There are no standard methods or criteria for acceptable methodologies for extrapolation of short-term test results over such long time frames. DOE needs to develop a methodology to extrapolate short-term data to long-term performance objectives to confirm its data needs. This, in turn, will form a basis for the type and duration of short-term experiments that need to be conducted during site characterization and performance confirmation to predict long-term performance.

Uncertainty Title:	1) Waste Retrievability 2) Retrieval Demonstration During Site Characterization
SECY-88-285 Numbers:	Potential Technical Positions 3 and 4
Regulatory Requirements:	10 CFR 60.111 (a) requires that the geologic repository operations areas shall be designed so that protection against radiation exposures and releases of radioactive material is provided, and 10 CFR 60.111(b) requires that the design of the geologic repository operations area shall preserve the option of waste retrieval. Explicit requirements in 10 CFR Part 60 that pertain to retrievability include designing stable openings for the repository drifts and designing a ventilation system that operates separate circuits for the excavation and emplacement areas and controls transport and releases of radioactive particulates. The specific requirements are found in 10 CFR 60.130, 60.131, 60.132, 60.133, and 60.135.
Nature of Uncertainty:	Technical uncertainties exist with regard to: 1) what level of equipment and operational demonstration of waste retrieval is needed in order to prove that the requirements are met; 2) what type of host-rock data needs to be collected that pertains to retrieval; 3) what kinds of retrievability methodology will constitute a demonstration of compliance with the regulatory requirements; and 4) what criteria are to be used to establish the acceptability of that methodology.

Significance to Regulatory and Licensing Process:

In its License Application, DOE must describe an acceptable plan to retrieve emplaced waste during normal operations of the geologic repository and demonstrate that the design of the repository does not preclude retrieval of wastes. Reduction of this uncertainty will provide guidance for DOE to determine the level of retrieval demonstration necessary in the development of the repository design, and the types of information and data that need to be obtained during site characterization to support this demonstration.

Uncertainty Titles:

1) Repository Design
2) Application of Existing Regulatory Guides to Subsurface Design
3) Application of Existing Regulatory Guides to Surface Design

SECY-88-285 Numbers: Potential Technical Positions 5, 21, and 22

Regulatory Requirements: The general design criteria for the geologic repository operations area are given in 10 CFR 60.131. 10 CFR 60.132 contains additional design criteria for the surface facilities of the geologic repository operations area and 10 CFR 60.133 contains additional design criteria for the underground facilities of the geologic repository operations area.

Nature of Uncertainty: All of the regulatory design criteria given in 10 CFR 60.131, 10 CFR 60.132, and 10 CFR 60.133 are qualitative in nature. Therefore, there is uncertainty in the specific design criteria needed to demonstrate compliance with the requirements.

DOE has requested that the staff identify what existing NRC Regulatory Guides can be applied in the repository program.

Significance to Regulatory and Licensing Process:

Reduction of these uncertainties will provide guidance for DOE to develop the detailed design criteria needed to demonstrate compliance with the regulations. In addition, the staff must identify what NRC Regulatory Guides, or Regulatory Positions in the Guides, it finds acceptable for the HLW program. It is important that DOE have sufficient guidance to ensure that it is proceeding on an acceptable course for the repository design.

Uncertainty Title:	Scope for Waste Package/Engineered Barrier Testing
SECY-88-285 Number:	Potential Technical Position 6
Regulatory Requirements:	10 CFR 60.113 contains the performance objectives for particular barriers of the repository, including the waste package.
Nature of Uncertainty:	The technical uncertainty arises because the scope of the testing program needed to support the models used to demonstrate compliance with the requirements given in 10 CFR 60.113 are not explicitly established for the period of interest (10,000 years) of the repository.

Significance to Regulatory and Licensing Process:

The types of information from testing programs to demonstrate compliance with 10 CFR 60.113, need to be determined. Having a knowledge of the types of information needed, DOE can then determine the types of data it needs to collect and thus, the types of testing that need to be done. The results of the tests will support the development of the models necessary to assess compliance with 10 CFR 60.113.

