NRC LICENSING REQUIREMENTS FOR HIGH LEVEL RADIOACTIVE WASTE PACKAGES

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ABSTRACT

This paper addresses current and proposed NRC requirements for high level waste (HLW) packages as those requirements are presented in various documents released to the general public or under development. The documents in question include (a) those sections of Part 60 of Title 10 of the Code of Federal Regulations (10 CFR 60) that are most directly related to high level waste package concerns, and (b) formal technical positions and recent NRC memoranda that have the purpose of providing specificity regarding HLW package licensing requirements that are addressed in only general terms in 10 CFR 60. Clarification is provided for the "substantially complete containment" performance objectives for HLW packages and the "one part in 100,000" radionuclide release rate requirement. NRC Waste Management Engineering Branch Technical Positions address the following waste package areas of concern: (1) waste package technical issues for basalt, tuff and salt repositories and (2) waste package reliability. The Draft Technical Position (DTP) on Waste Package Reliability describes an assessment method that would be acceptable to NRC staff for demonstrating reasonable assurance that the waste package will meet 10 CFR 60 performance objectives.

INTRODUCTION

Licensing requirements for high level (radioactive) waste (HLW) packages for geologic repositories are contained in Part 60 to Title 10 of the Code of Federal Regulations (10 CFR 60)[1]. That regulation prescribes the procedures to be followed by the Department of Energy (DOE) and the Nuclear Regulatory Commission in the process of licensing a geologic repository for HLW disposal. This paper will address NRC Licensing Requirements for High Level Radioactive Waste Packages as those requirements are presented in Part 60 and in various ancillary documents that are intended to provide clarification or elaboration of Part 60. The supplementary documents in question include (a) formal staff technical positions that have the purpose of providing specificity on waste package matters that are addressed in only general terms in Part 60 and (b) recent NRC memoranda and correspondence that attempt to clarify portions of Part 60.

10 CFR 60

Purpose and Scope (Part 60.1)

Part 60 - Disposal of High-Level Radioactive Wastes in Geologic Repositories, prescribes rules governing the licensing of the U.S. Department of Energy to receive and possess source, special nuclear, and byproduct material (i.e., high-level radioactive waste) at a geologic repository operations area. There are eight subparts (A-H) to Part 60. In the discussion to follow, the focus will be on portions of Subpart A - General Provisions, Subpart B - Licenses, Subpart E - Technical Criteria, and Subpart F - Performance Confirmation Program.

Definitions (Part 60.2)

High-level radioactive waste packages are part of the engineered barrier system portion of the geologic repository. As defined in 10 CFR 60.2, "waste package" means the waste form and any containers, shielding, packaging and other absorbent materials immediately surrounding an individual waste container. The fact that the package is considered to end at the outer boundary of the packing material, not at the surface of the waste package overpack or canister, has important implications with respect to the requirements for radionuclide containment. For example, if the packaging around the container can be shown to significantly retard the migration of radionuclides away from a breached container, this could be given credit in demonstrating that the 300 to 1000-year "substantially complete containment" criterion (in Part 60.113) will be met. "Waste form" is defined to mean the radioactive waste materials and any encapsulating or stabilizing matrix. Thus, spent fuel pellets, fuel rod cladding, and any glass or crystalline ceramic used to encapsulate the waste products from reprocessing is considered to be part of the waste form.

Site Characterization Report (Part 60.10 and 60.11)

The steps involved in the process of licensing a geologic repository for high-level radioactive waste (HLW) have been presented and discussed in various documents and will not be covered further here except to touch upon a few reporting requirements having to do specifically with aspects of the waste package. There are two such requirements identified in Part 60.11, which addresses the contents of Site Characterization Reports (SCRs): a description of the quality assurance program to be applied to data collection, and a description of the research and development activities being conducted by DOE that deal with the waste form and packaging as such activities may be considered appropriate for the site to be characterized, including research planned or underway to evaluate the performance of such waste forms and packaging.

