

10 CFR Parts 960-963

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Tuesday  
November 30, 1999

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**Part IV**

**Department of  
Energy**

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10 CFR Parts 960 and 963  
Office of Civilian Radioactive Waste  
Management; Nuclear Waste Repositories;  
Yucca Mountain Site Suitability  
Guidelines; Proposed Rulemaking

## DEPARTMENT OF ENERGY

## 10 CFR Parts 960 and 963

[Docket No. RW-RM-99-963]

RIN No. 1901-AA72

**Office of Civilian Radioactive Waste Management; General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories; Yucca Mountain Site Suitability Guidelines**

**AGENCY:** Office of Civilian Radioactive Waste Management, Department of Energy (DOE).

**ACTION:** Supplemental Notice of Proposed Rulemaking.

**SUMMARY:** DOE invites public comment on a revised proposal to amend the policies under the Nuclear Waste Policy Act of 1982 for evaluating the suitability of Yucca Mountain, Nevada, as a site for development of a nuclear waste repository. Today's revised proposal focuses on the criteria and methodology to be used for evaluating relevant geological and other related aspects of the Yucca Mountain site. Consistent with longstanding policy to conform DOE regulations regarding its nuclear waste repository program to comparable regulations of the Nuclear Regulatory Commission, DOE's proposed criteria and methodology are based on the Nuclear Regulatory Commission's recently proposed regulations for licensing a nuclear waste repository at Yucca Mountain.

**DATES:** Written comments must be received by February 14, 2000. DOE requests one copy of the written comments. DOE will hold two public hearings on this supplemental notice of proposed rulemaking. A subsequent **Federal Register** document, that will announce hearing dates, locations, and times, will be issued during the comment period.

**ADDRESSES:** Written comments should be addressed to Dr. William J. Boyle, U.S. Department of Energy, Yucca Mountain Site Characterization Office, P.O. Box 98608, Las Vegas, Nevada 89193-8608, or provided by electronic mail to 10CFR963@notes.ymp.gov.

Copies of the transcripts of the hearings, written comments, and documents referenced in this notice may be inspected and photocopied in the Yucca Mountain Science Center, 4101B Meadows Lane, Las Vegas, Nevada, (702) 295-1312, and the DOE Freedom of Information Reading Room, Room 1E-190, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC (202) 586-3142,

between the hours of 8:30 a.m. and 4 p.m., Monday through Friday, except for Federal holidays. For more information concerning public participation in this rulemaking, please refer to the Opportunity for Public Comment section of this notice.

**FOR FURTHER INFORMATION CONTACT:** Dr. William J. Boyle, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Yucca Mountain Site Characterization Office, P.O. Box 98608, Las Vegas, Nevada 89193-8608, (800) 967-3477.

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**I. Introduction**

DOE today publishes this supplementary notice of proposed rulemaking in order to revise its December 16, 1996, proposal (61 FR 66158) to amend the "General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories" (Guidelines) (10 CFR part 960) that DOE promulgated under the Nuclear Waste Policy Act (NWPA) in 1984 (42 U.S.C. 10101, *et seq.*). The General Guidelines describe the DOE policies applicable to three sequential stages of the NWPA siting process, which are: (1) Preliminary site screening; (2) nomination of sites for site characterization (geological investigation of selected sites); and (3) selection of a site for recommendation to the President. The Guidelines are consistent with the licensing regulations of the Nuclear Regulatory Commission (NRC) in 10 CFR part 60.

In its December 16, 1996, proposal, DOE published proposed regulatory amendments to the Guidelines to reflect the prevailing scientific view on how to evaluate the suitability of the Yucca Mountain site for the development of a nuclear waste repository. Because the preliminary site screening stage was complete and Congress has required DOE to focus on Yucca Mountain, Nevada, DOE's proposed regulatory amendments dealt with provisions of the Guidelines applicable to the site recommendation stage. Today DOE is revising the terms of its proposal for three reasons.

First, during the comment period on the December 16, 1996, proposal, DOE received comments from members of the public, State and local officials of Nevada, the U.S. Environmental

Protection Agency (EPA), and the U.S. Nuclear Waste Technical Review Board, that in substance criticized the omission from the proposed regulatory amendments of the essential details of the criteria and methodology for evaluating the suitability of the Yucca Mountain site for the location of a nuclear waste repository. Some of the comments made pointed recommendations for guidelines at a more definitive level of specificity than the proposed regulatory text provided. Also, there were comments critical of the legal basis for DOE's proposal and its consistency with what those commenters viewed as DOE's past position on the meaning of sections 112(a) and 113(b) of the Act. As explained in detail later in this notice, DOE concluded that there was enough merit in these comments to warrant revision of the proposed regulatory amendments and expansion of the explanation of the factual and legal bases for them.

Second, in December, 1998, DOE issued, pursuant to Congressional direction, the Viability Assessment of a Repository at Yucca Mountain (Viability Assessment) (DOE/RW-0508). This document, which is available through the Internet on the web site ([www.ymp.gov](http://www.ymp.gov)) or in hard copy upon request (see above, Further Information) sets forth the bases for the site suitability criteria DOE is proposing to use and the methodology for applying the criteria to a design for a proposed repository at the Yucca Mountain site. DOE can now assist commenters in responding to DOE's proposal with appropriate descriptions of, and references to, key portions of the Viability Assessment in the Supplementary Information.

Third, after the close of the comment period, the U.S. Nuclear Regulatory Commission (NRC), consistent with Congressional direction to the EPA to develop a site-specific radiation protection standard for the Yucca Mountain site, proposed to issue site-specific licensing requirements for that site in a new 10 CFR part 63 and to eliminate the site from coverage under 10 CFR part 60. Thereafter, EPA issued the Congressionally-mandated proposal for site-specific public health and safety standards for a repository at Yucca Mountain, to be codified at 40 CFR part 197. Section 113(c) of the NWPA provides that a determination of site suitability for development as a repository is largely an *estimate* that an application to the NRC for a construction authorization would be successful. 42 U.S.C. 10133(c). Thus, the details of the NRC proposal, which were

not available when DOE formulated its December 16, 1996, proposal, affect the continuing usefulness of existing 10 CFR part 960, the text of DOE's proposed regulatory amendments, and the bases for those amendments in performing the analysis required by section 113. For reasons explained in detail below, DOE is of the view that the proposed part 63, if finalized without significant change, would make it illogical to apply the existing provisions of 10 CFR part 960, which are explicitly linked to provisions of the NRC's part 60. Moreover, the details of the NRC's proposal suggest the need for making conforming changes to the December 16, 1996, proposal to set forth the requirements for carrying out a total system performance assessment as the method for applying the site suitability criteria to the data developed during site characterization of the Yucca Mountain site.

Consistent with EPA's proposal for site-specific public health standards and NRC's proposal to limit part 60 and to establish a new part 63 for the Yucca Mountain site, DOE today is proposing regulations to: (1) Limit 10 CFR part 960 to preliminary site screening for repositories located elsewhere than Yucca Mountain; and (2) establish a new part 963 to contain the site suitability criteria and the methods for considering the potential of the Yucca Mountain site for a nuclear waste repository under those criteria. The proposed suitability criteria and methods provide a link between the geologic considerations identified in section 112(a) of the NWPA as primary criteria for siting a repository, and the current scientific understanding of site characteristics and related processes that are important to assessing the performance and safety of a potential geologic repository at the Yucca Mountain site. Although closely linked to the NRC's proposed part 63 licensing criteria and requirements, as is necessary and appropriate, DOE's proposed regulations in part 963 are not the equivalent of a *determination* that the site necessarily will meet all requirements to obtain a license from the NRC, or to be recommended by the Secretary for development as a geologic repository. Rather, DOE is proposing this new rule to better define its policies and criteria for determining the suitability of the Yucca Mountain site only in terms of, and based on, the information and data developed through the program of site characterization activities DOE has conducted over the years at Yucca Mountain under section 113(b) of the NWPA.

In issuing this notice, DOE is seeking to improve its policies for determining site suitability by enhancing their transparency, validity, and verifiability. In terms of transparency, DOE is aiming at regulations that are easier to read and understand. In terms of validity, DOE is aiming at an explanation of the legal and scientific basis for the regulations that shows how DOE's policies logically follow from scientifically supportable and legally sound premises. In terms of verifiability, DOE is aiming to show that the scientific conclusions underlying its policies are based on documented empirical results of experiments, and computer analyses of relevant data sufficient to warrant the conclusions DOE may eventually draw from known facts in a supporting statement for site recommendation to the President.

DOE hereby invites interested members of the public, State and local officials, and other Executive Branch agencies to review today's revised proposal and to provide comments on how well this rulemaking achieves these objectives. In addition, DOE intends to follow the consultation procedures set forth in section 112(a) of the NWPA for promulgation of the Guidelines in seeking review and comment on this revised proposal.

## II. Background

This section provides an overview of the developments which have led DOE to propose to revise certain sections of the existing General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories and to adopt a new rule governing the site suitability criteria for the Yucca Mountain site.

### A. Enactment of the Nuclear Waste Policy Act of 1982

#### 1. Development of the Nuclear Waste Policy Act

The Nuclear Waste Policy Act of 1982 (NWPA) was enacted to provide for the siting, construction, and operation of repositories for which there is a reasonable assurance that the public and the environment will be adequately protected from the hazards posed by spent nuclear fuel and high-level radioactive waste (hereinafter referred to as "spent fuel" or "high-level waste" or both). The NWPA established the Federal responsibility and defined Federal policy for the disposal of spent fuel and high-level waste. Because this waste remains radioactive for many thousands of years, Congress recognized that disposal involved many complex and novel technical and societal issues. To develop an appropriate framework for the resolution of these issues, several

years of intense legislative effort were required before a political consensus emerged to support enactment of the NWPA.

To meet the well-recognized reluctance of communities to host such facilities, the NWPA included a national site selection process that was designed to ensure fairness and objectivity in the identification of potential candidate sites for a repository. To ensure that the DOE would consider only candidate sites that had good potential for being licensed by the NRC, the NWPA required the DOE to obtain NRC concurrence on the DOE's general siting guidelines. And to ensure that the regulatory requirements for a repository would be set independently of any responsibility assigned to the DOE to develop that repository, the EPA was authorized to promulgate generally applicable standards for the protection of the environment. The NRC was authorized to establish repository licensing requirements and criteria, although these requirements and criteria could not be inconsistent with any comparable standards promulgated by the EPA.

## 2. Overview of the Nuclear Waste Policy Act

As originally enacted in 1982, the NWPA set forth requirements for selecting sites for the disposal of spent fuel and high-level wastes in a geological repository. 42 U.S.C. 10101, *et seq.* Several stages were established for the evaluation of potential sites, and these stages were defined in section 112, Recommendation of Candidate Sites for Site Characterization; section 113, Site Characterization; and section 114, Site Approval and Construction Authorization.

Section 112 of the NWPA addresses the initial stage of the site selection process, and includes four distinct steps: (1) DOE preliminary site screening (42 U.S.C. 10132(a)); (2) DOE nomination of at least five sites as suitable for characterization (42 U.S.C. 10132(b)(1)(A)); (3) DOE recommendation to the President of three of the five nominated sites as candidates for characterization (42 U.S.C. 10132(b)(1)(B)); and (4) Presidential approval of nominated sites for characterization (42 U.S.C. 10132(c)). Specifically, section 112(a) directs the DOE to issue general guidelines for the recommendation of candidate sites for site characterization. Section 112 directed DOE to consult with several federal agencies and obtain NRC concurrence on these guidelines.

Under section 112(a), DOE was required to specify in the guidelines: (1)

detailed geologic considerations that were to be the primary criteria for the selection of sites for characterization in various geologic media; (2) certain factors (e.g., hydrology, geophysics, seismic activity) that would either qualify or disqualify a site from characterization; and (3) population density and distribution factors that would disqualify any site for characterization. 42 U.S.C. 10132(a). Section 112(a) also required DOE to include certain factors related to the comparative advantages among candidate sites. The DOE was directed to use the guidelines to consider candidate sites for recommendation as candidates for characterization. Section 112(a) explicitly authorized DOE to modify the guidelines consistent with the provisions of section 112(a).

Furthermore, section 112(a) directed DOE to develop certain qualifying or disqualifying factors for the preliminary site screening stage of the site selection process. Except for population density, the specific content of the qualifying or disqualifying factors was left to DOE's informed discretion. Because these factors are part of the Guidelines, their specific content could be modified in accordance with the authority in section 112(a).

Section 112(b) of the NWPA addressed DOE's recommendation to the President of sites for site characterization, that is, for intensive investigation of geologically related characteristics through surface and subsurface testing, among other investigative techniques. DOE was to nominate at least five sites as suitable for characterization. Each nominated site was to be accompanied by an environmental assessment. Of the five sites, DOE was to recommend three to the President for characterization. Section 112(c) of the NWPA addresses the President's review and approval of candidate sites for characterization.

Section 113 of the NWPA addresses site characterization, which involves activities that could proceed only after the section 112 actions had been completed. Section 113(a) authorizes DOE to conduct site characterization activities at the sites that had been approved by the President for characterization. Section 113(b) establishes the scope of DOE's site characterization activities, and directs the publication of a general plan for these activities. 42 U.S.C.

10133(b)(1)(A). DOE is to report semiannually on its ongoing and planned site characterization activities and the information derived therefrom. 42 U.S.C. 10133(b)(3). Section 113(b) also directs that the DOE include in the

site characterization plan, criteria to be used to determine the suitability of a site for the location of a repository, developed pursuant to section 112(a). 42 U.S.C. 10133(b)(1)(A)(iv). Section 113(c) establishes limits on DOE's site characterization activities, and provides direction on how DOE is to proceed if at any time it determines that a site would be unsuitable for development as a repository.

Section 114 addresses site approval and construction authorization, and can only proceed as the section 113 site characterization activities near completion. Four distinct steps are defined in this section: (1) DOE recommendation of a site to the President for approval to develop as a repository [42 U.S.C. 10134(a)]; (2) recommendation of a site by the President to Congress [42 U.S.C. 10134(a)(2)]; (3) Congressional designation of the site [42 U.S.C. 10134(b)]; and (4) conduct of a licensing proceeding by the NRC [42 U.S.C. 10134(c)]. Further, under section 115, after the President recommends a site to Congress, the Governor and the legislature of the host State may submit a notice of disapproval. If the State disapproves, Congress must enact a resolution of siting approval in order to designate the site. 42 U.S.C. 10135(b). If the Congressional designation takes effect, DOE must submit an application to the NRC for a construction authorization. 42 U.S.C. 10134(b).

Section 114(a) provides for DOE activities necessary to prepare a recommendation to the President for Presidential approval of a site for development as a repository. These activities include public hearings in the vicinity of the site to inform residents of the area and receive their comments, and the completion of site characterization. Upon completion of these hearings and site characterization, the Secretary may decide to recommend the site to the President. A comprehensive statement of the basis for this recommendation is to accompany the recommendation, and be made available to the public. 42 U.S.C. 10134(a)(1). Section 114(b) then authorizes DOE to apply to the NRC for construction authorization, if the President recommends a site to the Congress and that recommendation is permitted to take effect. Sections 114(c)-(e) direct the NRC and DOE on certain aspects of the construction authorization process. Section 114(f) requires that a final Environmental Impact Statement (EIS) accompany the Secretary's recommendation of a site to the President.

## *B. DOE Promulgation of General Guidelines at 10 CFR Part 960*

### 1. Overview of the General Guidelines

Section 112(a) of the NWPA directed DOE to issue general guidelines for the recommendation of sites for characterization, in consultation with certain Federal agencies and interested Governors, and with the concurrence of the NRC. These general guidelines were to be comparative in nature, as DOE was required to consider various geologic media and such considerations as proximity to where spent fuel and high-level waste were stored. The general guidelines were also to consider non-geologic factors, such as population density and distribution, that would not be examined in site characterization. No other procedural requirements were imposed on the issuance of these guidelines.

DOE promulgated the section 112(a) guidelines by notice and comment rulemaking, in addition to the consultation and concurrence process specified in the NWPA. The DOE also conducted several public meetings on the guidelines. These additional activities, although not required by the NWPA, enabled DOE to receive comments from interested members of the public. The general guidelines were promulgated on December 6, 1984, and codified in the Code of Federal Regulations at 10 CFR part 960, General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories. 49 FR 47714.

### 2. Structure of the General Guidelines

The Guidelines promulgated by DOE defined the basic technical requirements that candidate sites must meet, and specified how DOE would implement its site-selection process. The Guidelines were structured according to three categories: implementation guidelines, preclosure guidelines and postclosure guidelines. The implementation guidelines addressed general application of all the guidelines, and established the methodology for applying the guidelines during the various stages of the siting process: site screening and nomination, recommendation for characterization, and recommendation for repository development. The preclosure guidelines governed the siting considerations that dealt with the operation of a geologic repository before it is closed. The postclosure guidelines governed the siting considerations that dealt with the long-term behavior of a geologic repository after waste emplacement and closure.

Both the preclosure and postclosure guidelines were organized under general categories of interest, for example, geohydrology and geochemistry. Each category was further divided into system guidelines and corresponding technical guidelines. The system guidelines addressed broad requirements for a geologic repository under preclosure and postclosure conditions; the corresponding technical guidelines specified conditions that would qualify or disqualify a site, and conditions that would be considered favorable or potentially adverse. 49 FR 47724. In effect, the technical guidelines and the associated qualifying and disqualifying conditions imposed specific "subsystem" performance requirements; each subsystem requirement would be used to evaluate the merits of a site, independent of the other requirements.

Section 112 of the NWPA described the minimum steps that DOE was to take during site screening and prior to site characterization. When promulgating the Guidelines in 1984, DOE determined that application of the Guidelines should extend beyond preliminary site screening to encompass site characterization activities and site recommendation to the President. Appendix III to the Guidelines explained how certain of the Guidelines would be applied at the principal decision points of the siting process: (1) identification of a site as being potentially acceptable under section 112(b); (2) nomination and recommendation of sites as suitable for characterization under sections 112(b) and (c); and (3) recommendation of a site for development as a repository (sections 113 and 114). 49 FR 47729–47730. With respect to the third decision point, which would be reached only after completion of site characterization activities and non-geologic data gathering activities, DOE did not promulgate separate Guidelines. Instead, DOE indicated that the preclosure and postclosure Guidelines would be applied to this decision, and appropriate findings issued, in the manner prescribed in Appendix III. Appendix III specified the types of findings that were to be issued from the application of the disqualifying and the qualifying conditions at each of the three decision points. The types of findings corresponded with the level of confidence required to make a finding; that is, a lower level finding required one degree of confidence in the finding, and a higher level finding required an increased level of confidence in the finding over the lower level. 49 FR

47728–47729. Appendix III included a table summarizing the level of the finding required at each of the three decision points.

Appendix III represents the analytical process DOE would follow to issue findings relative to the disqualifying and qualifying conditions of a site, and use in its decision-making on site selection. This analytical process dictates a higher-level of confidence in the findings of qualifying or disqualifying conditions at the last stage of the siting process, site selection for repository development, compared to the initial stage of the siting process, site nomination for site characterization. DOE anticipated that the higher-level of confidence in its technical findings would be obtained through the site characterization process undertaken at the later stages of the selection process.

### 3. Bases for the Structure of the General Guidelines

The structure and development of the Guidelines were based on four primary sources of information and considerations: (1) The direction in the NWPA, as originally enacted; (2) the extant understanding of geologic disposal in the scientific and technical community; (3) applicable regulations proposed by the NRC and the EPA governing the disposal of spent nuclear fuel and high-level radioactive waste in geologic repositories; and (4) public comments.

DOE initiated the rulemaking process by assembling a task force of program experts. 49 FR 47718. The task force developed draft Guidelines based on criteria used earlier in the National Waste Terminal Storage Program, including program objectives, system performance criteria, and site performance criteria. At the time, the task force reviewed other criteria defined for geologic repositories by the National Academy of Sciences and the International Atomic Energy Agency.

The task force also sought consistency with NRC regulations and proposed EPA regulations related to geologic repositories. 49 FR 47718. NRC is the statutory agency responsible for licensing the construction and operation of a geologic repository; EPA is the statutory agency responsible for setting public health and safety standards for a geologic repository. Consistency of the DOE Guidelines with these regulatory standards was essential, since any potential site would be evaluated based on its ability to meet applicable regulatory requirements. 49 FR 47721.

In sum, the structure and content of the Guidelines was based on the state of knowledge in the late-1970s and early-

1980s in the regulatory community, as well as the national and international scientific community, regarding the development of geologic repositories.

DOE sought and received extensive public comments on a draft of the Guidelines before submitting them to the NRC for concurrence. On February 7, 1983, the proposed Guidelines were published in the **Federal Register** (48 FR 5670) for public review and comment. In addition, DOE published a separate notice soliciting comment from the Governors of the six States with potentially acceptable sites, and then met individually with officials from each of these States. DOE also held a series of regional public hearings. After considering the comments received, DOE drafted a set of alternate Guidelines to address the comments. The alternate Guidelines and public comments were made available in a second notice on June 7, 1983 (48 FR 26441), followed by a second public comment period. Further regional meetings and consultations with Federal agencies were held before DOE submitted the Guidelines to NRC for concurrence on November 22, 1983. 49 FR 47718–47719.

#### 4. Consistency With NRC Technical and Procedural Conditions

Of particular importance to DOE's formulation of the Guidelines was consistency with NRC licensing regulations for the disposal of waste in a geologic repository. 49 FR 47718. In June 1983, NRC amended its licensing regulations at 10 CFR part 60 with respect to subpart E, technical criteria addressing siting, design and performance objectives of a geologic repository. 48 FR 28194. NRC concurred in the Guidelines subject to conditions that would satisfy the overall need to maintain consistency between NRC regulations and the DOE Guidelines. Among the NRC conditions were: (1) DOE clarifications and deletions of certain limiting terms such as "permanent" and "significant"; (2) DOE modifications for consistency with NRC criteria regarding anticipated processes and events, potentially adverse conditions, and the role of engineered barriers during the process for screening candidate sites for characterization; and (3) DOE revisions and additions to disqualifying conditions to ensure that unacceptable sites would be eliminated as early as practicable. 49 FR 47719–47722.

NRC concurrence conditions also addressed general, procedural aspects of how the DOE was to apply the Guidelines. For example, NRC concurrence was conditioned on a lack

of conflict between NRC regulations at 10 CFR part 60 and the Guidelines, recognition by DOE that NRC regulations were controlling in the event of any differences, and a commitment that DOE would obtain NRC concurrence on any future revisions to the Guidelines. 49 FR 47719–47720. NRC also requested DOE to specify in greater detail how the Guidelines would be applied at each siting stage. This specificity was provided by the addition of Appendix III to the Guidelines. Appendix III indicated how the Guidelines would be applied at all of the site selection stages, including the recommendations to the President for site characterization and for the development of a site as a repository.