Uncertainty Title:	Waste Package Reliability Analysis
SECY-88-285 Number:	Potential Technical Position 7
Regulatory Requirements:	In addition to 10 CFR 60.113, which establishes the performance objectives for particular barriers of the repository, including the waste package, 10 CFR 60.135 contains the design requirements for the waste package.
Nature of Uncertainty:	This technical uncertainty arises because there are no methods for analyzing the reliability of the waste package over the time period (10,000 years) covered by the repository and thus, demonstrating compliance with the performance objective and design requirements.

Significance to Regulatory and Licensing Process:

Without conducting the proper waste package reliability analysis, DOE will not be able to acceptably demonstrate compliance with the overall performance objectives of 10 CFR 60.113 and the design requirements of 10 CFR 60.135. Reduction of this uncertainty will affect the information DOE must collect to support the methods it will use to conduct the analyses.

Uncertainty Title:	Radionuclide Transport
SECY-88-285 Number:	Potential Technical Position 8
Regulatory Requirements:	10 CFR 60.122(b)(3) and (4) identify the favorable geochemical conditions for the repository and 10 CFR 60.122(c)(8) identified the potentially adverse geochemical conditions.
Nature of Uncertainty:	The geochemical siting criteria of 10 CFR 60.122 are generically applicable to any candidate site. However, there are large uncertainties as to whether DOE can demonstrate compliance with the regulations because its present approach is to assume that the chemistry in unsaturated rock is identical with that in saturated rock. Technical uncertainties exist because radionuclide transport in an unsaturated, fractured medium like Yucca Mountain can be affected by gas/liquid interactions that are not being considered.

Significance to Regulatory and Licensing Process:

Criteria must be established to give DOE guidance on mechanisms that need to be considered for radionuclide transport in an unsaturated medium. In considering these mechanisms, DOE may be required to add to site characterization, and the results of these activities may impact on the design of the repository. The reduction of this uncertainty will guide DOE as to what level of site characterization is necessary in order to support its License Application.

Uncertainty Title:	Chemical Interactions in Fractured Unsaturated Rock
SECY-88-285 Number:	Potential Technical Position 9
Regulatory Requirements:	10 CFR 60.122(b)(3) and (4) identify the favorable geochemical conditions for a repository, and 10 CFR 60.122(c)(7), (8), and (9) address the potentially adverse groundwater and geochemical conditions.
Nature of Uncertainty:	The siting criteria of 10 CFR 60.122 are generically applicable to any candidate site. However, it is uncertain that DOE can demonstrate compliance with the applicable regulations because its present approach is to assume that the chemistry in unsaturated rock is identical with that in saturated rock. Technical uncertainty exists because geochemical changes for a fractured, unsaturated rock like Yucca Mountain involve gas/liquid interactions that are not being considered.

Significance to Regulatory and Licensing Process:

Reduction of this uncertainty will provide guidance for DOE to determine what standard tests and analyses can be used in an unsaturated medium, and what additional tests need to be conducted, or what changes need to be made to models. Without having a complete geochemical testing and modeling program, DOE cannot demonstrate compliance with the regulations. In addition, reduction of this uncertainty will help DOE identify what information is needed from the tests and analyses to support licensing.

Uncertainty Title:	Pre-Closure Earthquake Hazard Evaluation Methods
SECY-88-285 Number:	Potential Technical Position 10
Regulatory Requirements:	In order to demonstrate compliance with 10 CFR 60.131(b)(1), DOE must consider what natural phenomena are anticipated at the geologic repository operations area.
Nature of Uncertainty:	Although 10 CFR Part 100 was established to identify siting criteria for nuclear power plants, there are elements of the 10 CFR Part 100, Appendix A methodology that can be used in the HLW program. Uncertainties arise concerning the applicability of specific values and procedures stated in 10 CFR Part 100, Appendix A with regard to a geologic repository.

Significance to Regulatory and Licensing Process:

Reduction of this uncertainty will guide DOE on the use of 10 CFR Part 100, Appendix A in evaluating the design basis earthquake and the seismic hazard, which must be developed by DOE for a geologic repository. In addition, 10 CFR Part 100, Appendix A criteria describe a method of investigations and analysis that is acceptable to obtain the geologic and seismic data necessary to determine site suitability. Reduction of the uncertainty will allow DOE to confirm that its seismic investigation program in the SCP is sufficient to support licensing.

