

CHANGE NOTICE

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Approved by: N/A  
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Training Required:  
Yes  No

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Currently Read as Follows:

1. Section 1.0, Second sentence: "These items . . . . highest quality assurance level (QA level I) of this . . . ."
2. Section 2.0, Last sentence: As published
3. Section 2.1, First sentence: As published
4. Section 2.1, Last sentence: As published
5. Section 2.2, Second sentence: As published
6. Section 3.2, Last sentence: As published
7. Section 4.0, Paragraph before last, Second sentence: As published
8. Section 4.0, Paragraph before last, Last sentence: As published

NOTE: THIS CHANGE NOTICE IS TO BE FILED AT THE FRONT OF THE AFFECTED DOCUMENT

**CHANGED TO READ:**

1. **Section 1.0, Second sentence:** "These items . . . . quality assurance controls of this . . . ."
2. **Section 2.0, Last sentence:** Delete "QA Level I"
3. **Section 2.1, First sentence:** Delete "Level I"
4. **Section 2.1, Last sentence:** Delete "Level I"
5. **Section 2.2, Second sentence:** "These items are also subject to the appropriate QA controls of this QAPP."
6. **Section 3.2, Last sentence:** "Other activities which are subject to QA controls, such as designing, inspecting, and purchasing, will not be identified in PRAs."
7. **Section 4.0, Paragraph before last, Second sentence:** Delete "Level I"
8. **Section 4.0, Paragraph before last, Last sentence:** Delete "Level I"

NUCLEAR WASTE MANAGEMENT PROGRAM

CONTROLLED COPY NO. 0089

Subject: APPENDIX I - REQUIREMENTS FOR THE IDENTIFICATION OF ITEMS  
AND ACTIVITIES SUBJECT TO QUALITY ASSURANCE  
REQUIREMENTS

Approved: FEB 20 1989

Approved by: [Signature] Date: 12/21/88 Approved by: [Signature] Date: \_\_\_\_\_  
Yucca Mountain Project Leader Quality Assurance Manager

### 1.0 GENERAL

This Appendix provides requirements for the identification of items important to safety and the identification of items and activities important to waste isolation. These items and activities are subject to the highest quality assurance level (QA Level I) of this QAPP and are listed on a "Q-List".

### 2.0 QUALITY ASSURANCE CRITERIA FOR LICENSING

The purpose of the geologic repository program is to permanently dispose of high-level nuclear waste. In order to obtain a license for receipt and possession of radioactive material at the geologic repository, it must be demonstrated that the repository system will function as required to protect health and safety of the public and the environment. Requirements for licensing a repository to meet this goal are specified in 10 CFR Part 60. These requirements describe the performance objectives and other technical criteria to assure safe operation during waste emplacement and retrieval (if necessary), as well as effective containment and long-term isolation of waste following permanent closure of the geologic repository. The QA Level I requirements of this QAPP specify the QA Program for these items and related activities important to safety and/or waste isolation to assure that their characterization, design, construction, and operation comply with the requirements of 10 CFR Part 60.

#### 2.1 QUALITY ASSURANCE CRITERIA FOR THE Q-LIST AND QUALITY ACTIVITIES LIST

The QA Level I requirements of this QAPP apply to items and activities important to safety and/or waste isolation. As derived from 10 CFR Part 60 (60.152), this QA program is based on the 18 criteria of 10 CFR Part 50 Appendix B. These criteria address, in general terms, the basic elements of a QA program, such as organization, design control, test control, inspection, and records management. As noted in 10 CFR 60.152, these criteria are supplemented as necessary to meet the specific requirements of the repository program. In addition to the QA Level I requirements of this QAPP items important to safety and the waste package are subject to the design criteria of 10 CFR 60.131(b) and 60.135 respectively.