The NRC required additional changes after it met publicly with representatives of several interested states, Indian tribes, and DOE. After DOE committed to making those changes, the NRC voted to concur in the Guidelines. 49 FR 47720. Thus, the current Guidelines represent the substantial input provided by the NRC in 1984 through the statutory concurrence process.

#### C. DOE Application of the Guidelines

Consistent with section 112(b) of the NWPA, DOE applied the Guidelines to: (1) Nominate five sites as suitable for characterization; and (2) recommend to the President three of those five nominated sites for characterization as candidate sites for the first repository. On May 27, 1986, the President approved each of the sites that had been recommended for characterization. Yucca Mountain was one of the three sites that DOE recommended. The recommendation to the President was documented in a DOE report, Recommendation by the Secretary of Energy for Site Characterization for the First Radioactive-Waste Repository (May 1986; DOE/S-0048). In addition, a draft environmental assessment was prepared for each of the five sites and final environmental assessments were prepared for each of the three sites that were recommended.

This action concluded the process that had been established by the NWPA for identifying sites for characterization. The Guidelines' role of structuring DOE's process for identifying sites for characterization was completed in accordance with the Congressional directives to DOE. Under DOE's formulation of the Guidelines at that time, however, the Guidelines would remain relevant and applicable through the third principal siting decision point, the selection of a site to be

recommended for the development of a repository.

#### D. 1987 Amendments to NWPA

In 1987, Congress amended the NWPA to mandate Yucca Mountain as the sole site to be characterized. 42 U.S.C. 10172 (Supp. V 1987). The processes for site characterization under section 113 and site approval under section 114 were made applicable to only Yucca Mountain. Under sections 113(a) and (b), Yucca Mountain was designated as the site for which site characterization activities would take place, and a site characterization plan would be issued, respectively. Under section 113(c), Congress amended the statute to name Yucca Mountain as the site for which the restrictions on site characterization activities would be applicable. That is, DOE was directed to conduct only such activities at Yucca Mountain that are necessary to evaluate the suitability of the site for an application to the NRC for a construction authorization, and to comply with requirements under the National Environmental Policy Act (NEPA). Section 114 was amended to restrict DOE's analysis of alternative sites in any environmental impact statement (EIS) that may be prepared for the Yucca Mountain site under NEPA. Any such EIS would analyze the Yucca Mountain site, and no other sites, for potential development of a geologic repository. Further, section 160(b) directed DOE to "terminate all site specific activities (other than reclamation activities) at all candidate sites, other than the Yucca Mountain site." 42 U.S.C. 10172(a)(2).

In sum, Congress made clear its intent for DOE to focus its resources on investigating Yucca Mountain, and only Yucca Mountain, as a potential site for a high-level radioactive waste repository.

#### E. Yucca Mountain Site Characterization Plan

##### 1. Statutory Requirements

Under sections 113 and 160 of the NWPA, as amended, DOE was authorized to conduct site characterization activities at the Yucca Mountain site. Prior to initiating site characterization under section 113, DOE was required to prepare a general plan for site characterization activities at the Yucca Mountain site. DOE was required to submit the plan to the NRC and the State of Nevada for their review and comment [42 U.S.C. 10133(b)(1)], as well as to members of the public in the vicinity of Yucca Mountain [42 U.S.C. 10133(b)(2)]. Certain contents of the

plan were mandated by section 113(b), including, among other things, a description of planned excavation and other testing activities, a description of the possible form or packaging of the high-level waste, and the criteria to be used to determine the suitability of the site for the location of a repository, developed pursuant to section 112(a). Section 113(b)(3) also required DOE to report every six months on the progress of site characterization activities at Yucca Mountain, and to provide the reports to the NRC, and the Governor and the legislature of the State of Nevada.

DOE prepared the site characterization plan in draft form in January 1988. In preparing the plan, DOE followed NRC guidance, as specified in the document, Standard Format and Content of Site Characterization Plans for High Level Waste Geologic Repositories, Regulatory Guide 4.17 (NRC 1987). After review and comment by NRC, the State of Nevada, and interested members of the public, DOE finalized the Site Characterization Plan: Yucca Mountain Site, Nevada Research and Development Area, Nevada (December 1988; DOE/RW-0198) (hereinafter also the SCP), in December 1988.

## 2. Structure of the Site Characterization Plan

“Site characterization” is defined in the NHPA to include research activities undertaken to establish the geologic condition of a site, for example, borings and surface excavations, and in situ testing necessary to evaluate the suitability of a candidate site for the location of a repository. 42 U.S.C. 10101(21). In the SCP, DOE described the purpose of its site characterization program at Yucca Mountain was to obtain the information necessary to determine whether the site is suitable for a repository, and could satisfy NRC licensing requirements (which must be consistent with EPA public health and safety standards). DOE also explained there that the information obtained from site characterization, such as the geologic, geoengineering, hydrologic, and climatological conditions at a site, would be used to develop and optimize repository design and to evaluate the performance of the site and the engineered barriers as an integrated system.

The purpose of the SCP was threefold: (1) To describe the site, and the preliminary designs for the repository and the waste packages in sufficient detail to form the basis for the site characterization program; (2) identify issues to be resolved during site

characterization and present the strategy for resolving the issues; and (3) describe the plans for the work needed to obtain the information deemed necessary and to resolve outstanding issues. The SCP was organized along two lines: (1) An issues hierarchy, which embodies the DOE, NRC and EPA regulations governing the repository system; and (2) an issue-resolution strategy.

The issues hierarchy was a three-tiered framework laying out what must be known before the Yucca Mountain site could be selected and licensed. “Issues” were defined as questions related to performance of the repository that must be resolved to demonstrate compliance with applicable regulations of DOE, NRC and EPA. DOE identified four key issues to be addressed, based on regulatory requirements and the four system guidelines in part 960: (1) Postclosure performance; (2) preclosure performance; (3) environment, socioeconomic, and transportation impacts of a repository; and (4) ease and cost of repository siting, construction, operation and closure. DOE also explained that only the first, second, and part of the fourth key issue would be addressed in the site characterization program, since resolution of these other key issues (that is, key issue 3 and part of key issue 4) were not dependent on information from site characterization activities. The issue-resolution strategy consisted of four parts: Issue identification, performance allocation, data collection and analysis, and documentation of issue resolution. This framework was used to develop test programs and explain why the test programs were adequate and necessary. The object was to collect information to be used in a concluding set of analyses to resolve the issues, and to document resolution of the issues.

As required by section 113(b)(1)(A)(iv), the SCP included criteria to determine the suitability of the site for development of a repository. Those “criteria” were the provisions within the Guidelines pertinent to site characterization activities, namely, the postclosure guidelines, and the preclosure guidelines related to radiological safety and technical feasibility of repository siting, construction and operation, to be applied in the manner described in Appendix III. Appendix III set out the level of findings DOE must make relative to the system and technical requirements found in the postclosure guidelines (subpart C) and preclosure guidelines (subpart D) at the final decision point of recommending a site for development as a repository. DOE believed that the information gained

through site characterization and the issue resolution process would form the basis for these findings.

DOE also explained in the SCP that not all of the Guidelines would be addressed as part of site characterization activities. The SCP would not address the environmental, socioeconomic and transportation guidelines, or certain guidelines related to ease and cost of repository siting, construction, operation, and closure, since DOE would not develop information related to those guidelines through site characterization activities. Those guidelines would be addressed in other investigations and plans to be conducted concurrently with the site characterization program. Also, in light of the 1987 amendments to the NHPA permitting site characterization to proceed only at Yucca Mountain, DOE stated in the SCP that the comparative portions of the Guidelines would not be applied in the site suitability determination to be made under section 113(b).

In accordance with section 113(b)(3), approximately every six months DOE issues a report updating information on the conduct of site characterization activities at the Yucca Mountain site. Those reports briefly summarize the characterization activities undertaken at the site, the technical and scientific issues of key interest and their resolution, and issues that remain for further characterization and resolution. In addition, the semiannual reports provide references and a bibliography of other reports and documents containing more detailed information regarding site characterization activities. DOE provides the reports to the NRC, the Governor of Nevada, and the legislature of the State of Nevada.

The progress reports reflect DOE’s ongoing interaction with the NRC. In July 1986, the NRC amended its regulations at 10 CFR part 60 (51 FR 27158) to establish the method of interaction between DOE and the NRC on the development and implementation of the site characterization plan. NRC established a system for DOE to report on the results of site characterization, identify issues, plan for additional studies, eliminate planned studies no longer necessary, and identify decision points reached. In this manner, the NRC established a clear pathway to interact with DOE in the management and direction of the site characterization program.

Site characterization activities have continued up to and including the present, and are described in greater detail below in section II.G.

#### F. Energy Policy Act of 1992

In 1992, Congress enacted certain provisions in the Energy Policy Act of 1992 (Pub. L. No. 102-486) impacting the nation's nuclear waste repository program. In section 801(a) of the Energy Policy Act of 1992 (EPACT), Congress directed EPA to promulgate a new, health-based standard to ensure protection of the public health from high-level radioactive waste that may be disposed in a geologic repository located at Yucca Mountain. The new standards could depart from the generic EPA standards promulgated at 40 CFR part 191, and would be specific to Yucca Mountain. In section 801(b), Congress also directed the NRC, within one year of EPA adopting a new standard, to modify its technical requirements and criteria under section 121(b) of the NWSA [42 U.S.C. 10141(b)] (i.e., 10 CFR part 60), as necessary, to be consistent with the new EPA standards.

Before setting the new standard, however, EPA was required to contract with the National Academy of Sciences (NAS) to conduct a study to provide findings and recommendations on reasonable standards for protection of the public health and safety. Under section 801(a) of the EPACT, EPA was required to promulgate its new standards based on, and consistent with, the NAS findings and recommendations. Under the EPACT and accompanying congressional instruction, NAS's charge was to answer three specific questions embodied in section 801(a)(2), and to advise EPA on the technical basis for the health-based standards it was mandated to prepare. The three questions posed in section 801(a)(2) addressed: (1) Whether a health-based standard based on doses to individual members of the public would provide a reasonable basis for protecting public health and safety; (2) whether it is reasonable to assume that a system for postclosure oversight of the repository, using active institutional controls, will prevent an unreasonable risk of breaching the repository's engineered or natural barriers, or of increasing the exposure of individual members of the public to radiation beyond allowable limits; and (3) whether it is possible to make scientifically supportable predictions of the probability that the repository's engineered or natural barriers will be breached as a result of human intrusion over a period of 10,000 years.

In August 1995, NAS published the statutorily mandated report, entitled *Technical Bases for Yucca Mountain Standards*. In sum, NAS issued findings

that: (1) A health standard for Yucca Mountain based on risk to individuals of adverse health effects from releases from the repository (rather than EPA's generic standards which contain both individual dose and release limits) was an appropriate standard that would adequately protect the health and safety of the general public; (2) it is not reasonable to assume that a system for postclosure oversight can be developed, based on active institutional controls, which will itself prevent an unreasonable risk of breaching the repository's engineered barriers or of increasing the exposure of individual members of the public to radiation beyond allowable limits; and (3) it is not possible to make scientifically supportable predictions of the probability that a repository's engineered or geologic barriers will be breached as a result of human intrusion over a period of 10,000 years. Notwithstanding the latter two findings, the NAS recommended EPA include in its regulations a stylized human intrusion event. The NAS reasoned that such an analysis may provide useful insight into the degree to which the ability of a repository to protect the public health and safety would be degraded by an intrusion.

In reaching its findings and recommendations, the NAS consulted with numerous entities, including local, state and federal government agencies, private organizations, and scientists and engineers, both national and international, familiar with the technical issues under study, and held five open technical meetings to ensure a thorough review of the scientific literature on the subject. In the *Technical Bases for Yucca Mountain Standards*, the NAS provides a detailed explanation of the assumptions and analyses underlying the study, and the reasons for NAS's findings and recommendations. Among the more important of these is the NAS assumption, confirmed by its technical review, that it is possible to conduct scientifically justifiable analyses of repository behavior over thousands of years in order to assess whether a repository can comply with the applicable public health standard. In addition, based on its analyses, the NAS concluded that the proper way to evaluate the risks of adverse health effects, and to compare those risks to the proposed standard, is to assess the estimated potential future behavior of the entire repository system and its potential effect on humans. The procedure used to perform this analysis is called performance assessment

(alternately called total system performance assessment).

In discussing the possible implications of its conclusions, the NAS noted that, if EPA issues standards based on individual risk (as recommended by the NAS), then the NRC would be required to revise its regulations embodied in 10 CFR part 60 to be consistent with EPA. This is because NRC's 10 CFR part 60 is directed in part to subsystem technical requirements, whereas the NAS concluded that it is the performance of the total system, rather than that of its individual elements in isolation, that is crucial in the context of a risk-based standard. Under a risk-based standard, imposing subsystem performance requirements might result in a deficient repository design even if each subsystem element meets or exceeds a certain performance standard. The NAS also observed that its recommendations, if adopted, implied the development by EPA of different regulatory and analytical approaches than those employed in the past, and that the process of establishing the new standards would require significant time and opportunity for public comment and review. Nevertheless, NAS noted that these potential changes should not impede site characterization work by DOE at Yucca Mountain.

At present, EPA is in the process of preparing new standards pursuant to EPACT and in light of the NAS findings and recommendations. Those new standards have proposed in a rulemaking proceeding for public review and comment. Also consistent with EPACT, section 801(b), the NRC has proposed new regulations governing the technical requirements and criteria for licensing a potential geologic repository at the Yucca Mountain site based on the NAS findings and recommendations and in anticipation of new EPA standards. The EPA's and NRC's proposed regulations are discussed in greater detail below, in section II.J, and II.K, respectively.

#### G. Evolution of the Site Characterization Program

Since publication of the SCP in 1988, DOE's site characterization program at Yucca Mountain has made substantial progress in developing information and data about the site and resolving outstanding technical issues. Over time, the site characterization program has evolved and been driven by advances in science and technology, as well as legislative and managerial changes. The following summarizes the evolution and status of the site characterization program.

*Technical Components of the Site Characterization Program.* The three main technical components of the site characterization program are testing, design, and performance assessment. Testing encompasses the investigation of natural features and processes at the site through field testing, conducted above and below ground, and laboratory testing of rock and water samples. Design refers to work on development of the description of a repository and waste packages tailored to the site features, supported by laboratory testing of candidate materials for waste packages and design-related testing in the underground tunnels similar to those in which waste would be emplaced. Performance assessment refers to the quantitative estimates of the performance of the total repository system, over a range of possible conditions and for different repository configurations, by means of computer modeling techniques that are based on site and materials testing data and accepted principles of physics and chemistry.

Through the testing program, DOE has learned a great deal about the geologic conditions of the site. The single largest effort undertaken in this regard has been construction of the Exploratory Studies Facility (ESF). Construction of this facility began in 1992 and was completed in 1998. The ESF, a 4.9 mile long underground tunnel, has enabled DOE to conduct testing and exploration activities at the depth of the proposed repository. Utilization of this facility has formed the basis for increased knowledge and understanding of the mechanical and hydrologic characteristics of the geologic formation in which the repository would be constructed. Ongoing work at this facility will focus primarily on thermal and hydrologic testing in the cross drift to extend and, where necessary, modify this understanding of the properties of the host rock.

The design component of the site characterization program comprises those activities aimed at developing concepts for the engineered components of the geologic repository. Design activities use information about the site gained through the testing program, and information about the engineered barrier system gained through other scientific investigations, to generate and develop design concepts that can meet the requirements placed on the engineered components of the repository. Site characterization activities are structured to acquire data needed to support the design. For example, a number of the site characterization program tests focus on the hydrological, geomechanical and

thermal properties of Yucca Mountain. These tests are significant because they provide the fundamental information needed to specify the approach to be used in developing the geologic repository thermal loading and underground support schemes. Also, under the design program, DOE examines various approaches to meeting engineered facility requirements, and conducts comparative evaluations of the costs and benefits of different approaches to developing design concepts.

The performance assessment component of site characterization represents the analytical method (i.e., computer modeling) DOE uses to forecast the performance of the repository within the Yucca Mountain setting and assess that performance against regulatory standards. Put in simplified terms, performance assessment uses the information and data collected under the testing and design programs to feed computer models that describe how the site would behave in the presence of a repository and how the engineered system would behave within the environmental setting of the mountain. Each model, called a process model, is designed to describe the behavior of individual and coupled physical and chemical processes. A total system performance assessment (TSPA) links the results of individual process models to construct a computer model of the repository system and surrounding environment that are important to assessment of overall repository performance. With the TSPA model, DOE can estimate releases of radionuclides from a repository under a range of conditions, over thousands of years, and forecast the consequent probable doses to persons.

Performance assessment (or TSPA), as described above, is an accepted method to assess the performance of a repository at Yucca Mountain. DOE's use of performance assessment models began even before issuance of the SCP in 1988. Since that time, however, significant advancements have been made in the technical capability, acceptance, and use of this analytical tool. In 1991, the Nuclear Energy Agency Radioactive Waste Management Committee and the International Atomic Energy Agency International Radioactive Waste Management Advisory Committee confirmed that TSPA provides an adequate means to evaluate long-term radiological impacts of a waste disposal system. On a national level, the NRC, the NAS and the Nuclear Waste Technical Review Board (a Congressionally mandated committee of experts chartered to evaluate the

technical and scientific validity of activities undertaken by DOE to characterize Yucca Mountain to determine its suitability as a location for a repository) have acknowledged the value of this method for evaluating postclosure performance for a repository at Yucca Mountain.

A significant portion of the DOE site characterization program has been aimed at developing the scientific bases that serve as the foundation for the process models used in performance assessment. DOE developed performance assessment models and conducted benchmark performance assessments of the total repository system in 1991, 1993 and 1995. Between these benchmark assessments, DOE conducted many performance assessments to evaluate selected features of the site and the evolving design. DOE used these total system and subsystem performance assessments to evaluate design options and to determine further data needed from site investigations. The most recent TSPA was conducted in 1998, the results of which are contained in the report, *Viability Assessment of a Repository at Yucca Mountain* (December 1998; DOE/RW-0508).

*Redirection of the Site Characterization Program.* In 1994, DOE conducted extensive internal and external reviews of the program. As a result of those reviews, documented in the *Civilian Radioactive Waste Management Program Plan* (December 1994; DOE/RW-0458) (Program Plan), DOE identified cost-cutting measures to reduce the cost of completing site characterization. In response to Congressional concern with the 1994 Program Plan, DOE submitted a revised Program Plan to Congress that was designed to maintain scientific investigations at the site, and retain target dates for determining site suitability and recommendation for construction authorization. *Civilian Radioactive Waste Management Program Plan, Revision 1* (May 1996; DOE/RW-0458). As part of the revised strategy, DOE redirected project efforts to address the major unresolved technical questions and to complete an assessment of the viability of licensing and constructing a repository at Yucca Mountain. Congress indicated its approval of the revised Program Plan in the *Conference Report on the Energy and Water Development Appropriations Act, 1997, H.R. Rep. No. 782, 104th Cong., 2d Sess. 82* (1996), by directing that the appropriated funds be used in accordance with the revised Program Plan issued by DOE in May 1996.

In the Fiscal Year 1997 Energy and Water Development Appropriations Act (Pub. L. No. 104–206), Congress directed DOE to provide the viability assessment of the Yucca Mountain site, referenced in DOE's revised Program Plan, to Congress and the President as a basis for making future decisions on program funding and direction. DOE issued the Viability Assessment of a Repository at Yucca Mountain (Viability Assessment) in December 1998. Drawing on 15 years of scientific investigation and design work, the Viability Assessment summarizes a large technical basis of field investigations, laboratory tests, models, analyses and engineering. The Viability Assessment also identifies major uncertainties relevant to the technical defensibility of DOE's analyses and designs, the approach to managing these uncertainties, and the status of work relative to the target dates of 2001 for a determination on recommendation of Yucca Mountain and 2002 for submittal of a license application to NRC. The Viability Assessment also includes the most recent iteration of the TSPA, and the results of that process.

*Coordination with NRC.* DOE's implementation of its site characterization program and the issue resolution strategy embodied in the SCP has been conducted in close coordination with the NRC. In 1995, the NRC revised its prelicensing repository program as a result of changes in the DOE civilian radioactive waste management program, the findings of a NAS committee recommending changes to the public health standard for a potential Yucca Mountain repository, and budgetary constraints imposed by Congress. The NRC adjusted the scope of its program to focus only on those topics most critical to repository performance, termed "key technical issues." These issues were intended to be a vehicle to communicate to DOE those technical matters for which the NRC had remaining unanswered questions regarding the performance of the Yucca Mountain site, or the data needed to assess that performance. DOE's management of the site characterization program includes activities to obtain information to address the NRC key technical issues. DOE has structured the site characterization program such that one of its goals is for DOE and NRC to reach consensus that the remaining key technical issues have been addressed adequately, or that adequate plans are in place to address the issues.

#### *H. The 1993–1995 Public Dialogue on the Guidelines*

In the SCP, issued in December 1988, DOE described how it would apply the Guidelines as part of the site characterization program to evaluate the suitability of the site. DOE indicated in the SCP that the Guidelines related to site characterization activities would be applied as the suitability criteria. DOE also indicated there that the comparative provisions of those requirements would not be applied in light of the 1987 amendments to the NWPA limiting site characterization activities to Yucca Mountain. Notwithstanding this explanation, a number of interested parties suggested it remained unclear how DOE would apply the Guidelines in the future. Because of this continuing stated uncertainty, the DOE instituted an ongoing dialogue with external parties on the Guidelines.

In October 1993, DOE briefed the representatives of the affected units of local government and the State of Nevada on its plans for activities related to site suitability evaluation. DOE followed this briefing with a Notice of Inquiry in the **Federal Register** (59 FR 19680), dated April 25, 1994, eliciting the views of the public on the appropriate role of the Guidelines. A public meeting was held on May 21, 1994 in Las Vegas, Nevada. The purposes of the meeting were to follow-up on a previous public meeting held in August 1993; to update the public on site characterization activities; and to provide an opportunity to discuss the development of a process to evaluate site suitability. DOE then published a second **Federal Register** notice (59 FR 39766) on August 4, 1994, announcing that it intended to use the Guidelines as currently written, subject to the programmatic reconfiguration directed in the 1987 NWPA amendments. Through that notice, DOE also announced the availability of a draft description of the proposed process and its intention to hold two additional public meetings to discuss the matter. Although several options were discussed, DOE discerned no clearly preferred option from this public comment process. In response to public comments at the meetings, DOE committed to provide background information and its rationale for maintaining the use of the Guidelines as originally promulgated, with modification to eliminate application of the comparative portions of the Guidelines. In September 1995, DOE published in the **Federal Register** the background information and its

rationale, as committed to in previous public meetings. 60 FR 47737.