Uncertainty Title:	Probabilistic Seismic Hazard Analysis
SECY-88-285 Number:	Potential Technical Position 11
Regulatory Requirements:	In 10 CFR 60.112, the EPA Standard (40 CFR 191.13) is identified as the overall system performance objective for the geologic repository after permanent closure.
Nature of Uncertainty:	The uncertainty associated with the probabilistic seismic hazard analysis estimation arises from the difficulties with extrapolating the limited available seismic data, and predicting the maximum earthquake magnitude to the 10,000-year time frame required for the repository.

Significance to Regulatory and Licensing Process:

As part of meeting the EPA Standard, DOE must perform a seismic hazard analysis. The results from this seismic hazard analysis will be used to calculate mechanical and structural failure and to estimate frequencies of consequences of such failure for the pre-closure and post-closure periods of the facility. For the post-closure periods of the facility, these calculations will be combined with other processes and events calculations to form an overall complementary cumulative distribution function that will be used to demonstrate that the likelihood of radioactive material released to the environment for the 10,000 years after disposal for all significant processes and events will not exceed specified EPA values. Reduction of this uncertainty will guide DOE in the development of a method for probabilistically assessing seismic hazards in order to meet the EPA Standard.

Uncertainty Title:	Volcanic Hazards Analysis
SECY-88-285 Number:	Potential Technical Position 12
Regulatory Requirements:	10 CFR 60.111 provides for the performance of the geologic repository operations area through permanent closure. 10 CFR 60.112 provides for the overall system performance for the geologic repository after permanent closure. 10 CFR 60.113 deals with the performance of particular barriers after permanent closure. In addition, 10 CFR 60.122(b)(1) identifies the favorable conditions for tectonic processes, whereas 10 CFR 60.122(c)(3) and 10 CFR 60.122(c)(15) contain the potentially unfavorable conditions for natural phenomena such as igneous activity, since the start of the Quaternary Period.
Nature of Uncertainty:	This technical uncertainty arises because there are no standard methods for projecting the nature and rates of volcanic hazards over long periods of time (10,000 years). Consequently, there is some uncertainty regarding the identification and interpretation of data related to processes which could produce volcanic hazards.

Significance to Regulatory and Licensing Process:

Without the proper identification of volcanic hazards, DOE will not be able to acceptably demonstrate compliance with NRC's overall performance objectives, (i.e., the EPA Standard).

Uncertainty Title:	Tectonic Models under 10 CFR Part 60
SECY-88-285 Number:	Potential Technical Position 13
Regulatory Requirements:	Under 10 CFR Part 60, DOE is obligated to thoroughly support models for determining the long-term performance of a repository. This obligation and requirement for development and confirmation of models are specified in 10 CFR 60.101(1)(2).
Nature of Uncertainty:	Conceptual tectonic models have a key role in determining the processes and events likely to occur in the period of concern for the repository and, therefore, in defining anticipated and unanticipated processes and events. Technical uncertainty resulting from an incomplete geologic record in the vicinity of a repository is likely to result in an inability to completely bound the possible future behavior of natural systems and to establish anticipated and unanticipated processes and events. In these circumstances, reliance on models based on the available data is necessary to attempt to bound the likelihood of possible disruptive geologic events.

Significance to Regulatory and Licensing Process:

Reducing this uncertainty through the use of tectonic models is important because the tectonic models selected by DOE will be used to establish design information and data for possible disruptive geologic events. In the absence of a complete geologic record, reliance on models is necessary. If tectonic models are not thoroughly supported and correctly implemented in the performance allocation and performance assessment processes, then site characterization activities may need to be expanded.

Uncertainty Title:	Natural Resources Assessment Methods
SECY-88-285 Number:	Potential Technical Position 14
Regulatory Requirements:	The natural resources assessment provisions of 10 CFR Part 60 center on: (1) the demonstration of compliance with 10 CFR 60.122(a)(1), which covers the contribution of geologic setting to waste isolation; (2) the identification of favorable siting conditions as required in 10 CFR 60.122(b)(4); and (3) the identification of potentially adverse siting conditions discussed in 10 CFR 60.122(c)(17). In addition, the performance objectives relating to waste isolation given in 10 CFR 60.111(a), and overall system performance given in 10 CFR 60.112 must be met given the presence of potentially adverse conditions, including the presence of natural resources.
Nature of Uncertainty:	This technical uncertainty arises because there is not a clear consensus on what natural resource assessment methods can be used to demonstrate compliance with the appropriate sections of 10 CFR Part 60.