As addressed in Part 60.11, site characterization reports (or site characterization "plans" (SCPs), as they are called in the Nuclear Waste Policy Act (NWPA)), are intended to be submitted prior to site characterization. During site characterization, DOE is required to issue semi-annual and other reports on the waste form and packaging research and development. At any time NRC may comment in writing to DOE, expressing current views on any aspect of site characterization, including quality assurance and waste package/waste form research and development. Minor changes in the wording of this subsection of the regulation, to make it conform more closely to the provisions of the NWPA, are being proposed [2] as part of a potential rulemaking action.

License Applications, Issuance and Amendment (Part 60.21)

Part 60.21 deals with the required contents of license applications. A major portion of the application consists of the Safety Analysis Report (SAR). The SAR must address (1) the effectiveness of engineered barriers, (2) a description and analysis of the design and performance requirements for structures, systems, and components of the geologic repository which are important to safety, and (3) a description of the quality assurance program to be applied to engineered barriers important to waste isolation.

In processing DOE's license application, the NRC staff will, in part, review DOE's description of the waste package design and DOE's assessment of the performance of the design with respect to Subpart E of 10 CFR 60. In so doing, the staff will evaluate the data and analyses presented in the SAR. In certain critical areas, such as the determination of radionuclide solubility, the Staff may perform confirmatory tests. A major portion of the staff's review will involve the assessment of DOE's treatment of uncertainties. This will be covered in more detail in Section III (Reliability STP) of this paper.

Construction Authorization Considerations (Part 60.31)

This portion of 10 CFR 60 provides a list of items that the NRC must consider, upon review of an application and environmental review, in determining whether construction of a repository should be authorized. The three principal areas addressed in this section are: (a) safety, (b) common defense and security, and (c) environmental. It is under the first of these headings, "safety," that the kinds and quantities of radioactive waste to be received, possessed, stored, and disposed of in the geologic repository area are addressed. Waste package design falls under subcategory (v) "Features of components incorporated in the design for the protection of the public." The principal performance objectives and design criteria for the waste package are contained in Subpart E - Technical Criteria of Part 60.

License Specifications (Part 60.43)

A license, once issued, may contain certain conditions derived from the analyses and evaluations included in the application (Part 60.43). The license conditions shall include items in the following categories:

(1) Restrictions on the physical and chemical form and radioisotopic content of radioactive waste;

(2) Restrictions on the size, shape, and materials and methods of construction of radioactive waste packaging;

(3) Restrictions on the amount of waste permitted per unit volume of storage space considering the physical characteristics of both the *waste and host* rock.

Preclosure Concerns (Part 60.111)

Performance of the waste package prior to permanent closure of the repository is addressed in 10 CFR 60.111. In this section, protection against radiation exposures and releases of radioactive material is a principal concern, as is retrievability. As noted in Paragraph (a) of Part 60.111, radiation exposures and radiation levels, as well as releases of radioactive material to unrestricted areas must at all times be maintained within the limits of 10 CFR 20[3] and such environmental standards as may have been established by the Environmental Protection Agency. This means that the waste packages should be designed and fabricated such as to be compatible with the Part 20 permissible dose limits for individuals in the repository operations area and unrestricted areas and with the "as low as reasonably achievable" radiation exposure goal.

As noted in Paragraph (b) of Part 60.111, the emplaced waste should be retrievable for 50 years after emplacement operations are initiated, with the caveat that the Commission has the option to specify or approve a different time period, if necessary, on a case-by-case basis. Thus, DOE should demonstrate that the waste package container and packing will not compromise retrievability (i.e., the waste packages should be designed to maintain waste containment during transportation, emplacement, and retrieval). Labels provided on the package container for identification purposes should accommodate retrievability and should not impair the integrity of the waste package.

Post-closure Concerns (Part 60.113)

In Paragraph 60.113 of Subpart E - Technical Criteria, the performance objectives for waste packages (and the engineered barrier system in general) are presented. There are two basic requirements presented in this section. The first requirement has to do with "substantially complete containment" of HLW within the waste packages. The second performance objective has to do with the "one part in 100,000 per year" total release rate. Both of these requirements are explained below:

1. Substantially Complete Containment for 300-1000 Years

Paragraph 60.113(a)(1)(ii)(A) states the following:

Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission... provided that such period shall not be less than 300 years nor more than 1,000 years after permanent closure of the geologic repository.