In the September 1995 public notice, DOE explained that amending the Guidelines, either to remove those portions that are primarily used for comparative purposes or to develop guidelines tailored to evaluation of the suitability of the Yucca Mountain site, was not required at that time. DOE recognized then that the Guidelines might have to be amended at some future date to be consistent with any changes to EPA or NRC requirements. 60 FR 47740. Among the options considered in the 1993–1995 public dialogue was abandonment of the Guidelines and adoption of the NRC siting criteria in 10 CFR 60.122. DOE noted that the Guidelines were expressly derived from, and are tied to, the part 60 siting criteria. In addition, DOE noted that, should any differences between 10 CFR part 960 and 10 CFR part 60 be identified, 10 CFR part 60 would prevail in the licensing process. While recognizing that much of 10 CFR 960 subpart B, the implementation guidelines, was no longer applicable, DOE concluded that the Guidelines could be selectively interpreted to avoid the comparative aspects while applying the relevant provisions of subparts C and D, the postclosure and preclosure guidelines.

#### *I. The 1996 Notice of Proposed Rulemaking*

For many of the reasons described earlier in this notice, including changes in congressional direction of the repository program and advancements in site characterization, on December 16, 1996, DOE published in the **Federal Register** a notice of proposed rulemaking for 10 CFR part 960. 61 FR 66158. In that notice, DOE proposed to clarify and focus the Guidelines and to add a new, site-specific subpart E to the Guidelines. Subpart E would apply only to the Yucca Mountain site, and would contain preclosure and postclosure system guidelines, each with a single qualifying condition. 61 FR 66163. In each of the periods, the qualifying condition would be that a repository at Yucca Mountain be capable of limiting radiological releases within applicable standards to be set by EPA and implemented by the NRC through the repository licensing process. DOE would demonstrate this capability through performance assessments. 61 FR 66164. These performance assessments would forecast the performance of a proposed geologic repository at Yucca Mountain and compare the results of the assessments to the applicable regulatory standards to

determine whether the site would be suitable for development as a repository.

The 1996 proposal was consistent with the system-level evaluation originally envisioned for the conclusion of site characterization. DOE recognized in 1984 in the Guidelines that, only after the entire process of narrowing the number of potentially acceptable sites to one and after site characterization, would it be possible to conduct complete performance assessments. Such assessments require detailed information that can be obtained only during site characterization. 49 FR 47717. In addition, the 1996 proposal was consistent with DOE's longstanding position that the Guidelines must complement and not conflict with EPA and NRC regulations, since the ability to meet applicable public health and safety standards and develop information adequate to support a license application has always been central to the site suitability determination.

The 1996 proposal attracted a wide variety of comments from members of the public, the NRC, the EPA, and the Nuclear Waste Technical Review Board. The major issues that emerged from the public comment process are discussed in detail later in this Supplementary Information. For reasons also explained below, these comments persuaded DOE to reassess the clarity of the proposed regulations and the legal and policy basis for them.

#### *J. Proposed NRC Regulation, 10 CFR Part 63*

##### 1. Background

On February 22, 1999, the NRC published in the **Federal Register** a proposed new rule, 10 CFR part 63, containing licensing criteria for disposal of spent nuclear fuel and high-level radioactive waste in the proposed geologic repository at Yucca Mountain, along with proposed revisions to 10 CFR part 60 and other related regulations. 64 FR 8640. The proposed licensing criteria at part 63 would apply exclusively to Yucca Mountain; part 60 would be revised to make it applicable to any geologic repository other than one at Yucca Mountain. NRC's proposal seeks to establish a new system of risk-informed, performance-based regulation. Under this approach, risk insights, engineering analysis and judgment, and performance history are used to: (1) Focus attention on the most important activities; (2) establish objective criteria based upon risk insights for evaluating performance; (3) develop measurable or calculable parameters for monitoring system and licensee performance; (4) provide

flexibility to determine how performance criteria are met; and (5) focus on results as the primary basis for regulatory decision-making. 64 FR 8643.

The NRC's rationale for proposing part 63 stems from the requirements of the EPACT. 64 FR 8641–8643. Section 801(b) of EPACT requires that, within one year after EPA promulgates its new standards for protection of public health and safety, the NRC must modify its technical requirements and criteria for repository licensing (*i.e.*, part 60) to be consistent with the new EPA standards. In addition, the EPACT requires NRC to include in its modifications, consistent with the NAS findings and recommendations, certain assumptions that are specified in the EPACT with regard to the effectiveness of DOE's postclosure oversight of the repository.

The NAS issued its findings and recommendations in the report, Technical Bases for Yucca Mountain Standards, August 1995. The NAS findings and recommendations reported there, along with consultation NRC has had with EPA, provide the basis for NRC's proposed modifications. 64 FR 8641, 8643. The NAS recommended approach to setting a public health and safety standard has a different objective from the NRC approach reflected in the existing part 60 requirements and criteria. 64 FR 8643. Accordingly, the modifications proposed by the NRC, based on the NAS report, and the subsequently proposed EPA rule marked a change in methodology and licensing philosophy.

##### 2. Structure of Proposed Part 63

*Preclosure Requirements.* Proposed part 63 would require DOE to demonstrate compliance with the applicable preclosure regulatory standards by the use of an integrated safety analysis. 64 FR 8652. An integrated safety analysis is a systematic examination of the geologic repository operations area's hazards and their potential for initiating events (for example, accidents), the potential consequences of the events, and the site, structures, systems, components, equipment and activities of personnel. The analysis would be conducted to ensure that all relevant hazards that could result in unacceptable consequences have been adequately evaluated and appropriate protective measures have been identified. "Integrated" means joint consideration of safety measures that otherwise might conflict, including such measures as fire protection, radiation safety, criticality safety, and chemical safety. The results of the analysis would be used to support a finding of compliance with a

performance objective for the preclosure period of limiting radiation exposures and releases within a dose limit of 25 millirem (mrem) to any member of the public beyond the site boundary.

*Postclosure Requirements.* While certain parts of proposed part 63 are similar to part 60, in particular with respect to many procedural and administrative regulations, the substance of the regulations governing postclosure performance objectives is fundamentally different. The part 60 technical criteria for postclosure rely on several quantitative, subsystem performance objectives. In 1983–4, NRC believed this approach was best suited to meet its statutory requirement under section 121(b)(1)(B) of the NWSA to prescribe criteria that would involve use of a system of multiple barriers in the design of the repository. 64 FR 8648. At the time part 60 was written, NRC's technical opinion was that compliance with this requirement could be best demonstrated by specifying subsystem technical requirements, thereby assuring multiple, independent and redundant systems and barriers. Given advancements in technical understanding and analytical capability, and information acquired through site-characterization at Yucca Mountain, the NRC no longer believes this approach is an optimal and reliable approach to assure compliance with public health and safety standards. 64 FR 8648–8649.

Part 63 does not contain subsystem performance requirements, or analogs for those requirements, as found in part 60. The part 63 requirements are based on only one quantitative standard—demonstrating compliance with an individual dose limit. The part 63 technical criteria are compatible with the NRC's philosophy of risk-informed, performance-based regulation. This approach is consistent with NAS recommendations that would require compliance with a health-based standard established in consideration of risk to a hypothetical critical group as the only quantitative standard for postclosure repository performance. 64 FR 8643. The NRC concept of critical group means the hypothetical group of individuals reasonably expected to receive the greatest exposure to radioactive materials potentially released from a geologic repository at Yucca Mountain. The EPA proposes in its rule (described in section II. K) the use of a reasonably maximally exposed individual (RMEI). The RMEI is a hypothetical individual having certain characteristics that include where the RMEI lives, what the RMEI's diet would consist of and the amount of water consumed by the RMEI on daily basis.

For the purposes of this proposed rule, the term receptor is used in lieu of either the EPA or NRC concept. A receptor is intended to represent a member of the public, either an individual or group, that could be exposed to releases of radiation from a repository at Yucca Mountain. When the suitability determination is made, DOE would implement the regulatory concept applicable at that time.

This approach is also consistent with NRC's obligation to ensure a multiple barrier system by requiring DOE to demonstrate that the natural barriers and the engineered barriers will work in combination to enhance overall performance of the repository.

Part 63 would require DOE to demonstrate compliance with the applicable postclosure regulatory standard by the use of performance assessment. 64 FR 8650. Performance assessment is a systematic analysis that identifies the features, events, and processes that might affect performance of the geologic repository, examines their effects on performance, and estimates the resulting expected annual dose. Demonstrating compliance with the postclosure performance of 10 CFR part 63 would require a performance assessment to quantitatively estimate the expected annual dose, over the compliance period, to the average member of the critical group. The critical group would be a hypothetical group of individuals reasonably expected to receive the greatest exposure to radioactive materials released from the geologic repository. Consistent with the EPACT and the 1995 NAS report, the NRC proposed that the results of the performance assessment be the sole quantitative measure used to demonstrate compliance with the individual dose limit. 64 FR 8650.

Because of the importance of the performance assessment, part 63 is structured to establish certain minimum requirements governing the content and validation methods for the performance assessment. 64 FR 8650-8651. For example, DOE would be required to include in the performance assessment data related to the geology, hydrology and geochemistry of Yucca Mountain, as well as data related to the design of the engineered barrier system; to account for uncertainties and variabilities in the data used to model performance of the repository; to provide the technical basis for either inclusion or exclusion of specific features, events, and processes of the geologic setting; and to provide the technical basis for the models used in the overall performance assessment by providing, for example, comparisons

of the output of detailed process-level models and empirical observations. In addition, part 63 would prescribe the characteristics of the reference biosphere and receptor to be used in the performance assessment. DOE also would be required to conduct a separate performance assessment based on a limited human intrusion scenario prescribed by the NRC.

#### *K. Proposed EPA Regulation, 40 CFR Part 197*

##### 1. Background

On August 27, 1999, the EPA published in the **Federal Register** a proposed new rule, 40 CFR part 197, to establish public health and safety standards governing the storage and disposal of spent nuclear fuel and high level waste in a potential repository at Yucca Mountain, Nevada. 64 FR 46975. EPA is promulgating this rulemaking pursuant to section 801(a) of the EPACT. As explained earlier in this preamble (section I.F.), in section 801(a)(1) of the EPACT Congress directed EPA to promulgate a health-based standard for the protection of the public from releases from radioactive materials stored or disposed of in a repository at the Yucca Mountain site. Also under EPACT, Congress directed that the EPA standard was to be the only standard applicable to the Yucca Mountain site, and that the EPA standard must be based upon and consistent with NAS' findings and recommendations.

As directed by Congress in the EPACT, it is EPA's role to establish the public health and safety standard, and NRC's role to implement that standard in any licensing process NRC may conduct for a repository at Yucca Mountain. It is anticipated that NRC would conform its proposed licensing regulation at 10 CFR part 63 to the final EPA radiation protection standards, as necessary and appropriate.

##### 2. Structure of Proposed Part 197

The proposed EPA rule is structured in two parts. Part A of the rule would establish the environmental standards for storage of spent nuclear fuel and high level waste at Yucca Mountain; part B would establish the environmental standards for disposal of spent nuclear fuel and high level waste at Yucca Mountain. The following is an overview of the main components of EPA's proposed rule; in many areas of the rule EPA has proposed alternative language and requirements for public review and consideration. For simplicity, not all of those alternative considerations will be presented here.

For storage of spent nuclear fuel and high level waste, EPA proposes a standard limiting the annual committed effective dose equivalent (CEDE) to no more than 15 millirems to any member of the public in the general environment. This limit would apply to releases from the combination of management and storage of spent nuclear fuel and high level waste that is within the Yucca Mountain repository (below ground) and outside the Yucca Mountain repository but within the Yucca Mountain site (aboveground). EPA proposes this standard to be consistent with the risk level set in its generic standards for management and storage of spent nuclear fuel, high level waste, and transuranic waste, codified at subpart A of 40 CFR part 191 and with its interpretation of section 801 of EPACT requiring it to set site-specific standards for storage of waste at Yucca Mountain. In EPA's view, storage of waste, whether inside the Yucca Mountain repository or outside the Yucca Mountain repository but within the Yucca Mountain site, presents the same technical situation and is analogous to the storage of radioactive waste at other facilities covered by 40 CFR part 191. Accordingly, EPA proposes the storage standard for Yucca Mountain be essentially the same as the standard applicable to other facilities subject to subpart A of 40 CFR part 191.

For disposal of spent nuclear fuel and high level waste, EPA proposes essentially three standards—an individual protection standard, a human intrusion standard, and a groundwater standard—that DOE would need to demonstrate to the satisfaction of the NRC to ensure protection of public health and safety. Under the individual protection standard, DOE would demonstrate that there is a reasonable expectation that for 10,000 years following disposal the reasonably maximally exposed individual (RMEI) receives no more than an annual committed effective dose equivalent (CEDE) of 15 millirems (mrem) from releases from the undisturbed Yucca Mountain disposal system. All potential pathways must be included in this analysis. In proposing this individual protection standard, EPA concluded that radiation release limits, such as those embodied in 40 CFR part 191, were not necessary in order to protect members of the general public from releases from a repository at Yucca Mountain.

For the proposed human intrusion standard, EPA proposes two alternative rules, one of which would impose a CEDE limit of 15 mrem to a RMEI based on an assumed human intrusion event,

while the alternative rule would impose the dose limit if complete waste package penetration can be shown to occur before 10,000 years after disposal. EPA also proposes a rule outlining the elements of the human intrusion scenario to be used in the analysis.

Under the proposed groundwater protection standard, EPA would require DOE to provide in its license application a reasonable expectation that for 10,000 years of undisturbed performance after disposal, releases of radionuclides from radioactive material in the Yucca Mountain disposal system will not cause the level of radioactivity in the representative volume of ground water at the point of compliance to exceed certain limits (*e.g.*, combined beta and photon emitting radionuclides cannot exceed a limit of 4 millirems per year to the whole body or any organ). EPA presents for public review and comment several alternatives for the selection of the representative volume of water and for the location of the point of compliance.

EPA's proposed approach to setting public health and safety standards for a repository at Yucca Mountain follows the NAS recommendations and findings, and the regulatory approach proposed by the NRC in its proposed licensing regulations. Although EPA has proposed some requirements in its rulemaking that differ from certain NAS findings and recommendations and NRC's proposed licensing regulations, (for example, EPA proposes use of a dose standard instead of a risk standard, and use of the RMEI concept instead of critical group), EPA's proposed rule is consistent with the primary NAS findings and recommendations that a public health standard based on risk or dose to an individual member of the public can be protective of general public health and safety, and that the Yucca Mountain-related physical and geologic processes are sufficiently quantifiable and the related uncertainties sufficiently boundable that the performance can be assessed over certain time frames.

EPA assumes, and, in the case of the individual protection standard, EPA would expressly require DOE to use performance assessment to calculate the dose limits established in its proposed radiation protection standards for disposal. Although EPA generally would not prescribe requirements on how the performance assessments would be conducted, it would impose certain limitations. For example, proposed section 197.40 would limit consideration by DOE in its performance assessments of events that are estimated to have less than one

chance in 10,000 of occurring within 10,000 years of disposal. In addition, EPA, similar to the NRC, acknowledges certain inherent limitations in DOE's ability to demonstrate compliance with the public health and safety standard through use of performance assessment, but nevertheless mandates the use of that method of assessment. EPA's rule recognizes, through the concept of reasonable expectation, that, among other things, there are inherent uncertainties in making long-term projections of the performance of the Yucca Mountain disposal system, that performance assessments and analyses should be focused upon the full range of defensible and reasonable parameter distributions, and that assessments should not exclude important parameters simply because they are difficult to precisely quantify to a high degree of confidence.

### III. Basis for Proposal

#### A. Legal Authority and Necessity To Amend the Guidelines and Criteria

##### 1. Overview

Section 112(a) of the NWPA explicitly establishes DOE authority to "issue general guidelines for the recommendation of sites for repositories" and to "use [the] guidelines established under this subsection in considering candidate sites for recommendation under subsection (b)." Subsection (b) of section 112 provides for a process, to be conducted following promulgation of the guidelines that would result in: (1) the nomination of 5 potential sites for characterization; and (2) the selection of 3 of those 5 sites for recommendation to the President as suitable for site characterization activities. Section 112(a) also includes explicit authority to revise the guidelines, from time to time, consistent with the provisions of 112(a).

Shortly after the enactment of the NWPA, DOE promulgated the Guidelines (codified at 10 CFR part 960) to implement section 112. The approach taken at that time was to structure the Guidelines to provide a framework not only for the section 112 decisions (for which it was statutorily required) but also for subsequent steps in the site selection process. Consistent with this view, the Guidelines as originally promulgated also addressed actions to be taken under sections 113 and 114. The rationale permitting that approach was the provision in section 113(b) that DOE include in its site characterization plan "criteria to be used to determine the suitability of [a] site for the location of a repository, developed pursuant to section 112(a)." 49 FR 47730. DOE

reasoned that, since the site characterization plan was to be an element supporting any Secretarial recommendation of one site for development under section 114, the Guidelines were "intended to be used in deciding which among the characterized sites is to be recommended to the President, the Congress, and finally to the NRC for appropriate approvals." 47 FR 47730. That approach was understandable in 1984 when DOE anticipated the need to evaluate by comparison multiple characterized sites, a comparison similar to the choosing of sites for characterization for which the Guidelines were required by section 112(a) of the NWPA. After the 1987 amendments to the NWPA designated Yucca Mountain as the only site to be characterized, DOE chose to apply some, but not all, of the Guideline provisions in the Site Characterization Plan prepared under section 113(b) of the NWPA as criteria to determine site suitability. DOE/RW-0199 (1988). In 1995, DOE reconsidered the Guidelines in the context of evaluating the suitability of the Yucca Mountain site under the Site Characterization Plan. DOE decided then that "[b]ecause DOE need apply only the relevant provisions" of the Guidelines, amending or supplanting them with "Guidelines specifically tailored" to evaluating the suitability of the Yucca Mountain site was "not required at this time." 60 FR 47737, 47740 (1995).

As discussed in greater detail below, DOE now has determined that a new approach is called for in light of the cumulative effect of the intervening legislative, regulatory, and technical developments that have occurred since 1984. DOE now proposes to develop criteria, using section 112(a) in the development of the criteria, but not adopting the particular section 112(a) Guidelines as those criteria, to form the basis for a determination of the suitability of the Yucca Mountain site for the location of a repository. The rationale for this approach stems from the basic analysis recommended by the National Academy of Sciences, which differed from that embedded in the 1984 Guidelines, and the advent of new regulations proposed by the NRC that, under the NWPA's structure, must define the areas and methodology of DOE's inquiries into Yucca Mountain's suitability.

Accordingly, DOE today proposes to revise the existing Guidelines at 10 CFR part 960 to limit their application to only the initial site selection process set forth in section 112. DOE may make additional revisions to the Guidelines if, in the future, circumstances were to

change and DOE were to reinitiate a preliminary site screening process under section 112. Further, DOE proposes today to promulgate a new rule, consistent with section 113(b)(1)(A)(iv), to establish criteria to be used to determine the suitability of Yucca Mountain for the location of a geologic repository. The criteria identified in this new rule are based on the geologic factors and considerations referenced in section 112(a), as they relate to DOE's current scientific understanding and methodology for assessing the suitability of the Yucca Mountain site as a location for a repository.

## 2. Section 112

DOE's approach in today's proposal is grounded on the text of section 112(a) and the basic structure of the NWPA, as originally enacted and as amended. As originally enacted, the NWPA set up a sequential process for selecting, comparing, and evaluating potential sites for the development of a geologic repository for high-level waste. The 1987 amendments eliminated any continued comparison of sites; only Yucca Mountain is authorized for site characterization activities leading to possible recommendation as a repository site. Beyond the first step in the process, recommendation of multiple sites for site characterization (section 112), there is no explicit direction in the Act (in its original enactment or amendment) whether or how to utilize the Section 112(a) Guidelines in the succeeding site selection processes (sections 113 and 114). Instead, section 112(a) specifies the intended use of the Guidelines: "[t]he Secretary shall use guidelines established under this subsection in considering sites to be recommended for site characterization under section 112(b)." Likewise, the environmental assessment of the various sites nominated for characterization pursuant to section 112 is to include "evaluation" of each nominated site under each Guideline not requiring characterization for its application and all the Guidelines pertinent to whether a site is "suitable for site characterization." 42 U.S.C. 10132(b)(1)(D)(i)&(ii). Nowhere in its text does section 112 require any additional use of the Guidelines.

In sum, the text of section 112 and its relation to other provisions in the NWPA indicate that the Guidelines are to govern the process of selecting and comparing among potential sites to determine which sites are appropriate to proceed to the next, more detailed evaluation stage, site characterization. In contrast, nothing in the text of section

112 specifies that the Guidelines are also to govern the process for determining site suitability and site recommendation under sections 113 and 114.

## 3. Section 113

Section 113 of the NWPA requires DOE to prepare a site characterization plan for a candidate site selected under section 112 for site characterization activities. A required element of a site characterization plan is "criteria to be used to determine the suitability of such candidate site for the location of a repository, developed pursuant to section 112(a)." 42 U.S.C.

10133(b)(1)(A)(iv) (emphasis added). The NWPA does not define the term "criteria." The NWPA does, however, define the term "site characterization" as activities "undertaken to establish the geologic condition" of a candidate site. 42 U.S.C. 10101(21)(B). This definition indicates that the required scope of the general site characterization plan and therefore of the section 113(b) "criteria" is limited to geologic considerations. This reading of section 113(b) is reinforced by the provisions of section 112(a) in which the only usage of the term "criteria" in that section are the "primary criteria" that are explicitly equated to "geological considerations."

Section 113(b) requires that the "criteria" to be included in the Site Characterization Plan be "developed pursuant to section 112(a)" of the NWPA. Because section 112(a) of the NWPA is devoted to the "Guidelines" for selecting candidate sites while section 113(b) is devoted to the "criteria" under which selected candidate sites subsequently are to be characterized, it is necessary to consider how the Guidelines are required to relate to the criteria by section 113's requirement that the criteria be "developed pursuant to section 112(a)."