Significance to Regulatory and Licensing Process:

Guidance on the method it can use to develop natural resource assessment methods will assist DOE in demonstrating compliance with the natural resources assessment provisions of 10 CFR Part 60. By having developed these models, DOE will then be able to demonstrate compliance with the regulations and confirm that its site characterization activities are sufficient in the area of natural resources.

Uncertainty Title: Geologic Mapping of Shafts and Drifts

SECY-88-285 Number: Potential Technical Position 15

Regulatory Requirements: The requirements for Geologic Mapping of Shafts/Drifts are in the following sections of 10 CFR Part 60:

(1) Subsections of 10 CFR 60.72 Construction Records including:

10 CFR 60.72(b)(1);
10 CFR 60.72(b)(2);
10 CFR 60.72(b)(3);
10 CFR 60.72(b)(4); and
10 CFR 60.72(b)(7).

(2) 10 CFR 60.140(a)(1)

(3) 10 CFR 60.141(a)
10 CFR 60.141(c)
10 CFR 60.141(d)

Related Performance Objectives include:

10 CFR 60.111, which provides for the performance of the geologic repository operations area through permanent closure, 10 CFR 60.112, which provides for the overall system performance for the geologic repository after permanent closure, and 10 CFR 60.113, which deals with the performance of particular barriers after permanent closure.

Nature of Uncertainty: New, unproven procedures are to be employed by DOE in mapping the shafts and drifts. Because of the unproven nature of these procedures, there is an uncertainty in determining if they will meet the NRC's regulations.

Significance to Regulatory and Licensing Process:

Because DOE is using state-of-the-art techniques, some of which are unproven, to map the shafts and drifts, reduction of this uncertainty will determine which procedures can be used to meet the regulations. In addition, DOE will be mapping its shafts and drifts during site characterization and needs to know the staff position on what constitutes acceptable mapping procedures.

Uncertainty Title:	Geomorphic Analysis
SECY-88-285 Number:	Potential Technical Position 16
Regulatory Requirements:	10 CFR 60.111 provides for the performance of the geologic repository operations area through permanent closure; 10 CFR 60.112 provides for the overall system performance for the geologic repository after permanent closure; and 10 CFR 60.113 deals with the performance of particular barriers after permanent closure. Other parts of 10 CFR Part 60 that require technical information and evaluation regarding geomorphic analysis of the proposed HLW site are: (1) the siting criteria in 10 CFR 60.122(b)(1), covering favorable conditions and 10 CFR 60.122(b)(5), which covers the conditions that permit the emplacement of waste at a minimum depth of 300 meters from the ground surface; (2) the potentially adverse conditions in 10 CFR 60.122(c)(3), which covers the potential for natural phenomena such as landslides and subsidence; and (3) 10 CFR 60.122(c)(16) which covers concerns evidence of extreme erosion during the Quaternary Period.
Nature of Uncertainty:	This uncertainty arises because no standard methodology exists for extrapolating short-term geologic models related to geomorphic conditions to the 10,000-year period required for the repository.

Significance to Regulatory and Licensing Process:

There is a need for DOE's geomorphic analysis to identify parameters related to geomorphology, physiography, and topography which should provide an adequate consideration of geomorphic processes such as erosion and mass wasting which are part of the geologic setting and could have an impact on the location of repository facilities. Reduction of this uncertainty will provide guidance to DOE on how to conduct the necessary geomorphic analysis over the 10,000-year period.

Uncertainty Title:	Scenario Identification and Screening
SECY-88-285 Number:	Potential Technical Position 17
Regulatory Requirements:	10 CFR 60.112 addresses the overall system performance objectives for the geologic repository after permanent closure.
Nature of Uncertainty:	This is a technical uncertainty because there are no standard methods for identifying scenarios that could potentially disrupt a repository and for screening those scenarios to determine which require additional analysis to demonstrate compliance with the various provisions of 10 CFR Part 60 (principally the overall performance objective of 10 CFR 60.112).