The operative key words in the cited paragraph are "substantially complete." At this time the NRC has not provided a quantitative definition of substantially complete containment. NRC staff would, however, look favorably on either of the following two approaches if DOE chose to pursue them:

(a) Use very conservative designs. The more conservative the design, the easier is the task of providing reasonable assurance that containment will be achieved;

(b) Demonstrate that during the 300-1000 year containment period the radionuclide release rate from the waste packages (on a radionuclide-specific basis) will not exceed the total number of curies allowed to be released per year in the post-containment period from the engineered barrier system.

The NRC staff believes that, by allowing these two approaches, the DOE is permitted ample flexibility in the design of the waste package. Especially by virtue of NRC's avoidance of a rigid, completely quantitative definition of "substantially complete" containment, DOE is free to use a systems approach to performance assessment. DOE can thus assign to each waste package component the design objectives needed to meet the performance objectives for the waste package. For example, with regard to the retardation of groundwater penetration of the waste package and release and concomitant migration of radionuclides outward through the various waste package components, DOE has the option of assigning (assuming the availability of adequate supporting data) time periods for the delay of flow through the packing, penetration of the container, leaching of the waste form, and so on. Thus, the 300 to 1000 year containment requirement may be satisfied through a series of sequential time steps associated with a specific package component function. Alternatively, a reliability analysis could be used to demonstrate reasonable assurance by producing a probability distribution for the time of containment (and rate of release of radionuclides thereafter). This is discussed in more detail in Section III.B of this paper.

2. One Part in 100,000 Release Criterion

Paragraph 60.113(a)(1)(ii)(B) states the following:

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.

The above cited criterion allows radionuclides which have very low inventories to be exempt from the one part in 100,000 annual release rate limit. The following discussion provides an example of how to determine whether or not a given nuclide is exempt. The calculation that follows is made for I-129, which has a low curie inventory at 1,000 years relative to the total inventory in the repository.

The total radioactive inventory at 1,000 years is computed from the data in Ref. 4 and is 17.6×10^5 μCi/kg U. This value is based upon a 33 MWd/kg U burnup. The total allowable release rate would be 17.6×10^5 μCi/kg U/yr x (1×10^{-5}) = 17.6 μCi/kg U/yr.

The I-129 inventory at 1,000 years is given as 32 μCi/kg U, so a primary release rate limit is 32×10^{-5} μCi/kg U/yr. For I-129 to be exempted from the one part in 100,000 annual release rate criterion, I-129 must have a release rate of less than 0.1 percent of the total release rate, or (17.6 μCi/kg U/yr) (10^{-3}) = 0.0176 μCi I-129/kg U/yr. However, if it is assumed that all the I-129 is released in one year, it will be released at a rate of 32 μCi/kg U/yr. Because this maximum annual rate of release exceeds 0.0176 μCi/kg U/yr, the I-129 can not be summarily dismissed. Nevertheless, if release rate information for I-129 can be obtained showing that the maximum annual release rate will not exceed 0.0176 μCi/kg U/yr, I-129 could then be dismissed from further consideration. For this second option to occur, an annual release rate fraction of less than (0.0176 μCi/kg U)/(32 μCi/kg U) = 5.5×10^{-4} would have to be demonstrated. This value would, however, be less restrictive than the one in 100,000 release value that would otherwise be required. This clarification of Paragraph 60.113(a)(1)(ii)(B) was transmitted[4] to DOE in September 1984.

Criteria for the Waste Package and Its Components (Part 60.135)

Part 60.135 contains the main body of design criteria for the waste package. The first portions of this section (Paragraphs 60.135(a)(1) and 60.135(a)(2) provide general guidance concerning the need for the waste package to have chemical, physical and nuclear properties that do not compromise the function of the waste package. A list of required design considerations is also provided and includes the following: 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.

Paragraph (b) of Part 60.135 contains the specific criteria for HLW package design. There are four basic categories of design criteria for the waste package: (1) Explosive, pyrophoric, and chemically reactive materials; (2) Free liquids; (3) Handling, and (4) Unique identification. The specified criteria are based upon engineering considerations that will contribute toward meeting the performance objectives for containment and controlled release.