It is unlikely that the Congress intended to require the "criteria" to be the Guidelines themselves. It would have been simple enough for Congress to have legislated that policy in section 113(b) by a straightforward requirement that the Site Characterization Plan specify that the "Guidelines developed pursuant to section 112(a)" would be used "to determine the suitability of each candidate site." Compare 42 U.S.C. 10133(b)(1)(A)(iv). Had Congress intended this policy result it is unlikely that it would have chosen such an elliptical and opaque way of expressing it as the actual statutory text that does not use the term "Guidelines" at all. And a construction of section 113(b) requiring the suitability "criteria" to be the same as the section 112 Guidelines

would risk tension with section 113(c)'s restriction that limits DOE to conducting "only" characterization activities "necessary to provide the data required" to prepare an NRC license application. The NRC, of course, is not required to base its licensing standards on the Guidelines adopted by DOE under section 112(a) of the NWPA (although it was required to concur in them), nor does section 112 afford the NRC the ability to compel DOE to reformulate the Guidelines should the NRC determine to amend or supplant its licensing standards.

Section 112(a) contains specific procedural mandates required to be employed by DOE in issuing or revising the Guidelines. Before DOE may promulgate the Guidelines DOE must consult with several specified federal agencies and with "interested Governors." 42 U.S.C. 10132(a). In addition, the NRC must "concur[]" in the issuance of the Guidelines. *Id.* These distinctive procedural requirements obviously are tailored to the particular circumstances of site decision-making under the NWPA and therefore specify procedural requirements that would not otherwise obtain under the rulemaking provisions of the Administrative Procedure Act or the rulemaking provisions of the Department of Energy Organization Act that were in force when the NWPA was adopted.

The requirement of section 113(b) that the SCP's "criteria" for characterizing sites be "developed pursuant to section 112(a)" therefore is best understood as mandating observance of the special procedural requirements of section 112(a) in formulating or altering the section 113(b) "criteria." This understanding of the statutory text seems the most faithful to its explicit terms and the larger statutory context in which it occurs. Moreover, it seems the only understanding of section 113(b) that is consistent with the 1987 changes to the NWPA (which mandated exclusive characterization work for the Yucca Mountain site without amending section 113(b) despite amending the statute elsewhere to remove the element of comparing sites, to which the Guidelines of section 112(a) were devoted). This understanding of the requirements of section 113(b) also comports with DOE's prior understanding, as was described in the 1995 notice, that not all the original Guideline elements need be applied in site characterization under section 113 of the NWPA.

*B. Events Necessitating Amendment of the Guidelines and Criteria*

1. Congressional Redirection of the Program

Since the NWPA was enacted in 1982 and the Guidelines promulgated in 1984, Congress has made major changes to the framework for developing a geologic repository. Those changes are described below and, in part, form the basis for the revisions to 10 CFR part 960 and the promulgation of a new 10 CFR part 963 proposed in this notice.

*1987 Amendments to the NWPA.* Congress amended the NWPA in 1987 to select Yucca Mountain as the only site to be characterized. In support of that decision, Congress directed DOE to terminate site-specific activities at the two other sites that had been recommended for site characterization in 1986. 42 U.S.C. 10172. Further, Congress restricted DOE's characterization activities at Yucca Mountain to only those the Secretary considers necessary to provide the data required for evaluation of the suitability of the site for NRC construction authorization (*i.e.*, license application), and for compliance with the National Environmental Policy Act of 1969. A provision was added to the NWPA to provide for termination of site characterization activities at Yucca Mountain if at any time the Secretary determines that Yucca Mountain is unsuitable for development as a repository.

Although the 1987 amendments to the Act were decisive in focusing the repository program and DOE's efforts on one specific site, for many years DOE maintained that these changes were not so significant as to warrant amendment of the Guidelines. Instead, DOE believed the Guidelines, for the most part, could be applied to Yucca Mountain for purposes of determining the suitability of the site (because Yucca Mountain already had been found suitable for characterization under other provisions of the Guidelines) in support of a possible site recommendation by the Secretary. The only changes to the Guidelines necessitated by the 1987 amendments were to eliminate consideration of those parts of the Guidelines related to comparative analysis. Similarly, the NRC had not made significant modifications to its technical requirements and criteria in 10 CFR part 60 as a result of the 1987 amendments to the Act.

*1992 Energy Policy Act.* In the 1992 Energy Policy Act, Congress reinforced its intent that Yucca Mountain was the exclusive focus of the nation's repository program, not only for DOE,

but also for the other federal agencies, EPA and NRC, with authority and responsibility over the repository program. Section 801 of the EPACT directed the EPA to promulgate, by rule, new public health and safety standards for the protection of the public from releases from radioactive materials stored or disposed of in a repository at the Yucca Mountain site. Unlike the previous standard, which was generic to geologic repositories and included limits on radioactive releases to the environment, the new standards were required to prescribe maximum annual radioactive dose limits to individual members of the public based on releases to the accessible environment from materials stored or disposed of at Yucca Mountain. To aid EPA in this process, Congress directed a National Academy of Sciences (NAS) study to provide findings and recommendations on reasonable standards for protection of the public health and safety. EPA was required to base its new rule on the findings and recommendations of the NAS. For Yucca Mountain, these standards would replace the generally applicable standards for the protection of the general environment that the EPA had promulgated at 40 CFR part 191 under the authority of section 121 of the NWPA.

The EPACT also directed the NRC to modify its technical requirements and criteria, as necessary, to be consistent with the EPA's new standards. In addition, NRC was directed to ensure that, consistent with the NAS findings and recommendations, its requirements and criteria for postclosure oversight of a Yucca Mountain repository would be sufficient to prevent any activities at the site posing an unreasonable risk of breaching the engineered and natural barriers of the site, and to prevent any increase in exposure of individual members of the public beyond allowable limits.

These changes were significant because they set the stage for future regulatory changes governing the standards a Yucca Mountain repository must meet to ensure public health and safety, and to obtain a license for construction. The ability to meet regulatory standards has always been a dominant factor in the site selection process. This requirement is reflected in the structure of the Guidelines, is reinforced by the 1987 amendments to the Act, and is a prime focus of DOE's site characterization program. Thus, the Congressional mandate in the EPACT directing new and revised regulations governing geologic disposal at Yucca Mountain necessarily impacts DOE's formulation of the criteria that will be

used to determine the suitability of Yucca Mountain as a site for development of a repository. Until recently, however, the full extent and nature of those impacts have not been defined. The NRC's recent proposal to amend 10 CFR part 60, its technical requirements and criteria for licensing a repository, to add a new part 63 specific to Yucca Mountain, provides DOE with an outline of anticipated regulatory changes, and signals for DOE how and why it must conform its Guidelines and criteria for determining the suitability of the Yucca Mountain site for the location of a repository.

Fiscal Years 1996 and 1997 Appropriations Acts and the Viability Assessment. Finally, in response to budgetary concerns, the Conference Report on the Energy and Water Development Appropriations Act, 1996 (Pub. L. No. 104-46) (H.R. Rep. No. 293, 104th Cong., 1st Sess. 68 (1995)) directed the DOE to focus on only those activities necessary to assess the performance of a repository at the Yucca Mountain site and to collect the scientific information needed to determine the site's suitability. DOE responded by revising its Program Plan for 1996 in which it indicated that, among other changes, DOE would complete a viability assessment of the Yucca Mountain site in 1998, and would develop a proposal to amend the Guidelines and develop new regulations specific to the Yucca Mountain site. Congress indicated its approval of the changes by directing that appropriated funds be used in accordance with the revised program plan. Congress reinforced this direction in the Fiscal Year 1997 Energy and Water Appropriations Act, where it mandated that DOE provide to the Congress and the President a viability assessment of the Yucca Mountain site in 1998.

These changes in budget for DOE's civilian radioactive waste management program indicate congressional intent for DOE to focus site characterization activities on assessing the viability and suitability of Yucca Mountain, and to complete those activities in the near term. In light of this congressional direction, it is reasonable for DOE to amend the Guidelines in a manner that acknowledges Yucca Mountain as the only site at which site characterization has occurred and for which DOE would need to conduct a suitability evaluation under section 113(b).

2. Consistency Between DOE and NRC Regulations

*Procedural Consistency.* The DOE's site characterization suitability criteria must be consistent with the NRC's

licensing criteria if the DOE is to present a potentially successful license application to the NRC. Such consistency originally was attained in the Guidelines through the NRC's concurrence process, as required by section 112(a) of the NWPA. DOE will preserve this consistency in these proposed suitability criteria by ensuring that they reflect the changes to the licensing criteria that recently have been proposed by the NRC in a new rule to be codified at 10 CFR part 63, and by soliciting NRC concurrence on DOE's proposed amendments to the Guidelines and the promulgation of a new regulation at 10 CFR part 963.

*Substantive Consistency.* NRC's proposed new rule establishing the technical requirements and criteria for repository licensing at Yucca Mountain, proposed 10 CFR part 63, is different from its existing general rule on repository licensing, 10 CFR part 60. DOE now has little choice but to propose site suitability criteria that are consistent with the NRC's proposed licensing requirements. The suitability of a site for the location of a repository is a function of the DOE's ability to demonstrate the site can meet applicable regulatory requirements. DOE has conducted the site characterization program at Yucca Mountain with the statutory objective [42 U.S.C. 10133(c)] of demonstrating its ability to obtain construction authorization from the NRC (*i.e.*, to meet NRC licensing requirements and EPA health and safety standards, as implemented by NRC through the license). DOE could not scientifically and technically support a suitability determination, and, hence, a license application, without conforming its criteria for suitability to the proposed NRC technical requirements and criteria for a repository license. Such conforming criteria are proposed in this notice.

The NRC proposed rule part 63 is a departure from the philosophy and technical requirements of 10 CFR part 60. The new rule would be based on the 1995 NAS report recommending a risk-limit standard for a repository at Yucca Mountain. The NRC timed publication of its proposal now to ensure NRC has sufficient time, once EPA issues its new standard, to put the new licensing standards in effect. The proposed rule embodies a new approach of risk-informed, performance-based regulation, and is specific to Yucca Mountain. The old rule relied on

subsystem performance objectives and a release limit standard. Under the proposed rule, the performance of a Yucca Mountain repository would be evaluated against a health-based standard in consideration of risk to a hypothetical critical group and this standard would be the only quantitative standard for the postclosure performance of the repository. The new rule would require DOE to demonstrate compliance with postclosure technical criteria through performance assessments, and preclosure criteria through an integrated safety analysis. The new approach embodied in the proposed rule would eliminate current part 60 design and siting criteria, as well as quantitative subsystem requirements, but would add specific requirements for the content of performance assessments to ensure their sufficiency and adequacy. In other words, a proposed Yucca Mountain repository would be evaluated as an entire system, not by assessing its individual parts in isolation, in order to determine whether it meets applicable standards to protect public health and safety.

Once the proposal is finalized, the current structure of DOE's technical guidelines, which is premised on a demonstration of system and subsystem technical requirements, will no longer be consistent with, and in some cases may conflict with, the NRC technical requirements to support a license application. For example, several of DOE's technical guidelines require compliance with the siting and design requirements set forth in 10 CFR parts 60.113, 60.122 and 60.133. Those requirements would not exist in proposed part 63 and would not be applicable to Yucca Mountain under proposed amendments to part 60. Those requirements are subsystem performance requirements that are inconsistent with the NRC's new approach of evaluating the technical merits of a potential site based on the performance of the repository system as an integrated whole, and not on the performance of each part independent of the other parts.

A good example of this is the geohydrology guideline at 960.4-2-1. Under this guideline, DOE set qualifying and disqualifying conditions for the geohydrology of a site. The qualifying condition for geohydrology requires a site be capable of compliance with radionuclide release limits set by EPA in 40 CFR part 191, and by NRC in 10 CFR part 60.112, as well as compliance

with DOE subsystem performance requirements that mirror NRC requirements in 60.113. At present, there is no applicable release limit set by EPA under 40 CFR part 191, and the NRC's proposed amendments to 10 CFR part 60 would nullify the applicability of 60.113 to Yucca Mountain and create a new part 63 for which there is no analogous release limit or subsystem performance objective for geohydrology. Accordingly, it would be illogical for DOE to reach a finding relative to this qualifying condition, as required by Appendix III, based on regulatory requirements that no longer would be applicable to the Yucca Mountain site and would not support a determination of site suitability for the Yucca Mountain site.

The DOE Guideline 960.4-2-1 also contains a disqualifying condition. Under this condition, DOE would disqualify a site if the pre-waste emplacement ground water travel time from the disturbed zone to the accessible environment is expected to be less than 1,000 years along any pathway of likely and significant radionuclide travel. Under the analogous NRC provision, 60.113, there is a performance objective directing that the pre-waste emplacement ground water travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment must be at least 1,000 years or such other travel time as approved by the NRC. Under NRC's proposed revisions to its regulations, this subsystem performance requirement would no longer apply to a repository at Yucca Mountain under part 60, and it would not exist, nor would there be any requirement similar to it, under new part 63. Accordingly, it would be illogical for DOE to reach a finding relative to this disqualifying condition, as required by Appendix III, based on regulatory requirements that no longer would be applicable to the Yucca Mountain site and would not support a determination of site suitability for the Yucca Mountain site.

Below is a table further illustrating the inconsistencies between the current Guidelines and the proposed part 63. Table 1 provides a cross walk between the technical guidelines to be applied as the criteria under section 113(b), their analog in existing part 60, and their analog, if any, in proposed part 63.

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Table 1

Section	Guideline	Condition	10 CFR 60	New 10 CFR 63
4-1(a)	System	Qualifying	60.112	63.113
4-2-1(a)	Geohydrology	Qualifying	60.112/113	63.113/None
4-2-1(d)	" "	Disqualifying	60.113(a)(2)	None
4-2-2(a)	Geochemistry	Qualifying	60.112/113	63.113/None
4-2-3(a)	Rock Characteristics	Qualifying	60.112/113	63.113/None
4-2-4(a)	Climatic Changes	Qualifying	60.112	None
4-2-5(a)	Erosion	Qualifying	60.112	None
4-2-5(d)	" "	Disqualifying	60.122(b)(5)	None
4-2-6(a)	Dissolution	Qualifying	60.112	None
4-2-6(d)	" "	Disqualifying	60.112	None
4-2-7(a)	Tectonics	Qualifying	60.112	None
4-2-7(d)	" "	Disqualifying	60.112	None
4-2-8(a)	Natural Resources	Qualifying	60.122(c)(1)	None
4-2-8(d)(1)	" "	Disqualifying	60.122(c)(1)	None
4-2-8(d)(2)	" "	Disqualifying	60.122(c)(1)	None
4-2-9(a)	Site Ownership and Control	Qualifying	60.121	63.121
5-1(a)(1)	System	Qualifying	60.111	63.111
5-1(a)(3)	System	Qualifying	None	None
5-2-1(a)	Population Density and Distribution	Qualifying	60.111	63.111
5-2-1(a)(1)	" "	Disqualifying	60.122(6)	None
5-2-1(a)(2)	" "	Disqualifying	60.122(6)	None
5-2-1(a)(3)	" "	Disqualifying	None	None
5-2-2(a)	Site Ownership and Control	Qualifying	60.121	63.121
5-2-3(a)	Meteorology	Qualifying	60.111	63.111
5-2-4(a)	Offsite Installations and Operations	Qualifying	None	None
5-2-4(d)	" "	Disqualifying	None	None
5-2-8(a)	Surface Characteristics	Qualifying	60.122(c)(1)	None
5-2-9(a)	Rock Characteristics	Qualifying	60.133(a)(1)	None
5-2-9(d)	" "	Disqualifying	None	None
5-2-10(a)	Hydrology	Qualifying	60.111	None
5-2-10(d)	" "	Disqualifying	None	None
5-2-11(a)	Tectonics	Qualifying	60.122(b)(1)	None
5-2-11(d)	" "	Disqualifying	None	None

As demonstrated in the above table, in most cases there is no analog between the DOE Guidelines and NRC's proposed part 63. In addition, the Guidelines could not continue to reference and rely on revised part 60, since NRC's proposed revisions to part 60 would make them inapplicable to a repository at Yucca Mountain. Under the circumstances, it would be irrational and difficult, if not impossible, for DOE to apply the Guidelines in their current form.

Under these changed circumstances, DOE must act to propose amendments to its outdated Guidelines and conform its site suitability criteria to the NRC proposed rule for licensing a Yucca Mountain repository.

### 3. Improvements in Analytical Methods

DOE's proposed changes will also serve to conform the rules for assessing the suitability of a site with the current scientific and technical methods developed and utilized by DOE in its site characterization program. The proposed changes in the regulatory scheme reflect the advances in the scientific and technological understanding of the processes relevant to assessing the long-term performance of a geologic repository. The regulatory revisions proposed by EPA, NRC and DOE, mark a change from generic regulations based on limited information about geologic disposal developed early in the Nation's quest for sites for geologic disposal, to regulations promulgated specifically for the Yucca Mountain site that reflect over 20 years of data collection and intensive site characterization activities at the Yucca Mountain site. It would be irrational for DOE to ignore these changes, and continue to rely on technical requirements that are not aligned with, and are not supported by, the prevailing scientific knowledge and understanding.

As recognized by the NRC in its proposed part 63, during the more than 15 years since the NRC promulgated its initial technical criteria at 10 CFR part 60 (and DOE promulgated matching technical requirements in 10 CFR part 960), there has been considerable evolution in the capability of technical methods for assessing the performance of a geologic repository at Yucca Mountain. 64 FR 8640-8641. These advances result from both improved computer capability and better analytical methods. Indeed, these changes for the first time enable the vast quantities of data that have been collected through site characterization to all be used in models that more accurately model site performance. NRC

stated that these new methods were not envisioned when the part 60 criteria were established, and that their implementation allows for the use of more effective and efficient methods of analysis for evaluating conditions at Yucca Mountain than do the existing NRC generic criteria in part 60. 64 FR 8641. Moreover, NRC believes that implementation of these new analytical methods for evaluating Yucca Mountain will avoid the imposition of unnecessary, ambiguous, or potentially conflicting criteria that could result from the application of some of the generic requirements of 10 CFR part 60. 64 FR 8641.

The evolution in performance assessment methodology formed the basis for DOE's 1996 proposal to amend the Guidelines. In that proposal, DOE explained that only by assessing how specific design concepts will work within the natural system at Yucca Mountain and comparing the results of these assessments to the applicable regulatory standards, can DOE reach a meaningful conclusion regarding the site's suitability for development as a repository. The proposed amendments to the Guidelines would have required a comprehensive evaluation focused on whether a geologic repository at Yucca Mountain would adequately protect the public and the environment from the hazards posed by high-level radioactive waste and spent nuclear fuel (61 FR 66160). DOE explained that recent results in four major areas have advanced the ability to evaluate the Yucca Mountain site, and geologic disposal, to the point that a system approach is now appropriate. These four areas are: (1) Analysis and integration of data collected from surface-based testing and regional studies; (2) examination of the potential repository horizon made possible by the excavation of the Exploratory Studies Facility; (3) the site-specific conceptual design of the engineered facilities; and (4) performance assessment analyses (61 FR 66161).

As with the NRC, DOE recognizes that this improved understanding now allows the reconsideration of general Guidelines that may be unnecessary, ambiguous, or potentially conflicting for Yucca Mountain. Based on the DOE's accumulated knowledge, and significantly enhanced understanding, DOE has determined that a system performance approach provides the most meaningful method for evaluating whether the Yucca Mountain site is suitable for development as a repository. In this revised proposal, DOE expands on its earlier proposal to modify the Guidelines and incorporate performance

assessment as the appropriate approach to assess the forecasted performance of a repository, and to serve as the basis for site characterization suitability criteria. This revised proposal provides greater detail, comprehension and transparency of information describing the performance assessment methodology, and how it serves as a foundation for site characterization suitability criteria.

### IV. Response to Public Comments on the 1996 Proposal

DOE requested public comments and announced a public hearing on the proposed amendments to the Guidelines in the Notice of Proposed Rulemaking published in the **Federal Register** on December 16, 1996. 61 FR 66157.

DOE received written and oral comments on the proposed amendments to the Guidelines from numerous organizations including Federal, state, and local government agencies; citizen and environmental groups; a nuclear industry group; a Native American group; and from individual citizens. Oral comments were also received during the January 23, 1997, public hearing in Las Vegas, Nevada. DOE received many comments concerned with issues that are not related to the proposed amendments to the Guidelines, such as issues that pertain to activities at the Nevada Test Site, the continued use of nuclear power, the broad powers of the federal government, as well as activities related generally to the civilian radioactive waste program but not at issue in this rulemaking, such as consideration of alternatives to geologic disposal, the Western Shoshone claims to land under the Ruby Valley Treaty, and opposition to or support of geologic disposal and the study of Yucca Mountain. Because these issues lie outside the scope of the proposed amendments to the Guidelines, they are not addressed in this notice. DOE notes that many of the comments received, especially from individuals, expressed a strong opposition to the selection of Yucca Mountain as the only site to be characterized. As explained in section II above, in the 1987 amendments to the NWPA, Congress limited DOE to characterizing only the site at Yucca Mountain. The wisdom of that decision is not the subject of this rulemaking proceeding.

The following discussion summarizes the issues emerging from the comments that bear on DOE's current proposal, and DOE's response to those comments. All issues and comments on the 1996 proposal may not be addressed here in light of DOE's decision in this notice to revise the 1996 proposal and provide a

full public comment period on the revised proposal.

#### A. Legal Authority.

Several commenters, including the State of Nevada, stated that DOE's proposal to amend the Guidelines is contrary to section 112(a) of the Act and cited the following three decisions by the U.S. Court of Appeals for the Ninth Circuit as support for this view: Nevada versus Watkins, 914 F.2d 1545 (9th Cir. 1990) (Watkins I), Nevada versus Watkins, 939 F.2d 710 (9th Cir. 1991) (Watkins II), and Nevada versus Watkins, 943 F.2d 1080 (9th Cir. 1991) (Watkins III). Specifically, the Attorney General of Nevada stated at the public hearing that section 112(a) of the Act and the Watkins I and II decisions stand for the proposition that the Guidelines were to be used to determine the suitability of the site, and at the time of a suitability determination the validity of the current Guidelines would be subject to review by the Court.

DOE recognizes that it did not set forth in the 1996 Notice of Proposed Rulemaking a full legal analysis of the statutory basis for the proposed rule, nor did DOE address the rulings of the 9th Circuit Court of Appeals in the three "Watkins" decisions cited by the State. In this notice, DOE has included an extensive discussion entitled "Legal Authority and the Necessity to Amend the Guidelines and Criteria" in order to more fully explain to the public DOE's interpretation of the pertinent sections of the NWA and why DOE believes that it not only may but must amend the Guidelines and promulgate a new part 963. While DOE believes that the "Watkins" rulings are instructive in interpreting various provisions of the NWA, DOE does not believe that these rulings support the contention that DOE may not amend the Guidelines, or that the criteria used for the suitability determination under section 113 must be identical to the conditions in the Guidelines that are used for site selection under section 112.