Significance to Regulatory and Licensing Process:

The identification and screening of potentially disruptive scenarios will be a major step in evaluating the acceptability of a repository. DOE can be expected to minimize the number of scenarios to be included in its analyses of facility performance, while other parties will argue that additional scenarios should be included.

Reduction of this uncertainty will provide DOE guidance for determining an acceptable method for identifying and screening scenarios. Once DOE begins to develop and screen the potential scenarios, it may find that additional site characterization is needed. In addition, the scenarios that are selected will contribute to the types of analyses DOE will conduct to demonstrate compliance with the applicable sections of 10 CFR Part 60.

Uncertainty Title:	Verification and Validation of Performance Assessment Models
SECY-88-285 Number:	Potential Technical Position 18
Regulatory Requirements:	Model verification and validation are not mentioned explicitly in the regulations, but can be implied as adding to the finding of "Reasonable Assurance" (e.g., 10 CFR 60.31(a)(2) and 10 CFR 60.101) that the site and design comply with the performance objectives of 10 CFR 60.111, 60.112, and 60.113.
Nature of Uncertainty:	This is a technical uncertainty that is focused principally on what constitutes adequate verification and validation of computer programs used to make findings of compliance with the performance objectives of 10 CFR 60.111, 60.112 and 60.113.

Significance to Regulatory and Licensing Process:

Mathematical models, usually implemented as computer programs, will be used extensively for all phases of site characterization and licensing, both to guide the site characterization efforts and to make determinations of compliance with the performance objectives. Verification and validation are key to demonstrating the validity of the models used to determine that 10 CFR Part 60 performance objectives are met. In addition, model verification is a key part of the documentation and quality assurance of computer codes used in the licensing assessments.

Uncertainty Title: Data and Parameter Uncertainty

SECY-88-285 Number: Potential Technical Position 19

Regulatory Requirements: 10 CFR 60.101 recognizes that while performance criteria are generally stated in unqualified terms, their determinations must be made under great uncertainty. It is recognized that one area of uncertainty covered by 10 CFR 60.101 includes the uncertainty associated with the data collected in the field and the input parameters used in the predictive models of performance.

Nature of Uncertainty: This is a technical uncertainty that is focused on, but is not limited, to the following issues:

- Nature of uncertainty, including scarcity of data, measurement error and bias, spatial variability, statistical error, and errors in interpretation of data because of faulty or overly simplistic models.

- Treatment of uncertainty, including response surface methods, Monte Carlo methods, differential analysis techniques, and geostatistical techniques.

- Experiences with uncertainty in model studies, including model intercomparison studies on field and synthetic data sets

Significance to Regulatory and Licensing Process:

Because uncertainty is unavoidable in the assessment of the safety of the HLW repository, criteria must be developed to guide DOE's development of methods to quantify and handle uncertainty in the licensing process.

Uncertainty Title:	Formal Use of Expert Judgment
SECY-88-285 Number:	Potential Technical Position 20
Regulatory Requirements:	10 CFR 60.101(a)(2) recognizes the role of reasonable assurance in making findings regarding compliance with all of the performance objectives in 10 CFR 60 Subpart E.
Nature of Uncertainty:	This technical uncertainty arises because there are no clear criteria for defining when the formal use of expert judgment can be relied on by DOE as an acceptable part of the assessment of the repository.

Significance to Regulatory and Licensing Process:

It is expected that expert judgment will play an important role in obtaining reasonable assurance that performance objectives are met and that DOE will rely upon expert judgment in the License Application.