Paragraph (c) of Part 60.135 deals with waste form criteria. There are three:

(1) Solidification. "All radioactive wastes (emplaced in the underground facility) shall be in solid form and placed in sealed containers."

(2) Consolidation. "Particulate waste shall be consolidated (for example, by incorporation into an encapsulated matrix) to limit the availability and generation of particulates."

(3) Combustibles. "All combustible radioactive wastes shall be reduced to a noncumbustible form..."

As in the case for the waste package criteria, the design criteria for the waste form are intended to contribute toward meeting the performance objectives for the waste package and EBS.

Monitoring and Testing Waste Packages (Part 60.143)

Subpart F - Performance Confirmation Program, addresses both geotechnical and waste package performance confirmation requirements. For the waste package it is intended that the monitoring program would continue up to the time of permanent closure of the repository. The waste package monitoring program is also intended to include laboratory experiments that focus on the internal condition of the packages. The laboratory experiments must, to the extent practical, duplicate the environmental conditions experienced by the waste packages within the underground facility.

TECHNICAL POSITIONS

Purpose and Scope

In communicating with licensees, applicants, members of the public, other governmental agencies, etc., the NRC generates and issues various types of documents, including so-called "Technical Positions" (TPs). The TPs are used to (a) present methods acceptable to the NRC staff of implementing specific parts of NRC regulations, (b) delineate techniques used by the staff in evaluating specific technical problems, and (c) provide guidance to appliants and licensees. Technical Positions are not substitutes for regulations, and compliance with them is not required if methods and solutions different from those set out in the guides provide an acceptable basis for the findings required for the issuance or continuation of a permit or license by the Commission. Two types of technical positions that have been recently drafted and released for comment are discussed next.

Issue-Oriented Site Technical Positions

1. What and Why

As one part of the geologic repository prelicensing consultation and guidance program now underway between the NRC and DOE staff's, the NRC has developed so-called "Issue-Oriented Site Technical Positions" (ISTPs)[5] The General purpose of the ISTPs is to identify and present the technical issues (and their rationales) that the NRC staff currently believes are important to licensing. These issues are, therefore, those that the staff is addressing as part of the technical review process. The issues are being developed and presented at this early stage of the prelicensing consultation and guidance process for several reasons:

(a) The issues (which are currently in draft form and which have been released for comment) will serve as a set of benchmarks against which the NRC staff can independently review the relevance and completeness of treatment of issues identified by the Department of Energy in its Site Characterization Plans (SCPs);

(b) The issues provide a systematic structure for staff guidance to DOE and for tracking the progress toward addressing staff concerns about licensing issues throughout the site characterization process. They are intended to be used in the establishment of a tracking system which will tie together all of the various documents that are pertinent to a given issue and which will provide a means of keeping current on the progress being made on issue resolution;

(c) The issues will provide a systematic and logical framework for the NRC staff to organize the ultimate task of assessing geologic repository performance and compliance with the criteria of 10 CFR 60.

2. Organization of Content

There are five ISTPs: One is for a basalt site, one is for a tuff site, and three are for salt sites in the Permian Basin, Paradox Basin (both of which are salt beds), and Gulf Coast domes, respectively. Each ISTP contains a list of site issues for geology/geophysics, hydrology, geochemistry, and waste package. These site issues are based on the current understanding of the characteristics of the sites, and as additional information becomes available during site characterization, the site issues will be added to or revised periodically as appropriate. In each ISTP rationale are provided for each of the identified technical issues. The rationale explain the significance of the site issue to geologic repository (or waste package) performance.

3. Definitions

In developing the issues the following definitions are used:

(a) Licensing issues are technical questions that the NRC staff will address to (1) complete the licensing assessment of site suitability and/or design suitability in terms of 10 CFR 60, Subpart E, and (2) adopt the Environmental Impact Statement (EIS) prepared by DOE. These licensing issues include "performance issues" and "site issues."

(b) Performance issues are broad questions common to all sites concerning both the operational and long-term performance of the various components of the overall repository system. These issues are derived directly from the performance objectives of 10 CFR 60, Subpart E.

(c) Site issues include site specific technical questions about those significant conditions and processes that are believed to be needed to address the performance issues.