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## 2.2 CRITERIA FOR NON-Q-LIST ITEMS

Certain items that are not important to safety and/or waste isolation are also addressed in the license application to demonstrate compliance with 10 CFR Part 60 requirements. While these items are not subject to the QA Level I requirements of this QAPP, QA Level II requirements are applied. Additional guidance related to this subject can be found in NUREG-1318, (April, 1988), Paragraph 5.1(b)

## 2.3 DATA NOT COLLECTED UNDER A 10 CFR 60 SUBPART G QA PROGRAM

All data collection, interpretations, analyses, and other work to be used to support findings important to safety and/or waste isolation in the licensing process are technically and procedurally defensible. "Existing data" are qualified in accordance with the requirements of Appendix G of this QAPP. In addition to existing data, some materials that may be important to safety and/or waste isolation may already have been purchased prior to implementation of a 10CFR 60 Subpart G QA Program. Supporting documentation of these materials (e.g. the technical specifications and QA records) are reviewed to determine whether they meet the technical and QA requirements for their designated function. If not, they are "qualified" for use to assure they will perform their intended function.

## 3.0 IDENTIFICATION OF ITEMS IMPORTANT TO SAFETY

Items important to safety are those items 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 unrestricted area at any time until the completion of permanent closure (10 CFR 60.2). The 0.5 rem value is, therefore, the threshold for determining what structures, systems and components are on the Q-list as items important to safety. The rationale for placing a system, structure, or component on the Q-list is to provide added assurance, via application of rigorous QA/QC and design requirements, that they should perform their designate function.

3.1 Probabilistic Risk Analysis (PRA) is used to the extent practicable, to support the identification of structures, systems, and components important to safety in the license application. Use of this approach for the operations phase of the HLW program is consistent with the approach prescribed by the EPA standard (40 CFR Part 191) for the overall system containment following emplacement of waste in a geologic repository. In cases where data are limited, engineering judgment and conservative bounding assumptions are used. Conservative assumptions include non-mechanistic failures where information and/or experience are not adequate to reliably determine failure modes and accident scenarios. However, non-mechanistic failures need not be considered where failure modes and mechanisms are understood and failure rates can be determined.

3.2 Operator actions or errors which could initiate accidents are identified in PRAs or other analysis. These are controlled to minimize the probability of occurrence. Other activities which are subject to QA Level I requirements, such as designing, inspecting, and purchasing will not be identified in PRAs but are controlled in accordance with QA Level I requirements.

3.3 PRAs utilize the following techniques:

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3.3.1 System modeling to depict the combination of safety function and system successes or failures which constitute accident scenarios. Two modeling techniques which may be used are event tree analysis, which identifies the sequence of events that may result in an accident, and fault tree analysis, which determines how failures in safety systems may occur. Both techniques are analytical tools which organize and characterize potential accidents in a methodical manner.

An event-tree defines a comprehensive set of accident sequences that encompasses the effects of all realistic and physically possible potential accidents. By definition, an initiating event is the beginning point in the sequence. Hence, a comprehensive list of accident-initiating events is compiled to assure that the event trees properly depict all important sequences.

A fault tree examines the various ways in which a system designed to perform a safety function can fail. Each safety system identified in the event tree as involved in an accident is examined to determine how failures of components within that system could cause the failure of the entire system.

If failure of a mitigating system could contribute to an off-site dose, individual components within the mitigating system are reviewed, using fault tree analysis, to determine the effect of their failure on performance of the overall system. For example, individual components in the ventilation system which may need to be analyzed include dampers, motors, and filters.

3.3.2 Consequence analysis of accident scenarios identified in event/fault tree analyses to determine the amount and kind of radionuclides which may reach the unrestricted area and contribute to an off-site dose. Consequence analysis includes identification of a source term for radioactive releases and evaluation of mechanisms for movement and deposition of radioactive materials released from the HLW facility. The energy, magnitude, and timing of radiological releases resulting from various accidents are considered in this analysis.

3.3.3 Analysis to assess the effect of uncertainties in the data base and uncertainties arising from modeling assumptions on the PRA findings. The insights gained in the analysis about features that are significant contributors to risk can provide qualitative understanding into system performance.