ENCLOSURE 3

LIST OF UNCERTAINTY GROUPS IDENTIFIED IN CNWRA 89-003

Uncertainty Group/Uncertainty Number	Title
I (UN 18-64)	Potentially Adverse Conditions
II (UN 16-17)	Favorable Conditions
III (UN 65-75)	Systems, Structures and Components Important to Safety
IV (UN 13-14)	Engineered Barrier System Performance
V (UN 9-10)	ALARA and Radiological Safety Considerations
VI (UN1, UN7, UN11)	Retrievability
VII (UN 3-4)	Conditions for Construction Authorization
+ VIII (UN 76-78)	Regulation of Mining Safety and Other Non-radiological Safety Considerations
+ IX (UN5, UN6, UN8)	License Amendments
+* UN2	Environmental Report
* UN12	Anticipated/Unanticipated Processes and Events
+* UN15	Land Ownership and Control
* UN44	Earthquakes "Typical of the Area"

* Individual uncertainties which could not be grouped

\+ These uncertainties are institutional uncertainties while the others are regulatory uncertainties

ENCLOSURE 4

Enclosure 4

DESCRIPTIONS OF UNCERTAINTIES IDENTIFIED IN CNWRA 89-003

The 78 uncertainties identified in CNWRA 89-003 were assembled into 13 groups which deal with similar topics and are generally drawn from the same section or subsection of 10 CFR 60. The regulatory requirements and the CNWRA's view of the nature of the uncertainty group are given below:

GROUP I: Potentially Adverse Conditions

Two uncertainties apply to the entire group of 24 potentially adverse conditions in 10 CFR 60.122(c); these uncertainties are identified as UN18 through UN64, except for UN44. The first example of uncertain language in 10 CFR 60.122(a), which has been identified as a separate uncertainty for each of the 24 potentially adverse conditions, is:

> 10 CFR 60.122(a)(iii)(A) The potentially adverse...condition...is shown <u>not to affect significantly the ability of the repository to meet the performance objectives relating to isolation of the waste</u>.

The underlined 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 causes 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 alarm level in an 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?

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:

> 10 CFR 60.122(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 seven or eight significant figures, for another, a handbook value to three significant figures might suffice.

GROUP II: Favorable Conditions

UN16 and UN17 in 10 CFR 60.122(b) both deal with projections into the future of groundwater travel time and consequent release of radioactive materials to the accessible environment, and thus with possible scenarios for such releases. UN16 lies in the language:

> 10 CFR 60.122(b)(1) The nature and rates of...process 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 is 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 project period but could have catastrophic consequences.

UN 17 is in:

> 10 CFR 60.122(b)(7) Pre-waste-emplacement groundwater travel time along the fastest path to the accessible environment that substantially exceeds 1000 years.

This statement contradicts 10 CFR Part 60.113(a)(2), in which the time of travel is to be at least 1000 years. 1001 years would qualify under the latter regulations but probably not be considered to "substantially exceed" 1000 years.

GROUP III: Systems, Structures and Components Important to Safety

UN65 through UN75 in 10 CFR Part 60.131(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 10 CFR Part 72. 10 CFR Part 60.131(b)(4) reads "the geologic repository operations area shall be designed to include onsite and available offsite emergency facilities and services..." while 10 CFR Part 72.72(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, 10 CFR Part 60 is less stringent and less precise than 10 CFR 72, resulting in identification of an uncertainty in 10 CFR Part 60.

In some cases, there are inconsistencies between sections of 10 CFR 60.131. For example, 10 CFR 60.131(b)(3)(iv) reads "the geologic repository operations area include explosion and fire...suppression systems" while 10 CFR Part 60.131(b)(e)(iii) gives criteria only for design of fire suppression systems.

GROUP IV: Engineered Barrier System Performance

UN13 in 10 CFR 60.113(a) deals with potential release of radionuclides from the engineered barrier system, and is related to the concept of substantially complete containment. In effect, the term "substantially complete" in 10 CFR Part 60.113(a)(1)(i)(A) needs definition so that there will be a specification for container design and so that NRC will have criteria by which to determine acceptable design.

UN14 in 10 CFR 60.113(a)(1)(i)(B) speaks of gradual release, and 10 CFR Part 60.113(a)(ii)(B) specifies maximum release rates. This is somewhat inconsistent with 10 CFR 60.135(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 10 CFR Part 60.135(c)(1) could be construed as requiring processing of spent fuel rods to remove gaseous fission products.

GROUP V: ALARA and Radiological Safety Considerations

UN9 and UN10 in 10 CFR Part 60.111(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 10 CFR Part 60.111(a) does not have a reference to ALARA, while the analogous section of 10 CFR Part 72 - 10 CFR Part 72.67(b) - has such a reference. (This uncertainty could have been included in Group III with the others that deal with inconsistencies between 10 CFR Part 60 and 10 CFR Part 72. The concern with radiation safety was the overriding criterion for the chosen grouping.)