4. Site Issues

The development of site issues involves judgment concerning the conditions and processes thought to be significant to the performance issues based upon current understanding of the site characteristics. Every possible condition and process is not listed, therefore, but only those currently considered by the staff to be potentially significant. The NRC staff's judgment is based upon an understanding of the technical concerns developed from staff and contractor reviews of site data and documents, site visits, NRC/DOE technical meetings, and research conducted by NRC, DOE, and other organizations. Engineering judgment is also a factor in developing the hierarchy into lower tiers of sub-issues.

Listed below are the nine 1st-tier issues for waste package design and performance prediction for salt repositories. These nine draft waste package site-specific issues will be the most likely ones to be followed by the "issue-tracking" system mentioned earlier, if the issue-tracking system is implemented. The nine 1st-tier issues may be divided into two main groups:

(a) The first group is comprised of site issues 1 through 4. These site-specific issues are solely concerned with the post-emplacement behavior and performance of the individual waste package components (packing, container, and waste form) and the performance of the waste packages as a whole. They are mass-transport related in the sense that they are concerned with either the migration of brine inward sequentially through the waste package components or with the release and migration of radionuclides outward from the waste form, through the container and packing, and into the near field. This group of four post-emplacement issues involves technical questions that are quite complex, as evidenced by the fact that there are as many as three sub-tier levels of issues assoicated with each first-tier issue.

(b) The second group of 1st-tier issues addresses areas that are identified clearly in 10 CFR 60, and which therefore require comparatively little additional elaboration. For example, site-specific issue 7 (regarding the exclusion of explosive, pyrophoric and chemically reactive materials) is explicitly addressed in 10 CFR 60.135 (b)(1), "Specific Criteria for HLW package design-(1), Explosive, pyrophoric and chemically reactive materials."

WASTE PACKAGE 1st TIER ISSUES FOR SALT REPOSITORIES

1. When, how, and at what rate will brine penetrate the packing around the waste package and contact the container?

2. When, how, and at what rate will brine penetrate the waste package container?

3. When, how, and at what rate will radionuclides be released from the waste form?

4. How and at what rates will radionuclides migrate through failed waste packages?

5. How does the waste package design address releases of radioactive materials to unrestricted areas within the limits specified in 10 CFR 60?

6. How does the design of the waste package accommodate the requirement that the waste should be retrievable at any time up to 50 years after emplacement?

7. How will the waste package design preclude explosive, pyrophoric, and chemically reactive materials?

8. What are the conditions that might affect criticality in the vicinity of the waste package?

9. How will the design of the waste package accommodate the monitoring of the package without adversely affecting waste package integrity?

The draft ISTPs were listed in the Federal Register in early November 1984 with a Notice of Availability which provided for a 60-day public comment period.

Draft Technical Position (DTP) on Waste Package Reliability

1. What and Why

As noted in the discussion of 10 CFR 60.113, the engineered barrier system must be designed so that, assuming anticipated processes and events, the waste containment and isolation requirements are met.

The rule [10 CFR 60.101(a)(2)] does not require a specified quantitative level of confidence or reliability to support a finding that the standard of performance has been met. Reasonable assurance is the standard; however, the Staff expects that the information considered in a licensing proceeding will include probability distribution functions for the consequences of anticipated and unanticipated events which may affect the ability of the repository to meet the performance objectives (Statement of Considerations for 10 CFR 60, page 28204, Federal Register/Vol. 48, No. 120/June 21, 1983).

Consideration of uncertainties in the data and models is a major concern that will need to be addressed in the license application. The data to address these uncertainties must be gathered during the site characterization program. Testing and data collection must consider in a systematic way all important interactions of the system that affect waste package performance.

In order to demonstrate reasonable assurance that the waste package designs proposed by DOE will meet the performance objectives of 10 CFR 60, it is NRC's position that DOE should assess the performance of the waste package in the repository environment over the period from permanent closure. An assessment of the performance of the waste package would be required in the repository license application and would need to address the following:

(a) identification and screening of failure modes;

(b) determination of the consequences of failure in containment;

(c) demonstration that for anticipated processes and events containment of the waste within the waste package for a period of 300 to 1000 years after permanent closure will be substantially complete;

(d) potential sources of uncertainty and their impact on containment and on release of radionuclides from the waste package, including temperature field, groundwater chemistry, groundwater flow rates, radiation field, pressure and stress fields, groundwater flux and flow rates, air composition and flow rate.