#### B. Relationship between DOE suitability determination and NRC licensing requirements.

Nye County expressed the view that due to funding cuts DOE was attempting to cut corners and accelerate the process toward licensing. Nye County was concerned that this would mask what it views as the distinction between site suitability and NRC licensing. Several individual commenters stated that DOE appeared to be: (1) Dropping the NRC licensing requirements for Yucca Mountain; (2) lowering the licensing

requirements; or (3) deleting some of the NRC requirements.

The following responds to the Nye County comments. First, although DOE suffered funding shortages in 1996, funding shortages were not the reason for the decision to propose amendments to the Guidelines in 1996. DOE stated the reasons for the 1996 proposal in the **Federal Register** notice announcing the proposal, and included DOE's intent to focus and clarify the site suitability evaluation of the Yucca Mountain site to reflect anticipated regulatory changes and the most current scientific and technical methods for assessing the expected performance of a geologic repository at Yucca Mountain.

Second, the 1996 proposed amendments to the Guidelines, as well as those proposed in this notice, are not an attempt to accelerate the licensing process, or otherwise mask the distinction between site suitability and licensing. Rather, they are an attempt to carry out the site characterization program for its intended purpose, that is, to determine if the site is suitable and potentially licensable. The site suitability criteria developed by DOE within the context of the site characterization program, and proposed here as new rule 963, are closely linked to the determination of the site's potential licensability, as they must be. DOE must conduct its site characterization process in accordance with section 113(c) of the NWA, which provides that DOE may conduct only such site characterization activities as DOE considers necessary to provide the data required for evaluation of the suitability of such site for an application to be submitted to the NRC for a construction authorization (often referred to as a "license") at such site, and for compliance with NEPA. 42 U.S.C. 10133(c). Therefore, DOE is required to base its site characterization activities on NRC licensing requirements and the environmental impact statement to be conducted under NEPA.

While today's proposal relies, in part, on newly proposed NRC licensing requirements, it is completely consistent with the letter and the purpose of the NWA. Although DOE is utilizing NRC's proposal to develop DOE's own proposal, DOE is not attempting to accelerate the licensing process. DOE must first complete all the steps in section 113 and section 114(a)(1) of the NWA before making a recommendation to the President, and receive presidential and congressional approval before submitting an application for a construction authorization to the NRC. Then, DOE

would have to participate in the licensing process outlined by NRC in its regulations. DOE, as a potential licensee subject to NRC regulation, has no authority to accelerate the licensing process; only NRC is authorized to do that.

The following responds to concerns raised by other commenters that DOE's proposal to change to part 960 is an attempt to eliminate or degrade NRC licensing requirements. That was not DOE's intent in the 1996 proposal, nor in today's proposal. To the contrary, DOE's proposed amendments to the Guidelines and new part 963 are designed to better align DOE's suitability criteria with newly proposed NRC licensing requirements. The NRC's recent proposed amendments to 10 CFR part 60 and proposed new part 63 are based on its own legal responsibilities and technical judgment. DOE has no authority to amend NRC requirements. DOE's objective in promulgating a new part 963 is to conform to, rather than deviate from, NRC requirements so that DOE can determine whether NRC is likely to approve an application from DOE for a construction authorization for a repository at Yucca Mountain.

#### C. The rules should not be changed to fit the site.

Some commenters stated their belief that Yucca Mountain would be disqualified under the existing Guidelines and therefore DOE is attempting to change the rules to fit the site.

DOE is not proposing to amend part 960 and adopt a new part 963 because it believes Yucca Mountain cannot satisfy the conditions in the current Guidelines. Rather, this proposal is intended to implement the statutory mandate in section 113 in a rational manner, consistent with the current regulatory framework and technical basis for assessing the performance of a geologic repository as an integrated system. DOE is convinced that the transition to a system performance approach will not result in a lower level of protection of public health and safety. DOE's reasons for proposing amendments to the Guidelines in 1996 were provided in the notice announcing that proposal. In this notice, DOE provides an extensive discussion of the basis and reasons for its revised proposal to amend part 960 and add new part 963.

Notwithstanding these explanations, DOE recognizes that many commenters believe that DOE is changing the Guidelines because of the fear that those requirements cannot be met. In particular, several commenters stated

their belief that the site could not meet the ground-water travel time disqualifying condition in the Guidelines (§ 960.4-2-1(d)).

DOE has not reached a conclusion on this issue. The disqualifying condition at § 960.4-2-1(d) requires disqualification if DOE determines that the pre-waste emplacement ground-water travel time is expected to be less than 1,000 years along any pathway of likely and significant radionuclide travel. Calculations performed in 1998 as part of the total system performance assessment for the Viability Assessment indicate that the average ground-water travel time is greater than 1,000 years. Based on investigations and calculations to date, DOE has not determined whether the ground-water travel time along any pathway of likely and significant radionuclide travel is less than 1,000 years. DOE continues to investigate and conduct research on ground-water travel time at Yucca Mountain to reduce uncertainties, to the extent possible, and to gain confidence in its calculations. In the meantime, DOE believes that there is no basis at this time to find that this disqualifying condition exists at Yucca Mountain.

In addition, under NRC's proposed changes to its licensing criteria and requirements for high-level waste repositories, the analogous provision to 960.4-2-1 in existing 10 CFR part 60 would no longer be applicable to a geologic repository at Yucca Mountain, and new 10 CFR part 63 would not contain such a condition, or any condition similar to it. As previously explained in section III.B.2. of this Supplementary Information, it would be illogical—and questionable in view of the characterization restrictions contained in section 113(a)(1) of the NWPA—for DOE to apply the Guidelines as currently written, including this particular guideline, in light of these proposed regulatory changes by the NRC.

*D. Any amendments to the Guidelines should continue to address all the pre- and post-closure factors, as well as the qualifiers and disqualifiers.*

Several commenters requested that DOE leave the Guidelines virtually intact and apply all of the pre- or post-closure guidelines. Some suggested that DOE only amend those specific guidelines that need to be amended. Some commenters were concerned that by eliminating certain individual guidelines and the qualifiers and disqualifiers, DOE was trying to ensure that Yucca Mountain would be found suitable for a repository even if it is an inadequate site.

As explained in previous sections of this Supplementary Information, DOE is proposing revisions to the Guidelines that are permissible under the NWPA, and that are intended to conform the Guidelines to anticipated changes in EPA and NRC regulations, and to the current state of scientific understanding of how to assess the suitability of a repository at Yucca Mountain. Nevertheless, in response to the comments about maintaining the pre- and post-closure factors in the Guidelines, DOE has structured the proposed suitability criteria to make transparent what characteristics and traits of a geologic repository at Yucca Mountain are most important to determining the suitability of the site during the preclosure and postclosure periods. The suitability criteria address and reflect the geologic considerations identified in section 112(a) that are relevant to and informed by site characterization activities. Siting considerations that are not addressed in the suitability criteria developed under section 113 (that is, as part of the site characterization program) would be addressed elsewhere by the Secretary when deciding whether to recommend the site to the President under section 114 of the NWPA. For example, environmental, transportation, and socioeconomic impacts would be considered in the EIS; the technical feasibility of constructing, operating, and closing a repository at the site would be included in the design work required for recommending the site. In sum, the considerations listed in section 112(a) of the NWPA and in the current Guidelines that are not addressed in either the preclosure or postclosure site suitability criteria proposed in part 963 would be addressed during the section 114 site recommendation process.

With respect to qualifying and disqualifying conditions, DOE believes that it is not reasonable or necessary to maintain these conditions in a proposed new rule. DOE proposes eliminating individual disqualifiers, since maintaining them would mask how the system as an integrated whole would function, and would be inconsistent with the NRC proposal. The only appropriate disqualifier is the applicable public health and safety standard.

As explained previously, the prevailing scientific view is that the most appropriate method for evaluating whether a site is suitable for a repository is through TSPAs. Under the proposed 10 CFR part 963, DOE would use the total system performance assessment method to evaluate whether a repository at the Yucca Mountain site is likely to

meet applicable NRC regulations, and thus is suitable for development of a repository.

In response to the 1996 proposal, several commenters expressed the common view that use of TSPA is appropriate and the Guidelines should be revised to match current technical understandings. For example, the NWTRB commented that the proposal's linking of suitability directly and unambiguously to overall system performance is a sounder approach than the approach in the original Guidelines. Also, the U.S. Department of the Interior (DOI) commented that the original guidelines are a relic of the early 1980s and now impose an unnecessary burden on the program. DOI observed that it makes little sense to comply with existing Guidelines based on EPA and NRC regulations that no longer apply to Yucca Mountain.

*E. DOE rationale for changing its position on the need to revise the Guidelines.*

In 1994, DOE issued a **Federal Register** notice stating that it had decided not to revise the Guidelines (59 FR 39766), despite the 1987 amendments to the NWPA. In a 1995 **Federal Register** notice, following continued public dialogue on this issue, DOE provided its rationale for not revising the Guidelines "at this time." 60 FR 47737. Ignoring the qualifying phrase "at this time," some commenters argued that by issuing the 1996 Notice of Proposed Rulemaking, DOE reversed its position from the 1994 and 1995 notices without a credible and persuasive explanation.

DOE has reassessed its 1994 and 1995 positions and has determined that now is the proper time to amend the Guidelines. DOE believes that events have transpired since the 1994 and 1995 notices were published and the 1996 amendments proposed, in particular NRC's proposed changes to its licensing regulations, that present DOE with a situation in which the most responsible and appropriate action is for DOE to amend the Guidelines. The nature of those amendments and the reasons for DOE's proposal to amend are provided in this notice. The public will be provided a full and fair opportunity to comment on DOE's proposal, and DOE will respond to those comments.

*F. Public participation process.*

The NWTRB suggested that DOE formally connect its site suitability determination to a public process for making the decision on whether to recommend to the President that Yucca Mountain be developed as a repository.

Such a process is provided for in section 114(a) of the NHPA. Before recommending the site for development as a repository, DOE must hold public hearings in the vicinity of the Yucca Mountain site to inform residents of the area and to receive their comments regarding the possible site recommendation. The preliminary suitability evaluation conducted under this proposed part 963 would be part of the information provided for public comment. In addition to these subsection 114(a) consideration hearings, the public will have opportunities to comment on the DOE's analyses of the potential impacts of developing a repository at the Yucca Mountain site during the repository EIS process.

Further, the site recommendation must be accompanied by a comprehensive statement of DOE's basis for the recommendation that will include the final EIS and the views and comments of the Governor and legislature of any State, or the governing body of any Indian tribe, together with the Secretary's response to those views. This comprehensive statement must be made available to the public, as well as submitted to the President. As further required by section 114 of the Act, the Secretary will notify the Governor and legislature of the State of Nevada of a decision to recommend the site at least 30 days before submitting a recommendation to the President.

*G. Clarification of, and suggested modifications to, the performance assessment methodology.*

A number of commenters asked for clarification or further explanation of the method and process for implementing the proposed total system performance assessment approach. The EPA and the NWTRB noted that a comprehensive explanation of TSPA would provide transparency and verifiability to DOE's evaluation process.

DOE has decided not to finalize the proposed Subpart E of the Guidelines but, instead, to propose a new part 963 that provides the level of detail, transparency and verifiability requested by the commenters. In this preamble, in particular sections II.G and VI, DOE provides a more comprehensive explanation of the background and evolution of the TSPA methodology and approach, and a description of how this methodology will be implemented in the postclosure suitability evaluation, than was provided for proposed Subpart E. In addition, DOE has structured the 963 rule itself to contain more specific requirements than those enunciated in

proposed Subpart E as to how and what must be evaluated in the TSPA analysis of postclosure suitability. For example, section 963.16 would require that DOE determine postclosure suitability based on TSPA analyses of repository performance in cases with and without a stylized human intrusion event. That section also enumerates certain required elements of those analyses, such as, inclusion of data related to the suitability criteria specified in 963.17, an accounting of uncertainties and variabilities in parameter values, identification of the natural and engineered barriers important to waste isolation, demonstration of the technical bases for the models used in the TSPA, and the conduct of appropriate sensitivity analyses. Moreover, DOE's proposed method and process for implementing the TSPA approach in part 963 is consistent with the TSPA concepts and requirements proposed by the NRC in section 63.102 and 63.114, as well as the implementation requirements proposed by EPA in proposed 40 CFR 197.13. DOE believes that conducting the TSPA analysis in the manner prescribed by the requirements of proposed 963 are responsive to public comments on the TSPA approach, and will provide a level of transparency and verifiability comparable to that proposed by the regulatory requirements of NRC and EPA.

*Role of Natural and Engineered Barriers.* Some commenters suggested that the proposed approach should include explicit requirements for performance of the natural and engineered barriers. The EPA recommended that the site suitability evaluation approach should distinguish contributions of site features to performance for extended periods of time and should make the role of natural barriers in containing waste clear to the public. The NWTRB also commented that the DOE should assess the relative roles of natural and engineered barriers and their interactions, but noted that specific requirements for individual components of the system could be arbitrary and unworkable.

DOE has responded to this comment by providing the specifications for how it will conduct a TSPA in support of determining site suitability. The relative contribution of the natural and engineered barriers to the waste containment and their interaction will be demonstrated through the conduct of the TSPA. Through the TSPA, the requirements of which are contained in proposed part 963, DOE can examine the contributions of site features

important to performance and the relative roles of the natural and engineered barriers. For example, by conducting sensitivity analyses, DOE can examine a specific feature, whether natural or engineered, and thereby determine its relative impact on the performance of the total repository system.

*Robust Compliance.* The NWTRB suggested that, in responding to comments that the proposed amendments "change the rules in the middle of the game," DOE should modify the amendments to strengthen confidence in the technical validity of the overall system performance assessment. The NWTRB submitted that the TSPA should not only show that the repository system complies with a standard, but does so "robustly." The NWTRB suggested three indicators of robust compliance: (1) Address uncertainties fully and accurately; (2) describe the results of sensitivity studies; and (3) specify a margin of safety, *i.e.*, require performance in excess of applicable radiation protection standards.

In conducting and documenting the TSPA under the proposed rule, DOE would identify the processes used to carry out the performance assessment, state the assumptions used in the assessments, address all uncertainties fully and accurately, and describe the results of sensitivity studies. By so doing, DOE would address two of the three indicators the NWTRB identified for showing robust compliance.

The NWTRB's third indication of robust compliance would be for DOE to require performance in excess of applicable standards. The EPA is required to establish radiological protection standards that are adequately protective of public health and safety. DOE believes that compliance with the required applicable standards, as described in this proposed rule, is a sufficient basis for evaluating the Yucca Mountain site's suitability for development. However, DOE would indicate, in its underlying technical documentation, by what margin the expected performance of the repository exceeds the applicable radiation protection standards.

*Specific Level of Confidence.* The NWTRB also suggested that DOE should modify the amendments to strengthen confidence in the technical validity of the overall system performance assessment. The NWTRB suggested that DOE specify the level of confidence that must be reached in its performance calculation before it is prepared to make a positive site suitability determination.

In the proposed rule, DOE is defining the criteria that would be considered in conducting the overall total system performance assessment. In this way, DOE believes that overall confidence in the calculation will be increased because the key building blocks (criteria) of the TSPA would each be identified and considered.

Moreover, while DOE appreciates the importance of the NWTRB comment that there should be a level of confidence in the performance calculation, DOE does not believe it is appropriate or most effective to address that comment by specifying or quantifying a level of confidence as part of the proposed rule. The reasons not to quantify the level of confidence in the rule are threefold. First, at this time, there is no universally accepted or standard technical basis for DOE to rely upon to quantify that level of confidence for inclusion in the proposed rule for a first of its kind facility for spent fuel and high-level waste; to adopt such a quantitative standard could inappropriately constrain the Secretary's determination of site suitability. Second, through the TSPA described in the proposed rule, DOE will generate, and the public will have access to, information about the probabilistic distribution of values around the expected value in order to assess the level of confidence in the performance calculation. Finally, in its proposed regulations at part 63 (which serve as the model for the TSPA method described in this proposed rule), the NRC does not specify or require a quantitative level of confidence to be shown in order to determine whether the Yucca Mountain site would meet applicable radiation protection standards. Taken together, these reasons suggest the better course is for DOE to not quantify the level of confidence for the performance calculation, but to utilize other mechanisms, such as defining the criteria that would be considered, to strengthen confidence in the technical completeness and validity of the performance calculation.

*Defense-in-Depth.* Another specific NWTRB comment was that DOE should demonstrate in its performance assessment how the repository system preserves the principle of defense-in-depth using multiple barriers.

In response, DOE believes that the issue of defense-in-depth will be addressed by the NRC's proposed requirements for using multiple barriers for the repository. Those requirements include descriptions of site characteristics and design components, process and performance assessment model analyses, and sensitivity studies.

However, DOE does not believe that it is appropriate for part 963 to articulate an explicit defense-in-depth strategy nor to require significant redundancy in repository design. The DOE rejected this approach in 1984 when the general Guidelines were promulgated (49 FR 47721) in choosing not to set numerical limits on individual site characteristics. The NRC, in its proposed part 63, also has rejected explicit, subsystem performance requirements as a means to demonstrate defense-in-depth.

#### *H. Data requirements for performance assessment.*

Two commenters expressed concern that, if DOE issues amended Guidelines prior to the EPA's promulgation of radiological standards specific to Yucca Mountain, the DOE may not have a full understanding of the health and safety standards, may need additional data collection and analysis, and may need to alter the Guidelines again after the EPA standards are issued. The EPA also commented that the new standards may warrant gathering different or additional data to provide the basis for compliance with the standards.

DOE responds to these comments by including in the proposed part 963 criteria that must be considered in a TSPA that are important to assessing the ability of a repository at the Yucca Mountain site to meet applicable NRC standards for the preclosure and postclosure periods, which will implement applicable EPA public health and safety standards. DOE believes that the criteria in proposed part 963 are related sufficiently to the data and analytical needs to address the proposed EPA standard as to warrant proposing it at this time. In addition, NRC's proposed part 63 is based on a dose standard, and includes data and analytical requirements necessary to meet that standard. DOE has structured the proposed part 963 based on NRC's proposed Part 63 and consistent with EPA's proposed 40 CFR part 197. Therefore, DOE believes that part 963 could be implemented without substantial revision.

In a similar vein, a variety of commenters questioned the state of DOE's understanding of the site and the potential repository system at Yucca Mountain. Some commenters indicated that the DOE does not yet know enough about the site to make the proposed changes to the Guidelines, others questioned whether the DOE would know enough at the planned time for a site recommendation, and others contended that the DOE could never know enough to apply a total system

performance assessment approach to a suitability evaluation.

In response, DOE notes that, although it is advantageous to limit uncertainties and strive to gain as much data and scientific understanding as practicable, the prevailing scientific view is that certainty, in the normal sense of that word, is not possible to achieve with respect to assessing the postclosure performance of a geologic repository intended to last for tens of thousands of years. The NRC's existing regulations at part 60 and proposed regulations at part 63 require "reasonable assurance" that the public and environment will be adequately protected from the radiation hazards posed by a repository. That standard reflects that there are inherent uncertainties in understanding the evolution of the geologic setting, the reference biosphere, and an engineered barrier system. Performance assessments are necessarily probabilistic; they can only analyze future repository performance in terms of the probabilities of different events and results.

Equally important, EPA recognizes the inherent uncertainty in this process in its proposed public health and safety standards. EPA would have the NRC implement the public health standard based on "reasonable expectation." According to EPA, reasonable expectation "means that the Commission is satisfied that compliance will be achieved based upon the full record before it. Reasonable expectation (a) requires less than absolute proof because absolute proof is impossible to attain for disposal due to the uncertainty of projecting long-term performance; (b) is less stringent than the reasonable assurance concept that NRC uses to license nuclear power plants; (c) takes into account the inherently greater uncertainties in making long-term projections of the performance of the Yucca Mountain disposal system; (d) does not exclude important parameters from assessments and analyses simply because they are difficult to precisely quantify to a high degree of confidence; and (e) focuses performance assessments and analyses upon the full range of defensible and reasonable parameter distributions rather than only upon extreme physical situations and parameter values."

#### *I. The ability to understand results of total systems performance assessment.*

The NWTRB commented that the performance assessment should be carried out in a manner that is highly transparent to the technical community, regulators, and interested members of the general public. Some commenters

stated that total system performance assessment would not likely be easily understood. Other commenters asserted that the approach in the 1996 proposed rule would be misleading or mask uncertainties and, therefore, not recognize potentially insufficient waste isolation capabilities of the site.

DOE has developed proposed part 963 taking into account these considerations. Proposed part 963 includes specific site suitability criteria and a description of the evaluation method to ensure the public is informed of how and what DOE will consider in reaching a suitability evaluation for completion of site characterization. DOE will conduct performance assessments in a manner that is transparent, valid and verifiable. In other words, these assessments will be clear, logical, technically defensible and adequately documented. A transparent system performance assessment will be clear not only to the technical analysts, but also to readers who are familiar with the particular aspects of the assessment, such as the fundamental scientific and engineering principles, numerical analytical methods, or regulatory implications.

In addition, DOE is currently using several methods to increase the traceability of these analyses. Analyses are traceable to the extent that a complete and unambiguous record exists of decisions and assumptions, and of models and data, and their use in arriving at the results of the analyses. These methods include abstraction workshops to ensure the completeness of models and approaches used in performance assessment, detailed documentation of each model, formal expert elicitations, and a participatory external peer review of the development, documentation, and results of the performance assessment for the Viability Assessment. The results of this peer review will be considered, as will be the comments of all oversight groups, to assist DOE's development of a TSPA for a possible site recommendation and subsequent license application. These actions should enhance confidence in the analyses and help communicate the complexities of predicting system behavior to a wide range of audiences.

A related concern is that system analyses could dilute or somehow mask the importance of specific, independent technical characteristics. On the contrary, it is the system analyses that assess the significance of any independent technical characteristic. The Yucca Mountain total system performance assessment is not a single computer model or analysis, but the

integrated result of several discrete process models, each of which in turn is supported by a group of more detailed data sets, models, and analyses. The total system performance assessment method permits evaluation of how certain individual characteristics, either alone or in combination, could cause the site to fail to meet the applicable standards, and how such failures are related to the performance of the total system. By not placing reliance on any single component of the system, the total system performance assessment method supports a multiple barriers approach, as required by NRC licensing regulations in order to provide reasonable assurance that the repository system will perform adequately.

#### *J. The relation of DOE and NRC requirements.*

The NRC commented that its regulations have a broader role than just to implement the EPA standards. They contain the technical criteria and requirements for licensing a geologic repository, as provided by subsection 121(b) of the NWSA. The NRC recommended that the DOE proposed postclosure guideline be changed to reflect that broader role and proposed that it be revised to read, " \* \* \* repository shall perform in accordance with both the EPA standards established specifically for the Yucca Mountain site and NRC's regulations applicable to the Yucca Mountain site."