UN10 in 10 CFR Part 60.111(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.

GROUP VI: Retrievability

UN1, UN7 and UN11 are included in this group. UN11 in 10 CFR Part 60.111(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 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 40 CFR Part 191.14(f), both of which imply the passive design criterion "not to preclude retrieval."

UN7 in 10 CFR Part 60.46, 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 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 10 CFR Part 60.15 and 10 CFR 60.17(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.

GROUP VII: Conditions for Construction Authorization

UN3 and UN4 occur in the same phrase in 10 CFR Part 60.32: "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 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 10 CFR Part 60.131(b)(9) and UN78 in 10 CFR 60.133(e) deal with jurisdiction over non-radiological safety and are considered institutional uncertainties. UN76 is the uncertainty in 10 CFR Part 60.131(b)(9) where Subchapter N is referred to and thus 30 CFR Part 56, "Surface Mining Regulations," is invoked. 30 CFR Part 57, "Deep Surface Mining Regulations,: is more inclusive than 30 CFR Part 56, and may have been what was intended.

UN77 is in 10 CFR Part 131(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 10 CFR Part 133(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.

GROUP IX: License Amendment

UN5, UN6 and UN8 in 10 CFR Part 60.51 and 10 CFR Part 60.52 are examples of confusing regulatory wording dealing with potential license amendments. UN5 and UN6 are in 10 CFR Part 60.51(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," virtually impossible to implement.

UN8 is derived from the language of 10 CFR Part 60.52(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; and (3) DOE will have title at closure and therefore will either retain title or transfer title and possession. Could the license ever be terminated under these regulations?

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

UN2: Environmental Report

UN2 stems from the language in 10 CFR Part 60.21(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.

UN12: Anticipated/Unanticipated Processes and Events

The uncertainty is in the language of 10 CFR Part 60.112 "...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. 10 CFR Part 60.2 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.

UN15: Land Ownership and Control

10 CFR 60.121(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 is not clear.

UN44: Earthquakes "Typical of the Area"

The uncertainty is in the description of the potentially adverse condition of 10 CFR Part 60.122(c)(14) "more frequent occurrence of earthquakes or earthquakes of high 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.

ENCLOSURE 5

RELATIONSHIP* OF UNCERTAINTIES IDENTIFIED IN CNWRA 89-003 TO POTENTIAL RULEMAKINGS AND TECHNICAL POSITIONS IDENTIFIED IN SECY-88-285

Uncertainties Identified in CNWRA 89-003		Related* Potential Rulemakings or Technical Positions Identified in SECY-88-285
Number	Title	
I	Potentially Adverse Conditions	None
II-UN16	Favorable Conditions/Projection of Processes	Scenario Identification and Screening Technical Position
II-UN17	Favorable Conditions/Groundwater Travel Time	Pre-waste Emplacement Groundwater Travel Time Rulemaking
III	Systems, Structures and Components Important to Safety	Repository Design Technical Position
IV	Engineered Barrier System Performance	Substantially Complete Containment Rulemaking
V-UN9	ALARA	Repository Design Technical Position
V-UN10	Radiological Safety Considerations	Design Basis Accident Dose Limit Rulemaking
VI	Retrievability	Waste Retrievability Technical Position
VII	Conditions for Construction Authorization	Content of the License Application Rulemaking
VIII	Regulation of Mining Safety and Other Non-radiological Safety Considerations	None
IX	Licensing Amendments	None
UN2	Environmental Report	Adopting DOE's Environmental Impact Statement Rulemaking
UN12	Anticipated/Unanticipated Processes and Events	Anticipated/Unanticipated Processes Processes and Events Rulemaking
UN15	Land Ownership and Control	None
UN44	Earthquakes "Typical of the Area"	Pre-closure Earthquake Hazard Evaluation Methods and Probabilistic Seismic Hazard Analyses Technical Positions

* This relationship is from CNWRA 89-003 and means that the uncertainties are closely related and could be addressed within the scope of the potential rulemaking or Technical Position.