One method of assessing the performance of the waste package that is acceptable to the staff is to use the reliability assessment techniques described in the DTP. Other approaches may also be found acceptable if, after staff review, it is determined that they address points (a) through (d) above.

2. DTP Reliability Approach

The approach to performing a reliability analysis is summarized below:

(a) Identify the types of potential failure modes for the proposed waste package for the given repository system;

(b) Conduct a screening evaluation of each potential failure mode to determine whether it is a possible cause of failure in the proposed repository environment;

(c) Use the results of the screening operation to assist in developing a model for each of the retained failure modes;

(d) Determine the ranges of parameters of the proposed repository environment and the other parameters which are relevant to the failure modes.

(e) Combine the set of waste package materials properties, environmental parameters and models in a scheme that serves to explore all interactions modeled and predict failure probabilities;

(f) Identify the most important failure modes and parameters, for example by sensitivity studies using codes based on the best available models and data.

The reliability analysis should contain the following:

(a) Waste package design and materials specifications;

(b) Environmental conditions;

(c) Material properties;

(d) Failure mode and effects analysis;

(e) Overall confidence in the Reliability Analysis;

(f) Quantitative assessment of reliability and uncertainty;

(g) Quality assurance procedures.

3. Limitations

The staff recognizes the limitations inherent in attempting to apply a traditional reliability analysis to assessment of the performance of the waste package. These limitations result from the uncertainties inherent in the compnents of a reliability analysis. These uncertainties are expected to be higher in this analysis than in a traditional analysis. The reason for this is that the type of data base used for a traditional reliability analysis (i.e., results of testing many components over their full design lifetime under well-characterized environmental conditions) may not be available for the waste package. Nevertheless, the staff considers that a reliability analysis, if supported by appropriate data, would be the most rigorous assessment of waste package performance that could be made.

The early use of a reliability analysis would permit the identification of those areas where there are insufficient data to demonstrate compliance with the performance objectives of 10 CFR 60. Through the reliability analysis, weak areas could be identified and the knowledge could be used to focus research and development activities on waste package modifications. The use of this analytical approach would facilitate the task of providing reasonable assurance that the waste package performance objectives will be met.

The draft technical position on Waste Package Reliability was released for comment[7] and listed in the Federal Register with a Notice of Availability in early November 1984. A 60-day comment period was provided for.

SUMMARY

The basic framework of licensing requirements for HLW packages is established in 10 CFR 60. To provide flexibility to DOE in the design and analysis of an HLW repository, 10 CFR 60 provides general technical requirements. The NRC staff is developing ancillary documents to provide more detailed guidance and interpretation of 10 CFR 60. Two such types of documents, the Issue-Oriented Site Technical Positions and the Reliability Draft Technical Position, have been released recently for comment.

REFERENCES

1. 10 CFR 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories," U.S. Government Printing Office, Washington, D.C., 1984.

2. U.S. Nuclear Regulatory Commission, "Disposal of High-Level Radioactive Waste in Geologic Repositories," Proposed Rule, Federal Register, Vol. 50, No. 12, p. 2579, January 17, 1985.

3. 10 CFR 20, "Standards for Protection Against Radiation."

4. R. E. Browning (NRC), Letter to W. Bennett (DOE), with attachment, "Calculation of I-129 Release Rate," September 10, 1984.

5. H. J. Miller (NRC), Letter to W. J. Purcell (DOE), Novermber 2, 1984, with Draft Issue-Oriented Site Technical Positions for Five Potential Repository Sites.

6. "Draft Site Characterization Analysis of the Site Characterization Report for the Basalt Waste Isolation Project," NUREG-0960, Vol. 1, March 1983.

7. H. J. Miller (NRC), Memorandum to J. M. Felton, "Notice of Availability of Draft Generic Technical Position on Waste Package Reliability," October 31, 1984.