DOE understands that the applicable NRC regulations containing the technical requirements and criteria for construction, operation, and closure of a geologic repository, as provided for by section 121 of the NWSA, will have a broader role regarding Yucca Mountain than just to implement the EPA standards for the Yucca Mountain site. The NRC regulations will govern the licensing process if the Yucca Mountain site is recommended by the Secretary to the President, approved by the President, and is designated by Congress under section 115 of the Act.

The use of the phrase "likely to meet applicable radiation protection standard" in the proposed part 963 is meant to clarify the role of NRC and EPA regulations in evaluating suitability and reaching a suitability determination. DOE would refer to applicable health and safety standards, both those promulgated by EPA and NRC, in determining site suitability in the preclosure and postclosure periods. In recognition of NRC's broader role in the licensing process, and in anticipation of submitting an application for a license, DOE has structured its rule regarding the

methods and procedure for evaluating suitability to be consistent with proposed NRC licensing criteria and requirements.

Notwithstanding these similarities in DOE's and NRC's proposed rules, DOE's determination of suitability is not the equivalent of a licensing decision. DOE's assessment of whether the Yucca Mountain site is suitable is a more preliminary assessment than the subsequent NRC licensing decision. Proposed part 963 would include many but not all NRC licensing requirements in the suitability determination; the intent is to provide the Secretary with sufficient information to determine whether the site should be recommended to the President based on, among other things, the likelihood the site would meet applicable regulatory standards for licensing.

#### *K. Definition of closure.*

Nye County, Nevada, suggested that the language of the general guidelines should allow for the possibility of having an open, naturally ventilated repository, to ensure that regulatory flexibility exists if such a design provides for greater protection of the public's health and safety and the environment. The County proposed that the definition of "closure" at § 960.2 be amended to eliminate reference to the "sealing of shafts" and add an explicit reference to "any extended period of natural ventilation."

DOE agrees that, during the design process, it would be appropriate to consider the potential benefits and consequences of maintaining a ventilated repository for an extended period of time. Any decision of whether and how to continue ventilation of the repository will consider the costs and benefits of that option, in light of the information available at that time. In response to this comment, DOE has modified the prior definition of "closure" by proposing in § 963.2 a definition including the phrase "except those openings that may be designed for ventilation or monitoring" to ensure that the option of a ventilated repository is not foreclosed.

### **V. Description of Proposal—10 CFR Part 960**

#### *A. Subpart A—General Provisions*

This section of the Guidelines contains the statement of applicability and definitions. The proposed revisions to section 960.1, Applicability, would limit the application of the Guidelines to evaluations of the suitability of sites for site characterization under section 112(b) of the NWSA. The revisions

would eliminate the applicability of the Guidelines to determinations of suitability of a site at the site characterization stage under section 113, or the site recommendation stage under section 114. These revisions would clarify the applicability of the Guidelines to the preliminary site screening stage, which entails a comparative analysis process, and thereby better align the application of the Guidelines with the structure of the NWSA, as originally enacted and as amended in 1987. The revisions to the third and fourth sentences would update the reference to other regulatory requirements of the NRC and EPA, in light of the current status of applicable NRC and EPA regulations relative to high-level waste geologic repositories. The fifth through seventh sentences would remain unchanged.

The proposed revisions to the definitions section would make the terms consistent with the NWSA and with the other proposed revisions to the Guidelines limiting applicability of subparts B, C, and D of the Guidelines to determinations of site suitability for site characterization under section 112 of the NWSA.

#### *B. Subpart B—Implementation Guidelines*

The proposed revisions to the Implementation Guidelines would limit the procedures and basis for application of the postclosure and preclosure guidelines of subparts C and D, respectively, to evaluations of the suitability of sites for site characterization.

Section 960.3, Implementation Guidelines, would be revised to eliminate the sentences in that section setting forth the procedures and basis for application of subparts C and D in evaluations and determinations of the suitability of a site under section 113 and section 114 of the NWSA. These revisions would remove section 960.3-1-4-4, Site Recommendation for Repository Development, in its entirety. That section pertains to the procedure and evidence required to make a site recommendation decision under section 113 and 114. Those decisions would not be governed by the Guidelines, and therefore reference to them would be removed. Section 960.3-1-5, Basis for Site Evaluation, would be revised to eliminate all references to Appendix III and the application of the requirements of that section in making suitability determinations at the site characterization or site recommendation stages. Only the last sentence of section 960.3-2, Siting Process, would be revised. This revision would limit the

applicability of the siting process to the recommendation of sites for site characterization. Section 960.3-2-4, Recommendation of Sites For the Development of Repositories, would be removed in its entirety. That section pertains to the comparison of characterized sites, leading to a recommendation by the Secretary to the President of a site for development as a repository. The proposed revisions would eliminate that decision process from evaluation under the Guidelines, and the section in its entirety would be removed.

#### *C. Appendix III*

The proposed revisions to Appendix III would remove and eliminate the applicability of this Appendix to decisions for repository site selection and siting decisions. The qualifying and disqualifying conditions of the technical guidelines in subparts C and D would apply only to the decision point for selecting sites for site characterization. All references to the site selection and site recommendation decisions under sections 113 and 114 would be removed, including the tabular column in Appendix III referencing the repository site selection siting decision.

With respect to the guidelines listed in Appendix III that apply to environmental quality, socioeconomic and transportation considerations, DOE considered whether to propose continuing to require their applicability to a Yucca Mountain site recommendation under section 114 of the NWSA. DOE decided not to do so because the issues addressed by these guidelines will be covered in the environmental impact statement for the Yucca Mountain site, and section 114(a)(1)(D) requires that the final environmental impact statement be part of the comprehensive statement of the basis for a site recommendation to the President. 42 U.S.C. 10134(a)(1)(D). Members of the public concerned about the analysis of environmental quality, socioeconomic and transportation issues will have ample opportunity to comment on these issues as part of the public review and comment process on the draft environmental impact statement and in additional public hearings required by section 114. In sum, DOE is of the view that the environmental quality, socioeconomic and transportation guideline requirements are substantially and unnecessarily duplicative of requirements under the procedures for developing an environmental impact statement and for formulating and informing a site recommendation under section 114.

## **VI. Description of Proposal—10 CFR Part 963**

The purpose of this part of the Supplementary Information is to explain the meaning and basis for those provisions of proposed part 963 that are not self-explanatory. The following is a section by section analysis of the proposed rule, and the accompanying explanation.

### *A. Subpart A—General Provisions*

Subpart A comprises two parts, the statement of Purpose, section 963.1, and Definitions, section 963.2.

*(a) Purpose—section 963.1.* The purpose of the proposed rule is as stated in this section: to establish the methods and criteria for determining the suitability of the Yucca Mountain site for the location of a geologic repository in completing DOE's site characterization program activities to be conducted under section 113(b) of the NWSA. The suitability evaluation methods to be used by DOE are consistent with the methods proposed by the NRC for assessing the potential of a geologic repository at the Yucca Mountain site to meet licensing criteria and requirements. The suitability criteria relate to the geologic considerations identified in section 112(a) as they reflect current scientific understanding and regulatory expectations (both NRC and EPA) regarding the performance and safety of a geologic repository during the preclosure and postclosure periods of operation. Because the suitability criteria are part of the site characterization program, these criteria relate to site characterization activities. Site characterization activities relate to scientific and technical investigations of the site to determine its natural properties and features, for example, studying the geohydrology and geochemistry of the site, as distinct from consideration of other features, such as cost, socioeconomic and transportation of waste to the repository. An explanation of how the suitability criteria were derived is provided below.

The proposed rule does not address the site recommendation process in its entirety. Other information required under section 114 of the NWSA that must be considered and submitted to the President and made available to the public if the site is recommended for development as a geologic repository is not addressed by the proposed rule. Regarding any repository site recommendation the Secretary of Energy shall make available to the public, and submit to the President, a comprehensive statement of the basis of

such recommendation, including the following: (a) A description of the proposed repository, including preliminary engineering specifications for the facility; (b) a description of the waste form or packaging proposed for use at such repository, and an explanation of the relationship between the waste form or packaging and the geologic medium of the site; (c) a discussion of data, obtained in site characterization activities, relating to the safety of such site; (d) a final environmental impact statement prepared for the Yucca Mountain site; (e) the preliminary comments of the NRC concerning the extent to which the at-depth site characterization analysis and the waste form proposal for such site seem to be sufficient for inclusion in any application to be submitted by the Secretary for licensing of such site as a repository; (f) the views and comments of the Governor and legislature of any State, or the governing body of any affected Indian tribe, as determined by the Secretary, together with the response of the Secretary to such views; (g) such other information as the Secretary considers appropriate; and (h) any impact report submitted under section 116(c)(2)(B) of the NWA [42 U.S.C. 10136(c)(2)(B)] by the State of Nevada.

(b) *Definitions—section 963.2.* The proposed rule includes definitions of certain words and terms. The definitions clarify DOE's intent and meaning in the context of this rule. The definitions are also intended to make the terms consistent with proposed NRC regulation governing the construction and licensing of a repository at the Yucca Mountain site. Several of the terms are important to understanding the suitability evaluation process, and are addressed here.

Criteria are those characterizing traits that are relevant to assessing the performance of a geologic repository at the Yucca Mountain site. The criteria relate to the geologic considerations identified in section 112(a) of the NWA that are relevant to the assessment of the performance of a geologic repository at the Yucca Mountain site. The geologic repository includes the natural barriers of the geologic setting and the engineered barriers of the repository design. The suitability criteria of the proposed rule are specific characterizing traits of the Yucca Mountain site that, through the site characterization process, DOE has identified as important indicators of the performance of the total repository system (that is, the integrated natural and engineered barrier systems).

Consistent with varying definitions in standard dictionaries, DOE considered narrowly defining the term "criteria" as benchmark, pass-fail standards rather than more broadly as "characterizing traits." DOE decided not to adopt the more narrow definition for four reasons. First, in section 112(a) of the NWA, the term "primary criteria" is used synonymously with the term "detailed geologic considerations," a term that does not necessarily imply any benchmark. Second, as used in context in section 113 of the NWA, the term "criteria" appears to refer to the considerations for evaluating whether a repository in a particular geologic medium is likely to meet applicable NRC standards, thus indicating that the site suitability criteria and the NRC standards are not one and the same. Third, section 121 of the NWA (which addresses NRC's regulatory responsibilities) distinguishes between "criteria" and "standards," a distinction which implies that "criteria" are not necessarily benchmark standards themselves. Finally, although some are inclined to define the term "criteria" narrowly, that inclination is not universal. For example, in 10 CFR part 50, the NRC sets forth quality assurance "criteria" that are in the nature of considerations, rather than benchmark, pass-fail standards.

The performance of the total system is evaluated using a computer modeling tool called total system performance assessment. Total system performance assessment identifies the features, events and processes that might affect the performance of a repository, as well as the probabilities and significance of occurrence. Total system performance assessment examines the effects of those features, events and processes on that performance by estimating the expected annual dose to the receptor as a result of releases from the repository.

For the preclosure period, suitability would be evaluated through a preclosure safety evaluation method. The preclosure safety evaluation would consider site characteristics and preliminary engineering specifications to assess the adequacy of the repository facilities to perform their intended functions and to mitigate the effects of design basis events, or credible accidents that could affect the ability of the geologic repository to operate safely. Design basis events are categorized in two ways: (1) those events, both natural and human-induced, that are expected to occur one or more times before permanent closure; or (2) those events, both natural and human-induced, that have at least one chance in 10,000 of occurring before permanent closure. The

preclosure safety evaluation would assess the ability of the geologic repository to meet the applicable radiation protection standard for the preclosure period under both categories of design basis events.

DOE's evaluation of the suitability of a geologic repository at the Yucca Mountain site would be based on consideration of a preliminary design for the geologic repository. The design is the description of the potential geologic repository, which includes multiple barriers to the release and transport of radionuclides. These multiple barriers consist of both the natural barriers and an engineered barrier system. The geologic repository includes not only the facilities and areas where radioactive wastes are handled, but also that portion of the geologic setting that provides isolation of the radioactive wastes. As used in the proposed rule, and in NRC's proposed part 63, isolation means inhibiting the movement of radioactive material from the repository to the location where the receptor resides, so that radiation exposures will be less than the radiation dose limits prescribed in NRC's proposed regulation.

#### *B. Subpart B—Site Suitability Determination, Methods and Criteria*

(a) *Scope—section 963.10.* The scope of subpart B includes, for both the preclosure and postclosure periods, the basis for DOE's suitability determination for the Yucca Mountain site. There are separate sections of the proposed rule for the preclosure and postclosure time periods. The scope of these sections also includes the site suitability criteria to be applied in accordance with section 113(b) of the NWA, the methods for applying the criteria and evaluating suitability, and the basis for the resulting suitability determination.

The proposed rule is divided into two sections corresponding to the preclosure and postclosure periods, and within each period, three subsections. The subsections present for each period: (1) the suitability determination; (2) the suitability evaluation method; and (3) the criteria to be used for the evaluation. The purpose of separating the preclosure and the postclosure periods is to make clear the differences in determining the suitability of a geologic repository during these two periods. This separation is consistent with the current structure of the Guidelines, and the structure of the current and proposed new NRC licensing regulations, which have separate performance objectives for the preclosure and the postclosure periods.

The preclosure method and criteria govern the suitability considerations that deal with the operation of the repository before it is closed, while waste is being received, stored and emplaced, and allow for the possibility of retrieval. These are the considerations important in protecting the public and repository workers from exposures to radiation during repository operations, especially if an accident should occur. The postclosure method and criteria govern the suitability considerations that deal with the long-term behavior of the repository. The behavior of interest here is after waste emplacement and repository closure.

(b) *Suitability determination—section 963.11.* This section describes how DOE will determine the suitability of the site based on the information and data developed through the program of site characterization activities at Yucca Mountain. DOE may find the Yucca Mountain site suitable for the location of a repository based on its determinations relative to the preclosure and postclosure suitability evaluations under sections 963.12 and 963.15. Those determinations, in turn, entail assessment of preclosure and postclosure suitability using the designated evaluation method and criteria for each time period. The overall suitability determination, if affirmative, will be one part of the Secretary's decision, under section 114, whether to recommend the Yucca Mountain site to the President for development of a repository.

(c) *Preclosure suitability determination—section 963.12.* The suitability evaluation of the Yucca Mountain site will consider the safety of the geologic repository during the operational or preclosure time period. The preclosure criteria to evaluate the suitability of a geologic repository operations area at Yucca Mountain will be considerations that are important to determining safety during construction and active operation and to demonstrating compliance with the applicable radiation protection standard.

(d) *Preclosure suitability evaluation method—section 963.13.* The preclosure suitability criteria will be applied through a preclosure safety evaluation method. The preclosure safety evaluation would support the recommendation to approve the Yucca Mountain site for submittal of a license application. The NRC provides a framework indicating how to conduct this type of evaluation in proposed 10 CFR 63.112. DOE designed the preclosure safety evaluation method proposed in this rule based on this NRC

framework and a DOE assessment of what information would be necessary and sufficient to determine, at the site suitability stage, whether a proposed geologic repository at Yucca Mountain is likely to meet the applicable radiation protection standards for the preclosure period.

The preclosure safety evaluation method, using preliminary engineering specifications, will assess the adequacy of the repository facilities to perform their intended functions and prevent or mitigate the effects of postulated design basis events that are deemed sufficiently credible to warrant consideration. The preclosure safety evaluation will consider: a preliminary description of the site characteristics, the surface facilities, and the underground facilities; a preliminary description of the expected design bases for the operating facilities and a preliminary description of any associated limits on operation; a preliminary description of potential hazards (for example, seismic activity, flooding and severe winds), event sequences, and their consequences; and, a preliminary description of the structures, systems, components, equipment, and operator actions intended to mitigate or prevent accidents. The purpose of the preclosure safety evaluation is to ensure that relevant hazards that could result in unacceptable consequences have been adequately evaluated and appropriate protective measures have been identified such that the geologic repository operations area will comply with the preclosure requirements for protection against radiation exposures and releases of radioactive material.

The preclosure safety evaluation will emphasize performance requirements, analytical bases and technical justifications, and evaluations that show how safety functions will be accomplished. The adequacy of the facility design will be evaluated by consideration of postulated design basis events viewed as sufficiently credible that the facility should be designed to prevent or mitigate their effects. Design basis events are those natural and human-induced events that are either expected to occur before closure, or have one chance in 10,000 of occurring before permanent closure. DOE will evaluate the probability of the event and the associated consequences. For events of high frequency, the consequences should be low. For less probable accidents that are potentially more severe, the allowable consequences are higher. In either case, the suitability determination will be supported by a design that DOE considers likely to meet

the applicable radiation protection standard.

(e) *Preclosure suitability criteria—section 963.14.* DOE will evaluate the suitability of the Yucca Mountain site during the preclosure period using the following criteria: (a) ability to contain and limit releases of radioactive materials; (b) ability to implement control and emergency systems to limit exposures to radiation; (c) ability to maintain a system and components that perform their intended safety functions; and (d) ability to preserve the option to retrieve wastes during the preclosure period. These criteria are considerations important to determining the performance of a potential repository at Yucca Mountain. For example, in applying the first criterion, DOE will ensure repository facilities are designed to keep the radioactive materials confined in order to limit releases of radioactive material. The second and third criteria address DOE's ability to ensure that emergency controls and procedures are developed to limit releases should an accident occur, and that the system and its components will perform their safety function as intended. The fourth and final criterion is also important to the safe functioning of a repository; that is, ensuring the capability to retrieve or recover the wastes from the repository should conditions warrant.

These criteria also relate to certain geologic considerations in section 112(a) of the NWPA. The geologic considerations identified in section 112(a) that are relevant to the preclosure period are hydrology, geophysics, seismic activity, atomic energy defense activities, proximity to water supplies and proximity to populations. These considerations are relevant to the evaluation of preclosure suitability because they bear on the evaluation of repository system safety during the preclosure period. The hydrology and geophysics of the site are important to preclosure safety because they are indicators of possible initiating events for accidents. Seismic activity is also important in this regard, as it is an indication of the potential for earthquake activity to disrupt normal functioning of a repository surface facility. The location of atomic energy defense activities in relation to the Yucca Mountain site is important to preclosure safety and would be considered to the extent they exist and may impact operations of the repository facility. Proximity to water supplies and proximity to populations are important to preclosure safety because they relate to potential locations where people could eventually be exposed to

radionuclides either through airborne transport or through a water pathway.

(f) *Postclosure suitability determination—section 963.15.* The postclosure suitability evaluation of the Yucca Mountain site will consider the safety of the geologic repository during the time after operations cease, the postclosure period. DOE will determine the suitability of the Yucca Mountain site for the postclosure period by examining the results of a TSPA conducted under section 963.16. If the results indicate a repository at Yucca Mountain is likely to meet the applicable radiation protection standard, then DOE may determine, on the basis of site characterization activities, that the site is suitable for the postclosure period.

(g) *Postclosure suitability evaluation method—section 963.16.* DOE will evaluate the suitability of a potential repository at the Yucca Mountain site using the TSPA method (described in greater detail below). Using the TSPA method, DOE will estimate quantitatively the expected annual dose, over the compliance period, to the receptor. With this estimate, DOE will evaluate the performance of the repository and its ability to limit radiological exposures within the applicable radiation protection standard.

(1) *Section 963.16(a).* Section 963.16(a) describes how DOE will conduct separate performance assessments in order to evaluate the postclosure performance of a geologic repository at Yucca Mountain. One TSPA will be conducted in accordance with the method described in 963.16(b) and using all of the criteria identified in section 963.17, except the criterion assuming a human intrusion into the repository. A second TSPA will be conducted in accordance with the method described in 963.16(b) (except not all engineered and natural barriers will be considered), and using all of the criteria in section 963.17, including the criterion assuming a stylized human intrusion into the repository, as defined by NRC regulations. The results of each performance assessment will be examined by DOE to determine the suitability of the site for the postclosure period.

The conduct of separate assessments is consistent with EPA's proposed 40 CFR part 197 and NRC's proposed regulations at 10 CFR part 63. The proposed regulations, in turn, are based on NAS recommendations in the report, Technical Bases for Yucca Mountain Standards, on how best to assess the performance and resilience of a potential repository. Because the

manner and likelihood of human intrusion occurring many hundreds or thousands of years into the future cannot be estimated reliably by examining either the historic or geologic record, the NAS recommended an approach that will assess how resilient the geologic repository would be against a postulated intrusion. The consequences of the assumed human intrusion event will be addressed in a "stylized" manner, that is, by assuming a particular human intrusion event occurs in a certain way, at a specified time. Proposed EPA and NRC regulations define different stylized human intrusion events to be examined by DOE. At the time of the suitability determination, DOE will conduct the human intrusion analysis within the framework of the applicable regulatory concept, and use the results of the performance assessment to evaluate the suitability of the site for the postclosure period.

(2) *Section 963.16(b).* Section 963.16(b) provides an outline of the contents and manner in which DOE will conduct its performance assessments. As described previously in this notice, and briefly summarized here, performance assessment in this context is a method of forecasting how a system or parts of a system designed to contain radioactive waste will behave over time. Its goal is to aid in determining whether the system can meet established performance requirements. A TSPA is a type of performance assessment analysis in which the components of a system are integrated or linked into a single analysis.

The TSPA treats both the engineered and natural system components. The engineered system is to some extent controllable, but the natural system generally is not. The responses of the total system extend over periods beyond those for which data have been or can be obtained. The relationship of the components of a TSPA is often described as a pyramid. The lowest level of the pyramid represents the complete suite of process and design data and information (that is, field and laboratory studies that are the first step in understanding the system). The next higher level indicates how the data feed into conceptual models that portray the operation of the individual system components. The next higher level represents the synthesis of information from the lower levels of the pyramid into computer models. The term abstraction often is used to indicate the extraction of essential information from large quantities of data. The TSPA models are usually referred to as abstracted models. At this point, the

subsystem behavior may be described by linking models together into representations; this is the point at which performance assessment modeling is usually thought to begin. This is also the basis for the identification of the Yucca Mountain specific suitability criteria contained in the proposed rule.

The upper level is the final level of distillation of information into the most significant aspects to represent the total system. At this point, the models are linked together. These are the models used to forecast system performance and estimate the likelihood that the performance will comply with regulations and ensure long-term safety.

As information flows up the pyramid, it generally is distilled into progressively more simplified or essential forms, or becomes more abstracted. However, abstraction is not synonymous with simplification. If a particular component model cannot be simplified without losing essential aspects of the model, then the model becomes part of the TSPA calculation tool. Thus, an abstracted model in a TSPA may take the form of something as simple as a table of values that were calculated using a complex computer model, or the abstraction may take the form of a fully three dimensional computer simulation.