Additional guidance related to the assessment of pre-closure accidents can be found in NUREG 1318, (April, 1988), paragraph 5.2(a).

#### 3.4 REDUNDANCY

The use of redundant structures, systems, and components is a method of providing additional assurance that necessary safety functions will be performed if an accident occurs and that the accident dose limit will not be exceeded. In a redundant system, the failure of one train of the system does not comprise or prevent the associated safety function from being performed. For the high-level waste repository, 10 CFR 60 [60.131(b) (5) (ii)] addresses requirements for redundancy. The items needed to provide redundancy of items important to safety are also on the Q-list.

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### 3.5 USE OF PREVIOUSLY ESTABLISHED GUIDELINES AND STANDARDS

Many guidelines and standards have been developed in the nuclear power reactor program and other nuclear programs which may be applicable for the geologic repository program.

For example, there are regulatory guides covering design basis earthquakes, floods, and tornado wind velocities which may be used in the design of the HLW facility and developing the Q-list. While some of these guidelines and standards may not be directly applicable to a geologic repository, they are considered to the extent practicable, to eliminate the need to develop new approaches.

### 3.6 RETRIEVAL

The option for retrieval of waste is addressed as a performance objective in 10 CFR 60.111(b). If retrieval is found to be necessary, analyses of retrieval operations are conducted at that time, to identify Q-list items.

### 4.0 IDENTIFICATION OF ITEMS AND ACTIVITIES IMPORTANT TO WASTE ISOLATION

The term "important to waste isolation" refers to engineered natural barriers that will be relied on to meet the containment and isolation performance objectives of 10 CFR 60 Subpart E. Four of the performance objectives for waste isolation after permanent closure are stated in 10 CFR 60.112 and 60.113 and include:

- o ground water travel time
- o waste package containment period
- o maximum yearly release rate from the engineered barrier system
- o the overall system performance objective in 10 CFR 60.112 for release of radioactive materials to the accessible environment (the EPA standard in 40 CFR Part 191).

The items and activities important to waste isolation include:

- o Components of the engineered barrier system relied on to meet the performance objectives.
- o Elements of the natural barrier system (e.g., host rock, and geochemical retardation characteristics) relied on to meet the performance objectives.
- o Activities necessary to demonstrate that the performance objectives will be met, including collection of data to characterize the site or performance of engineered barriers.
- o Activities in the preclosure phase that could effect post-closure performance.

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The broad performance objectives for waste isolation provide some flexibility in allocating credit among the various components of the natural and engineered barrier systems to meet each objective. For example, a 300 to 1000 year lifetime for the waste package might be achieved by a combination of performance from each of the components in the waste package or by a single component, such as the canister. The allocation of performance among the various components of the natural and engineered barrier system for each performance objective will provide the basis for determining which barriers are important to waste isolation. Performance assessments are conducted on these barriers to ascertain that those relied on will meet the waste isolation and containment performance objectives of 10 CFR Part 60.

The initial allocation of performance will provide a basis for determining what site characterization testing will be needed. The initial allocations of performance among the barriers is likely to change based on the results of performance assessments using data collected during site characterization.

It is expected that most of the data collected during the site characterization phase can potentially be used in the license application performance assessments. During the early phase of characterization in particular, when little is known about the site and the importance of data characterizing it, data collection activities are controlled in accordance with the QA Level I requirements of this QAPP. However, there may be cases where it is known that data are not needed for performance requirements of this QAPP and therefore would not have to be performed in scoping tests or tests to examine the feasibility and appropriateness of a data collection technique may not need to be performed in accordance with the QA Level I requirements of this QAPP.

Note: Additional guidance related to this subject can be found in NUREG-1318, "TECHNICAL POSITION ON ITEMS AND ACTIVITIES IN THE HIGH-LEVEL WASTE GEOLOGIC REPOSITORY PROGRAM SUBJECT TO QUALITY ASSURANCE REQUIREMENTS" (April, 1988).