The TSPA method described in section 963.16(b) is a systematic analysis that identifies the features, events, and processes (*i.e.*, specific conditions or attributes of the geologic setting, degradation, deterioration, or alteration processes of engineered barriers, and interactions between the natural and engineered barriers) that might affect performance of the geologic repository; examines their effects on performance; and estimates the expected annual dose. The features, events, and processes considered in the TSPA will represent a wide range of effects on geologic repository performance. Those features, events, and processes expected to affect compliance significantly or be potentially adverse to performance are included, while events of very low probability can be excluded from the analysis. The expected annual dose to the receptor is estimated using the selected features, events, and processes, and incorporating the probability that the estimated dose will occur.

The TSPA method described in section 963.16(b) is a systematic analysis that identifies the features, events, and processes (*i.e.*, specific conditions or attributes of the geologic setting, degradation, deterioration, or alteration processes of engineered

barriers, and interactions between the natural and engineered barriers) that might affect performance of the geologic repository; examines their effects on performance; and estimates the expected annual dose. The features, events, and processes considered in the TSPA will represent a wide range of effects on geologic repository performance. According to proposed EPA and NRC regulations, those features, events, and processes expected to affect compliance significantly or be potentially adverse to performance are included, while events of very low probability (less than one chance in 10,000 of occurring within 10,000 years of disposal) can be excluded from the analysis. The expected annual dose to the average member of the critical group is estimated using the selected features, events, and processes, and incorporating the probability that the estimated dose will occur.

The TSPA that will be used to assess the postclosure performance of the Yucca Mountain repository will be conducted in the manner described in section 963.16(b). It will synthesize data and information into a set of models that simulate the behavior of the individual system components. DOE will abstract essential information from its initial models and refine them into linked models, including computer models, that represent important aspects of system performance. DOE will use these models to forecast system behavior and the likelihood of system compliance with the applicable radiation protection standard.

The TSPA calculations will be used to address conditions in the natural and engineered components of a repository at Yucca Mountain over the time that the standards apply. The TSPA calculations will also be used to consider disruptive events that are improbable, but that are important to understanding the repository behavior in the future. A requirement for TSPA will be to identify the identification of those natural features of the geologic setting and the design features of the engineered barrier system that are considered barriers important to waste isolation. TSPA will be used to assess the capability of the barriers, identified as important to waste isolation, to isolate waste, taking into account uncertainties in characterizing and modeling the barriers. Sensitivity studies and the regulatory definition of very-low probability events will provide the technical basis for inclusion or exclusion of specific features, events, and processes of the geologic setting in the TSPA.

Specific features, events, and processes of the geologic setting will be evaluated through sensitivity analyses to determine if the magnitude and time of the resulting expected annual dose would be significantly changed by their omission. Sensitivity analysis is a technique that is used to examine how a system responds if one of its components is changed. Systems are said to be sensitive to such a component if the results of the calculation are changed significantly in response to changes in that component's values. The sensitivity calculations will also provide the technical basis for either inclusion or exclusion of degradation or alteration processes of engineered barriers in the TSPA. Degradation or alteration processes will be evaluated further if the magnitude and timing of the resulting expected annual dose would be significantly changed by their omission.

Using the TSPA results, DOE can examine the sensitivity of one or more components of the calculations in the assessment. DOE can examine the response of the geologic repository system with regard to sensitivities of the system to the suitability criteria, in order to evaluate whether the geologic repository meets the applicable radiation protection standard.

As part of the TSPA, DOE will account for uncertainties and variabilities in both calculations and data, and provide the technical bases for parameter ranges, probability distributions, and bounding values. The reason for this accounting is that it is recognized, by the NRC and others, that there are inherent uncertainties in the understanding of the evolution of the geologic setting, biosphere, and engineered barrier system. Under the circumstances, proof that the geologic repository will be in conformance with the applicable radiation protection standard is not to be had in the ordinary sense of the word. Instead, DOE will demonstrate compliance and the performance of the potential repository using sophisticated, complex predictive models that are supported by limited data from field and laboratory tests, site-specific monitoring, and natural analog studies that may be supplemented with expert judgment.

Another aspect of DOE's conduct of the TSPA is the analysis of alternative models of features and processes. Under 963.16(b)(3), DOE will consider alternative models of features and processes that are consistent with available data and current scientific understanding, and evaluate the effects that alternative models would have on the estimated performance of the geologic repository. In this regard, if

other interested persons suggest and present to DOE alternative models that are consistent with available data and current scientific understanding, DOE will evaluate those other models. In implementing this requirement, however, DOE does not believe it would be scientifically or technically useful, and may be administratively burdensome, to require that, in every case, DOE provide the bases for not using an alternative model suggested by another party. Other interested persons may suggest any number of alternative models, some of which may not be consistent with available data and current scientific thinking and therefore not add significant value to the TSPA analysis. Nevertheless, DOE may decide, on a case-by-case basis, to document consideration of alternative models that were suggested by other interested persons, but not used because, among other things, the model is not consistent with available data and current scientific understanding.

(h) *Postclosure suitability criteria*—section 963.17. The postclosure criteria to evaluate the suitability of a geologic repository at Yucca Mountain will be considerations that reflect both the processes and the models used to simulate those processes that are important to the total system performance of the geologic repository. These criteria are characterizing traits that are relevant and important in the processes to be modeled in the TSPA that evaluates the suitability of the Yucca Mountain site for the postclosure period. These criteria also are related to the section 112(a) geologic considerations identified in the NWPA. Following is a description of how the section 112(a) geologic considerations relate to the postclosure suitability criteria, as well as a discussion of the criteria as they relate to the processes and computer models to be used in evaluating the performance of a geologic repository in the postclosure period.

(1) *Section 112(a) geologic considerations*. The geologic considerations identified in section 112(a) of the NWPA that are relevant to the postclosure performance of a repository at Yucca Mountain are: location of valuable natural resources, hydrology, geophysics, seismic activity, proximity to water supplies, and proximity to populations. These considerations are relevant to postclosure performance because they impact components and processes of the repository system related to potential transport of radionuclides via ground water to members of the public.

The location of valuable natural resources is a relevant geologic

condition for postclosure performance because the presence of these resources in the geologic setting of Yucca Mountain could lead to exploratory drilling or excavation and a consequent breach of the repository's safety barriers. Hydrology- and geophysics-related conditions are relevant because they describe some of the geologic features of the site that are related to safety and the physical characteristics that are related to potential transport of radionuclides to the biosphere. Seismic activity is relevant to postclosure performance

because it is related to the potential for changes in geologic structures that could lead to enhanced transport of radionuclides. Proximity to water supplies and populations are relevant to postclosure performance because they are related to potential locations where people could eventually be exposed to radionuclides in their water.

Table 2 provides a cross-reference between the section 112(a) factors related to geologic considerations, and the postclosure suitability criteria. As previously stated, the postclosure suitability criteria largely represent the

process model components of the total system performance assessment that DOE will use to evaluate the performance of the repository during the postclosure period. DOE has identified these processes as pertinent to assessing the performance of a repository at Yucca Mountain through information and data developed under its site characterization program. These processes also are related to, and impacted by, the geologic considerations found in section 112(a) of the NWPA.

TABLE 2

NWPA § 112(a) factors	Postclosure suitability criteria
(a) Processes pertinent to total system performance:	
Hydrology, geophysics, seismic activity .....	(1) Site characteristics.
Hydrology, geophysics, seismic activity .....	(2) Unsaturated-zone flow characteristics.
Hydrology, geophysics, seismic activity .....	(3) Near-field environment characteristics.
Hydrology, geophysics, seismic activity .....	(4) Engineered barrier system degradation characteristics.
Hydrology, geophysics, seismic activity .....	(5) Waste form degradation characteristics.
Hydrology, geophysics, seismic activity .....	(6) Engineered barrier system degradation, flow, and transport characteristics.
Hydrology, geophysics, seismic activity .....	(7) Unsaturated-zone flow and transport characteristics.
Hydrology, geophysics, seismic activity .....	(8) Saturated-zone flow and transport characteristics.
Hydrology, proximity to water supplies, proximity to populations .....	(9) Biosphere characteristics.
(b) Disruptive processes and events:	
Hydrology, geophysics .....	(1) Volcanism.
Seismic activity, geophysics .....	(2) Seismic events.
Hydrology, geophysics, seismic activity .....	(3) Nuclear criticality.
Location of valuable natural resources, proximity to populations .....	(4) Inadvertent human intrusion.

(2) *Suitability criteria.* DOE has developed its site characterization program to address those processes of the repository system that are pertinent to understanding how a repository at Yucca Mountain would comply with applicable radiation protection standards. The program also has been developed to better understand these processes, and resolve or put in place methods to resolve issues related to those processes. DOE has described these processes, and the methods to resolve issues related to the processes, in the SCP, semi-annual progress reports on site characterization program activities, in several TSPAs conducted over the years, and most recently in the Viability Assessment. These processes are simulated through performance assessment models; those models are integrated and refined to a point resulting in a representation of the performance of the system in total.

Put in simple terms, the processes that are pertinent to understanding the performance of a repository at Yucca Mountain, and that form the basis for the numerical models in the TSPA and the suitability criteria in section 963.17, are those physical processes of water falling on Yucca Mountain as rain and

snow, moving into the mountain, down through the unsaturated zone to the potential repository level, from the repository level to the saturated zone, and from there to the outside environment. At the repository level, the water would be affected by the physical processes associated with the repository and with the waste packages and the waste forms. Eventually, the water could move out of the repository horizon and further downward through the unsaturated zone. Subsequently, it could move into the saturated zone where it could be transported to a point where humans could be exposed to any radionuclides carried in the water. Disruptive events could potentially affect these processes and, therefore, need to be considered. This set of physical processes is simulated in the numerical modeling method of the TSPA that will be used to assess quantitatively the radionuclide releases to the public and, consequently, the safety and suitability of the Yucca mountain site.

The suitability criteria proposed in this rule are derived from these pertinent physical processes. These criteria represent the characteristic traits pertinent to assessing the performance

of a geologic repository at the Yucca Mountain site. They also reflect and represent in a larger sense the geologic considerations identified in section 112(a) of the NWPA such as hydrology, geophysics, seismic activity, and proximity to water supplies and populations.

The sequence in which the suitability criteria are presented in the proposed rule generally corresponds to the process of water flow presented above. In general, the criteria can be thought of as building blocks; each criterion in the sequence is evaluated on its own, with the results of that evaluation incorporated into the evaluation of the succeeding criteria, and so on until the final analysis. As the site characterization program evolves, DOE may refine these process models to better reflect and assess the processes pertinent to performance of a geologic repository at the Yucca Mountain site. It is possible that the processes, as well as the design selected, could dictate other ways to arrange the information included under the individual criteria. While the individual components of the process models may vary according to improvements in data and information, DOE's resultant suitability

determination would be based on an evaluation of each of the postclosure suitability criteria.

The criteria are separated into two categories. The first category, presented in section 963.17(a), represent those criteria important to the total system performance assessment without accounting for disruptive processes and events that could impact that performance. The second category, presented in section 963.17(b), are those criteria representing disruptive processes and events that could adversely affect the characteristics of the repository system, and consequently release radionuclides to the human environment. Each criterion in the first category is linked to a specific TSPA model component that will be used to evaluate the performance of that criterion. Each criterion in the second category is generally treated as an effect imposed on the system at a time that reflects the probability of occurrence of the disruptive event.

Under section 963.17(a), the first and a fundamental criterion that will be modeled to assess performance of a repository at the Yucca Mountain site is the representation of pertinent site characteristics. The criterion of site characteristics includes: (a) The geologic properties of the site—for example, stratigraphy, rock type and physical properties, and structural characteristics; (b) the hydrologic properties of the site—for example, porosity, permeability, moisture content, saturation, and potentiometric characteristics; (c) the geophysical properties of the site—for example, thermal properties, densities, velocities and water contents, as measured or deduced from geophysical logs, and (d) the geochemical properties of the site—for example, precipitation, dissolution characteristics, and sorption properties of mineral and rock surfaces. Together, as reflected in the performance assessment, these characteristics enable a representative simulation of the behavior of a geologic repository at the Yucca Mountain site.

The second criterion, unsaturated zone flow characteristics, relates to the processes affecting the limitations and amount of water entering the unsaturated zone above the repository and contacting wastes in the repository. Unsaturated zone flow characteristics include: (a) Climate—for example, precipitation and postulated future climatic conditions; (b) infiltration—for example, precipitation entering the mountain in excess of water returned to the atmosphere by evaporation and plant transpiration; (c) unsaturated-zone flux—for example, water movement

through the pore spaces, or flowing along fractures or through perched water zones above the repository; and (d) seepage—for example, water dripping into the underground repository openings from the surrounding rock. Together, the first and second criteria define the temporal and spatial distribution of water flow through the unsaturated zone above the water table at Yucca Mountain, and the temporal and spatial distribution of water seepages into the underground openings of the repository.

The third criterion, near field environment characteristics, also relates to processes important to limiting the amount of water that could contact wastes. This criterion includes: (a) Thermal hydrology—for example, effects of heat from the waste on water flow through the site, and the temperature and humidity at the engineered barriers; and, (b) near-field geochemical environment—for example, the chemical reactions and products resulting from water contacting the waste and the engineered barriers materials. The thermal regime generated by the decay of the radioactive wastes can mobilize water over the first hundreds to thousands of years. For these reasons, the amount of water flowing in the rock and seeping into drifts is expected to vary with time.

The fourth criterion, engineered barrier system degradation characteristics, relates to the processes important to long waste package lifetimes. This criterion includes: (a) engineered barrier system component performance—for example, drip shields, backfill, coatings, or chemical modifications; and (b) waste package degradation—for example, the corrosion of the waste package materials within the near-field repository environment. This criterion and the first criterion, site characteristics, define the spatial and temporal distribution of the time periods when waste packages are expected to breach. The thermal, hydrologic, and geochemical processes acting on the waste package surface are the most important environmental factors affecting the waste package lifetime. In addition, the degradation characteristics of the waste package materials significantly impact the timing of waste package breaches.

The fifth criterion, waste form degradation characteristics, addresses the initial aspects of low rate of release of radionuclides. This criterion includes: (a) cladding degradation—for example, corrosion or break-down of the cladding on the individual spent fuel pellets; and, (b) waste form dissolution—for example, the ability of

individual radionuclides to dissolve in water penetrating breached waste packages. This criterion is important to understanding how and in what manner the waste forms will break down, permitting the release of radionuclides to the immediately surrounding environment.

The sixth criterion, engineered barrier system degradation, flow, and transport characteristics, addresses the processes important to the manner in which radionuclides can begin to move outward once the engineered barrier system has been degraded. This criterion includes: (a) colloid formation and stability—for example, the formation of colloidal particles and the ability of radionuclides to adhere to these particles as they may be washed through the remaining barriers; and (b) engineered barrier transport—for example, the movement of radionuclides dissolved in water or adhering to colloidal particles to be transported through the remaining engineered barriers and in the underlying unsaturated zone. This criterion and the first criterion, site characteristics, lead to a determination of the spatial and temporal distribution of the mass of radioactive wastes released from the waste packages. Each characteristic depends on the thermal, hydrologic, and geochemical conditions inside the waste package, which change with time.

The next two criteria—unsaturated zone flow and transport characteristics (criterion seven), and saturated zone flow and transport characteristics (criterion eight)—relate to processes important to radionuclide concentration reduction during transport. To assess the movement of radionuclides away from the degraded engineered barrier system, the first important process to understand is the unsaturated zone flow characteristics in combination with the unsaturated zone transport characteristics. The unsaturated zone flow and transport characteristics criterion includes: (a) unsaturated-zone transport—for example, the movement of water with dissolved radionuclides or colloidal particles through the unsaturated zone underlying the repository, including retardation mechanisms such as sorption on rock or mineral surfaces; and (b) thermal hydrology—for example, effects of heat from the waste on water flow through the site. The next criterion, saturated zone flow and transport characteristics, addresses similar radionuclide transport processes, only in the saturated zone. This criterion includes: (a) saturated zone transport—for example, the movement of water with dissolved

radionuclides or colloidal particles through the saturated zone underlying and beyond the repository, including retardation mechanisms such as sorption on rock or mineral surfaces; and (b) dilution—for example, diffusion of radionuclides into pore spaces, dispersion of radionuclides along flow paths, and mixing with non-contaminated ground water.

The ninth criterion, biosphere characteristics, addresses the characteristics that describe the lifestyle and habits of individuals who potentially could be exposed to radioactive material at a future time. Because of the difficulty in predicting the lifestyles and habits of future generations, such assessments are to be based on representative current conditions. Both the EPA and the NRC have proposed rules that would require DOE to apply current conditions in assessments of the reference biosphere. This criterion includes: (a) a reference biosphere and receptor defined, for example, by considering pathways, location and behavior representative of current conditions; and (b) biosphere transport and uptake—for example, the consumption of ground or surface waters through direct extraction or agriculture, including mixing with non-contaminated waters and exposure to contaminated agricultural products.

Together, the criteria of unsaturated zone flow and transport characteristics, saturated zone flow and transport characteristics, and biosphere characteristics, address the spatial and temporal variations of radionuclide concentrations in ground water. The ground water concentration ultimately yields the mass of radionuclides that may be ingested or inhaled by individuals exposed to that ground water, which in turn leads to a level of radiological dose or risk associated with that potential exposure. The concentration depends on both the mass release rate of the radionuclides as well as the volumetric flux of water along the different pathways in the different components.

Section 963.17(b) presents four final criteria (separately enumerated from section 963.17(a)) under the category of disruptive processes and events. These criteria relate to disruptive processes and events that could potentially release radionuclides directly to the human environment, or otherwise adversely affect the characteristics of the system. The criteria pertinent to assessing repository performance relative to this attribute include: (1) Volcanism—for example, the probability and potential consequences of a volcanic eruption intersecting the repository; (2) seismic

events—for example, the probability and potential consequences of a earthquake on the underground facilities or hydrologic system; and (3) nuclear criticality—for example, the probability and potential consequences of a self-sustaining nuclear reaction as a result of chemical or physical processes affecting the waste either in or after release from breached waste packages.

The last of the four disruptive processes and events criteria, inadvertent human intrusion, is a special criterion to be applied and assessed in its own performance assessment. Although characterization of the Yucca Mountain site and region indicates that it is not a likely choice for future exploration for natural resources, the NRC has identified the examination of a human intrusion scenario through drilling as a requirement for a TSPA in its proposed part 63. Accordingly, inadvertent human intrusion—for example, consequences to repository system performance following a stylized human intrusion scenario, is included in the criteria for disruptive processes and events, although it will be treated in a separate performance assessment. In making its suitability determination, DOE would apply the regulatory concept for human intrusion applicable at that time.

## VII. Opportunity for Public Comment

### A. Participation in Rulemaking

Interested persons are invited to participate in this proposed rulemaking by submitting written data, views, or comments with respect to the subject set forth in this notice. The Department encourages the maximum level of public participation possible in this rulemaking. Individuals, coalitions, states or other government entities, and others are urged to submit written comments on the proposal.

### B. Written Comment Procedures

The DOE invites public comments on the proposed rule. Written comments should be identified on the outside of the envelope, and on the comments themselves, with the designation: "Site Characterization Suitability Criteria NOPR, Docket Number [RW-RM-99-963]" and must be received by the date specified at the beginning of this notice in order to be considered. In the event any person wishing to submit written comments cannot provide them directly, alternative arrangements can be made by calling [(800) 967-3477]. All comments received on or before the date specified at the beginning of this notice and other relevant information will be considered by the DOE before final

action is taken on the proposed rule. All comments submitted will be available for examination in the Rule Docket File in the Yucca Mountain Science Center in Las Vegas, Nevada, and the DOE's Freedom of Information Reading Room. Pursuant to the provisions of 10 CFR 1004.11, any person submitting information or data that is believed to be confidential, and which may be exempt by law from public disclosure, should submit one complete copy, as well as two copies from which the information considered confidential has been deleted. The Department of Energy will make its own determination of any such claim and treat it according to its determination.

### C. Hearing Procedures

At the beginning of this notice, DOE indicated that there would be a separate **Federal Register** Notice informing the public of the time and location of the public hearings on this supplemental notice of proposed rulemaking. For obvious reasons, DOE will hold these hearings in the vicinity of Yucca Mountain because nearby residents would be especially impacted by the location of a nuclear waste repository at Yucca Mountain. These hearings will not be trial-type evidentiary hearings that require a lawyer. They will be informal, and DOE intends to use a facilitator in an effort to ensure they are fair and productive.

DOE is considering a format wherein DOE officials would make a presentation that summarizes the supplemental notice of proposed rulemaking, and members of the public would have the opportunity to make oral comments. Prior to or following the hearing, DOE officials may be available to answer technical questions about the proposed regulation articulated in this notice. However, the DOE officials could not make any commitments about the final rule, and in some instances, they might be limited to taking the oral comments under advisement. In fairness to all commenters, decisions about the final rule must await the close of the comment period and consideration by DOE senior policy makers.

## VIII. Regulatory Review

### A. Review for Compliance with the National Environmental Policy Act (NEPA)

The issuance of these amendments to the guidelines is a preliminary decision-making activity pursuant to subsection 112(d) and 113(d) of the Act and therefore does not require the preparation of an environmental impact statement pursuant to subsection

102(2)(C) of the NEPA or any other environmental review under subsection 102(2)(E) or (F) of the NEPA.

#### *B. Review under the Regulatory Flexibility Act*

The Regulatory Flexibility Act, 5 U.S.C. 601 *et seq.*, was enacted by Congress to ensure that a substantial number of small entities do not unnecessarily face significant negative economic impact as a result of Government regulations. The DOE certifies that the rule amending the guidelines will not have a significant impact on a substantial number of small entities. The final rule will not regulate or otherwise economically burden anyone outside of the DOE. It merely articulates considerations for the Secretary of Energy to use in determining whether the Yucca Mountain site is suitable for development as a repository. Moreover, in response to the initial notice of proposed rulemaking, a few entities who commented were small entities, and none of them identified economic burdens that the proposed regulations would impose. Accordingly, no regulatory flexibility analysis is required under the Regulatory Flexibility Act.

#### *C. Review under the Paperwork Reduction Act*

The DOE has determined that this rule, as proposed, contains no new or amended record keeping, reporting, or application requirements, or any other type of information collection requirements subject to the Paperwork Reduction Act (Pub. L. No. 96-511).

#### *D. Review under Unfunded Mandates Reform Act*

The Unfunded Mandates Reform Act of 1995 (Pub. L. No. 104-4) generally requires Federal agencies to closely examine the impacts of regulatory actions on State, local, and tribal governments. Subsection 101(5) of Title I of that law defines a Federal intergovernmental mandate to include any regulation that would impose an enforceable duty upon State, local, or tribal governments, except, among other things, a condition of Federal assistance or a duty arising from participating in a voluntary federal program. Title II of that law requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and tribal governments, in the aggregate, or to the private sector, other than to the extent such actions merely incorporate requirements specifically set forth in a statute. Section 202 of that title requires a Federal agency to perform a detailed assessment of the anticipated costs and

benefits of any rule that includes a Federal mandate which may result in costs to State, local, or tribal governments, or to the private sector, of \$100 million or more. Section 204 of that title requires each agency that proposes a rule containing a significant Federal intergovernmental mandate to develop an effective process for obtaining meaningful and timely input from elected officers of State, local, and tribal governments.

This rule, as proposed, is not likely to result in any Federal mandate that may result in the expenditure by State, local, and tribal governments in the aggregate, or by the private sector, of \$100 million or more in any one year. Further, the guidelines in 10 CFR part 960, the proposed amendments to part 960 and the proposed part 963 largely incorporate requirements specifically provided in Sections 112 and 113 of the Act. Moreover, Sections 112, 113 and 114 of the Act provide for meaningful and timely input from elected officials of State, local and tribal governments. Accordingly, no assessment or analysis is required under the Unfunded Mandates Reform Act of 1995.

#### *E. Review under Executive Order 12612*

Executive Order 12612, 52 FR 41685, requires that regulations, rules, legislation, and any other policy actions be reviewed for any substantial direct effect on States, on the relationship between the Federal government and the States, or in the distribution of power and responsibilities among various levels of government. If there are substantial effects, then the Executive Order requires a preparation of a Federalism assessment to be used in all decisions involved in promulgating and implementing policy action.

The rule, as proposed in this notice, will not have a substantial direct effect on the institutional interests or traditional functions of the States. Accordingly, no assessment or analysis is required under Executive Order 12612.

#### *F. Review under Executive Order 12866*

Section 1 of Executive Order 12866 ("Regulatory Planning and Review"), 58 FR 51735, establishes a philosophy and principles for Federal agencies to follow in promulgating regulations. Section 1(b)(9) of that Order provides: "Wherever feasible, agencies shall seek views of appropriate State, local, and tribal officials before imposing regulatory requirements that might significantly or uniquely affect those governmental entities. Each agency shall assess the effects of Federal regulations

on State, local, and tribal governments, including specifically the availability of resources to carry out those mandates, and seek to minimize those burdens that uniquely or significantly affect such governmental entities, consistent with achieving regulatory objectives. In addition, agencies shall seek to harmonize Federal regulatory actions with regulated State, local and tribal regulatory and other governmental functions."

Section 6 of Executive Order 12866 provides for a review by the Office of Information and Regulatory Affairs (OIRA) of a "significant regulatory action," which is defined to include an action that may have an effect on the economy of \$100 million or more, or adversely affect, in a material way, the economy, competition, jobs, productivity, the environment, public health or safety, or State, local, or tribal governments. The Department has concluded that this proposed rule is a significant regulatory action that requires a review by the OIRA. DOE submitted this rule for OIRA clearance, and OIRA has completed its review.

#### *G. Review under Executive Order 12875*

Executive Order 12875 ("Enhancing Intergovernmental Partnership"), provides for reduction or mitigation, to the extent allowed by law, of the burden on State, local and tribal governments of unfunded Federal mandates not required by statute. The analysis under the Unfunded Mandates Reform Act of 1995, above, satisfies the requirements of Executive Order 12875. Accordingly, no further analysis is required under Executive Order 12875.

#### *H. Review under Executive Order 12988*

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 61 FR 4729 (February 7, 1996), imposes on Executive agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. With regard to the review required by section 3(a), section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting

simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. The DOE has completed the required review and determined that, to the extent permitted by law, the rule, as proposed, meets the relevant standards of Executive Order 12988.

#### *I. Review under Executive Order 13084*

Under Executive Order 13084, "Consultation and Coordination with Indian Tribal Governments," DOE may not issue a discretionary rule that significantly or uniquely affects Indian tribal governments and imposes substantial direct compliance costs. This proposed rulemaking would not have such effects. Accordingly, Executive Order 13084 does not apply to this rulemaking.

#### *J. Review Under the Treasury and General Government Appropriations Act, 1999*

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Public Law 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule or policy that may affect family well-being. Today's proposal would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

#### **List of Subjects in 10 CFR Parts 960 and 963**

Environmental protection, Geologic repositories, Nuclear energy, Nuclear materials, Radiation protection, Waste disposal.

Issued in Washington, D.C. on November 19, 1999.

**Lake H. Barrett,**

*Acting Director, Office of Civilian Radioactive Waste Management.*

For the reasons stated in the preamble, DOE hereby proposes to amend part 960, and to add a new part 963 to, Chapter II of Title 10 of the Code of Federal Regulations as follows:

### **PART 960—GENERAL GUIDELINES FOR THE PRELIMINARY SCREENING OF POTENTIAL SITES FOR A NUCLEAR WASTE REPOSITORY**

1. The authority for 10 CFR part 960 is revised to read as follows:

**Authority:** 42 U.S.C. 2011, *et seq.*, 42 U.S.C. 7101, *et seq.*, 42 U.S.C. 10101, *et seq.*

2. The part heading for Part 960 is revised to read as set forth above:

#### **§ 960.1 [Amended]**

3. Section 960.1 is amended by removing the phrase "for the development of repositories" from the first sentence and removing the phrase "and any preliminary suitability determinations required by Section 114(f)" from the second sentence.

4. Section 960.2 is amended by revising the definitions of "Act," "Application" and "Determination" to read as follows:

#### **§ 960.2 Definitions.**

\* \* \* \* \*

*Act* means the Nuclear Waste Policy Act of 1982, as amended.

\* \* \* \* \*

*Application* means the act of making a finding of compliance or noncompliance with the qualifying or disqualifying conditions specified in the guidelines of subparts C and D of this part.

\* \* \* \* \*

*Determination* means a decision by the Secretary that a site is suitable for site characterization for the selection of a repository, consistent with applications of the guidelines of subparts C and D of this part in accordance with the provisions set forth in subpart B of this part.

\* \* \* \* \*

#### **§ 960.3 [Amended]**

5. Section 960.3 is amended by removing the phrase "for the development of repositories" from the first sentence.

#### **§ 960.3-1-4-4 [Removed]**

6. Section 960.3-1-4-4 is removed.

7. Section 960.3-1-5 is revised to read as follows:

#### **§ 960.3-1-5 Basis for site evaluations.**

(a) Evaluations of individual sites and comparisons between and among sites shall be based on the postclosure and preclosure guidelines specified in subparts C and D of this part, respectively. Except for screening for potentially acceptable sites as specified in § 960.3-2-1, such evaluations shall place primary significance on the postclosure guidelines and secondary

significance on the preclosure guidelines, with each set of guidelines considered collectively for such purposes. Both the postclosure and the preclosure guidelines consist of a system guideline or guidelines and corresponding groups of technical guidelines.

(b) The postclosure guidelines of subpart C of this part contain eight technical guidelines in one group. The preclosure guidelines of subpart D of this part contain eleven technical guidelines separated into three groups that represent, in decreasing order of importance, preclosure radiological safety; environment, socioeconomic, and transportation; and ease and cost of siting, construction, operation, and closure.

(c) The relative significance of any technical guideline to its corresponding system guideline is site specific. Therefore, for each technical guideline, an evaluation of compliance with the qualifying condition shall be made in the context of the collection of system elements and the evidence related to that guideline, considering on balance the favorable conditions and the potentially adverse conditions identified at a site. Similarly, for each system guideline, such evaluation shall be made in the context of the group of technical guidelines and the evidence related to that system guideline.

(d) For purposes of recommending sites for development as repositories, such evidence shall include analyses of expected repository performance to assess the likelihood of demonstrating compliance with 40 CFR part 191 and 10 CFR part 60, in accordance with § 960.4-1. A site shall be disqualified at any time during the siting process if the evidence supports a finding by the DOE that a disqualifying condition exists or the qualifying condition of any system or technical guideline cannot be met.

(e) Comparisons between and among sites shall be based on the system guidelines, to the extent practicable and in accordance with the levels of relative significance specified above for the postclosure and the preclosure guidelines. Such comparisons are intended to allow comparative evaluations of sites in terms of the capabilities of the natural barriers for waste isolation and to identify innate deficiencies that could jeopardize compliance with such requirements. If the evidence for the sites is not adequate to substantiate such comparisons, then the comparisons shall be based on the groups of technical guidelines under the postclosure and the preclosure guidelines, considering the levels of relative significance appropriate to the

postclosure and the preclosure guidelines and the order of importance appropriate to the subordinate groups within the preclosure guidelines. Comparative site evaluations shall place primary importance on the natural barriers of the site. In such evaluations for the postclosure guidelines of subpart C of this part, engineered barriers shall be considered only to the extent necessary to obtain realistic source terms for comparative site evaluations based on the sensitivity of the natural barriers to such realistic engineered barriers. For a better understanding of the potential effects of engineered barriers on the overall performance of the repository system, these comparative evaluations shall consider a range of levels in the performance of the engineered barriers. That range of performance levels shall vary by at least a factor of 10 above and below the engineered-barrier performance requirements set forth in 10 CFR 60.113, and the range considered shall be identical for all sites compared. The comparisons shall assume equivalent engineered barrier performance for all sites compared and shall be structured so that engineered barriers are not relied upon to compensate for deficiencies in the geologic media. Furthermore, engineered barriers shall not be used to compensate for an inadequate site; mask the innate deficiencies of a site; disguise the strengths and weaknesses of a site and the overall system; and mask differences between sites when they are compared. Releases of different radionuclides shall be combined by the methods specified in appendix A of 40 CFR part 191.

(f) The comparisons specified above shall consist of two comparative evaluations that predict radionuclide releases for 100,000 years after repository closure and shall be conducted as follows. First, the sites shall be compared by means of evaluations that emphasize the performance of the natural barriers at the site. Second, the sites shall be compared by means of evaluations that emphasize the performance of the total repository system. These second evaluations shall consider the expected performance of the repository system; be based on the expected performance of waste packages and waste forms, in compliance with the requirements of 10 CFR 60.113, and on the expected hydrological and geochemical conditions at each site; and take credit for the expected performance of all other engineered components of the repository system. The comparison of isolation capability shall be one of the

significant considerations in the recommendation of sites for the development of repositories. The first of the two comparative evaluations specified in the preceding paragraph shall take precedence unless the second comparative evaluation would lead to substantially different recommendations. In the latter case, the two comparative evaluations shall receive comparable consideration. Sites with predicted isolation capabilities that differ by less than a factor of 10, with similar uncertainties, may be assumed to provide equivalent isolation.

8. In section 960.3-2, the last sentence is revised to read as follows:

**§ 960.3-2 Siting process.**

\* \* \* The recommendation of sites as candidate sites for characterization shall be accomplished in accordance with the requirements specified in § 960.3-2-3.

**§ 960.3-2-4 [Removed]**

9. Section 960.3-2-4 is removed.

**Appendix III to Part 960 [Amended]**

10. Appendix III to Part 960 is amended as follows:

In paragraph 1, introductory text, first sentence, revise the phrase "the "principal to read ascertain"

In paragraph 1, remove the definition (decision point) for "Repository Site Selection."

In paragraph 2, remove the definition for the numeral "4" and paragraphs "(a)" and "(b)" which follow.

In the table, Findings Resulting From the Application of the Qualifying and Disqualifying Conditions of the Technical Guidelines at Major Siting Decisions, remove the column heading and corresponding entries for "Repository Site Selection" under the heading "Siting Decision."

4. New part 963 is added to read as follows:

**PART 963—YUCCA MOUNTAIN SITE SUITABILITY GUIDELINES**

**Subpart A—General Provisions**

963.1 Purpose.

963.2 Definitions.

**Subpart B—Site Suitability Determination, Methods and Criteria**

963.10 Scope.

963.11 Suitability determination.

963.12 Preclosure suitability determination.

963.13 Preclosure suitability evaluation method.

963.14 Preclosure suitability criteria.

963.15 Postclosure suitability determination.

963.16 Postclosure suitability evaluation method.

963.17 Postclosure suitability criteria.

**Authority:** 42 U.S.C. 2011 *et seq.*; 42 U.S.C. 7101 *et seq.*; 42 U.S.C. 10101, *et seq.*

**Subpart A—General Provisions**

**§ 963.1 Purpose.**

(a) The purpose of this part is to establish DOE methods and criteria for determining the suitability of the Yucca Mountain site for the location of a geologic repository. DOE will use these methods and criteria in analyzing the data from the site characterization activities required under section 113 of the Nuclear Waste Policy Act.

(b) This part does not address other information that must be considered and submitted to the President, and made available to the public, by the Secretary under section 114 of the Nuclear Waste Policy Act if the Yucca Mountain site is recommended for development as a geologic repository.

**§ 963.2 Definitions.**

For purposes of this Part:

*Barrier* means any material, structure or process that prevents or substantially delays the movement of water or radionuclides.

*Cladding* means the corrosion-resistant material, typically a zirconium alloy, that binds and contains the nuclear fuel material in individual fuel pellets.

*Closure* means the final closing of the remaining open operational areas of the underground facility and boreholes after termination of waste emplacement, culminating in the sealing of shafts and ramps, except those openings that may be designed for ventilation or monitoring.

*Colloid* means any fine-grained material in suspension, or any such material that can be easily suspended.

*Criteria* means the characterizing traits relevant to assessing the performance of a geologic repository, as defined by this section, at the Yucca Mountain site.

*Design* means a description of the engineered structures, systems, components and equipment of a geologic repository at Yucca Mountain that includes the engineered barrier system.

*Design basis event* means:

(1) Those natural and human-induced events that are expected to occur one or more times before permanent closure; or

(2) Other natural and human-induced events that have at least one chance in 10,000 of occurring before permanent closure.

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

*Engineered barrier system* means the waste packages and the underground facilities.

*Expected* means assumed to be probable on the basis of existing

evidence and in the absence of significant evidence to the contrary.

*Geologic repository* means a system that is intended to be used for, or may be used for, the disposal of radioactive wastes in excavated geologic media including the engineered barrier system and the portion of the geologic setting that provides isolation of the radioactive waste.

*Geologic setting* means geologic, hydrologic, and geochemical system of the region in which a geologic repository operations area at Yucca Mountain is or may be located.

*Infiltration* means the flow of a fluid into a solid substance through pores or small openings; specifically, the movement of water into soil and fractured or porous rock.

*Near-field* means the region where the adjacent natural geohydrologic system has been significantly impacted by the excavation of the repository and the emplacement of the waste.

*NRC* means the U.S. Nuclear Regulatory Commission or its duly authorized representatives.

*Perched water* means ground water of limited lateral extent separated from an underlying body of ground water by an unsaturated zone.

*Preclosure or preclosure period* means the period of time before and during closure of the geologic repository.

*Preclosure safety evaluation* means a preliminary assessment of the adequacy of repository support facilities to prevent or mitigate the effects of postulated design basis events (including fire, radiation, criticality, and chemical hazards), and the site, structures, systems, components, equipment, and operator actions that would be relied on for safety.

*Postclosure* means the period of time after the closure of the geologic repository.

*Radioactive waste* means high-level radioactive waste and other radioactive materials, including spent nuclear fuel, that are received for emplacement in the geologic repository.

*Reference biosphere* means the description of the environment, inhabited by the receptor, comprising the set of specific biotic and abiotic characteristics of the environment, including, but not limited to, climate, topography, soils, flora, fauna, and human activities.

*Repository support facilities* means all permanent facilities constructed in support of site characterization activities and repository construction, operation, and closure activities, including surface structures, utility lines, roads, railroads, and similar

facilities, but excluding the underground facility.

*Seepage* means the inflow of ground water moving in fractures or pore spaces of permeable rock to an open space in the rock such as an excavated drift.

*Sensitivity study* means an analytic or numerical technique for examining the effects on outcomes, such as radionuclide releases, of varying specified parameters, such as the infiltration rate due to precipitation, when a model run is performed.

*Site characterization* means activities, whether in the laboratory or in the field, undertaken to establish the geologic conditions and the ranges of the parameters of a candidate site relevant to the location of a repository, including borings, surface excavations, excavations of exploratory shafts, limited subsurface lateral excavations and borings, and in situ testing needed to evaluate the suitability of a candidate site for the location of a repository, but not including preliminary borings and geophysical testing needed to assess whether site characterization should be undertaken.

*Surface facilities* means repository support facilities within the restricted area located on or above the ground surface.

*System performance* means the complete behavior of a geologic repository system at Yucca Mountain in response to the conditions, processes, and events that may affect it.

*Total system performance assessment* means a probabilistic analysis that is used to:

(1) Identify the features, events and processes that might affect the performance of the geologic repository;

(2) Examine the effects of such features, events, and processes on the performance of the geologic repository; and

(3) Estimate the expected annual dose to the receptor as a result of releases from the geologic repository.

*Underground facility* means the underground structure, backfill materials, if any, and openings that penetrate the underground structure (e.g., ramps, shafts and boreholes, including their seals)

*Waste* is synonymous with "radioactive waste."

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

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

*Yucca Mountain site* means the candidate site in the State of Nevada

recommended by the Secretary to the President under section 112(b)(1)(B) of the Nuclear Waste Policy Act of 1982 (NWPA) [42 U.S.C. 1032(b)(1)(B)] on May 27, 1986.

## **Subpart B—Site Suitability Determination, Methods, and Criteria**

### **§ 963.10 Scope.**

(a) The scope of this subpart includes the following for both the preclosure and postclosure periods:

(1) The bases for the suitability determination for the Yucca Mountain site as a location for a geologic repository;

(2) The suitability evaluation methods for applying the site suitability criteria to a geologic repository at the Yucca Mountain site; and

(3) The site suitability criteria that DOE will apply in accordance with section 113(b)(1)(A)(iv) of the NWPA.

(b) DOE will seek NRC concurrence on any future revisions to this subpart.

### **§ 963.11 Suitability determination.**

DOE will evaluate whether the Yucca Mountain site is suitable for the location of a geologic repository on the basis of the preclosure and postclosure determinations described in §§ 963.12 and 963.15. If DOE's evaluation of the Yucca Mountain site for the location of a geologic repository under §§ 963.12 and 963.15 shows that the geologic repository is likely to meet the applicable radiation protection standards for the preclosure and postclosure periods, then DOE may determine that the site is a suitable location for the development of such a repository.

### **§ 963.12 Preclosure suitability determination.**

DOE will apply the method and criteria described in §§ 963.13 and 963.14 to evaluate the suitability of the Yucca Mountain site for the preclosure period. If DOE finds that the results of the preclosure safety evaluation conducted under § 963.13 show that the Yucca Mountain site is likely to meet the applicable radiation protection standard, DOE may determine the site suitable for the preclosure period.

### **§ 963.13 Preclosure suitability evaluation method.**

(a) DOE will evaluate preclosure suitability using a preclosure safety evaluation method. DOE will evaluate the performance of the geologic repository at the Yucca Mountain site using the method described in paragraph (b) of this section and the criteria in § 963.14. DOE will consider the performance of the system in terms

of the criteria to evaluate whether the geologic repository is likely to comply with the applicable radiation protection standard.

(b) The preclosure safety evaluation method, using preliminary engineering specifications, will assess the adequacy of the repository facilities to perform their intended functions and prevent or mitigate the effects of postulated design basis events that are deemed sufficiently credible to warrant consideration. The preclosure safety evaluation will consider:

(1) A preliminary description of the site characteristics, the surface facilities and the underground operating facilities;

(2) A preliminary description of the design bases for the operating facilities and a preliminary description of any associated limits on operation;

(3) A preliminary description of potential hazards, event sequences, and their consequences; and

(4) A preliminary description of the structures, systems, components, equipment, and operator actions intended to mitigate or prevent accidents.

#### **§ 963.14 Preclosure suitability criteria.**

DOE will evaluate preclosure suitability using the following criteria:

(a) Ability to contain radioactive material and to limit releases of radioactive materials;

(b) Ability to implement control and emergency systems to limit exposure to radiation;

(c) Ability to maintain a system and components that perform their intended safety functions; and

(d) Ability to preserve the option to retrieve wastes during the preclosure period.

#### **§ 963.15 Postclosure suitability determination.**

DOE will apply the method and criteria described in §§ 963.16 and 963.17 to evaluate the suitability of the Yucca Mountain site for the postclosure period. If DOE finds that the results of the total system performance assessments conducted under § 963.16 show that the Yucca Mountain site is likely to meet the applicable radiation protection standard, DOE may determine the site suitable for the postclosure period.

#### **§ 963.16 Postclosure suitability evaluation method.**

(a) DOE will evaluate postclosure suitability using the total system performance assessment method. DOE will conduct a total system performance assessment to evaluate the ability of the

geologic repository to meet the applicable radiation protection standard under the following circumstances:

(1) DOE will conduct a total system performance assessment to evaluate the ability of the geologic repository to limit radiological exposures in the case where there is no human intrusion into the repository. DOE will model the performance of the geologic repository at the Yucca Mountain site using the method described in paragraph (b) of this section and the criteria in § 963.17, excluding the criterion in paragraph (b)(4) of § 963.17. DOE will consider the performance of the system in terms of the criteria to evaluate whether the geologic repository is likely to comply with the applicable radiation protection standard.

(2) Consistent with applicable NRC regulations regarding a stylized human intrusion case, DOE will conduct a total system performance assessment to evaluate the ability of the geologic repository to limit radiological exposures in a stylized limited human intrusion case. DOE will model the performance of the geologic repository at the Yucca Mountain site using the method described in paragraph (b) of this section and the criteria in § 963.17. DOE will consider the performance of the system in terms of the criteria to evaluate whether the geologic repository is likely to comply with the applicable radiation protection standard. The human intrusion evaluation under this paragraph will be separate from the evaluation conducted under paragraph (a)(1) of this section.

(b) In conducting a total system performance assessment under this section, DOE will:

(1) Include data related to the suitability criteria in § 963.17;

(2) Account for uncertainties and variabilities in parameter values and provide the technical basis for parameter ranges, probability distributions, and bounding values;

(3) Consider alternative models of features and processes that are consistent with available data and current scientific understanding, and evaluate the effects that alternative models would have on the estimated performance of the geologic repository;

(4) Consider only events that have at least one chance in 10,000 of occurring over 10,000 years;

(5) Provide the technical basis for either inclusion or exclusion of specific features, events, and processes of the geologic setting, including appropriate details as to magnitude and timing regarding any exclusions that would significantly change the expected annual dose;

(6) Provide the technical basis for either inclusion or exclusion of degradation, deterioration, or alteration processes of engineered barriers, including those processes that would adversely affect natural barriers, (such as degradation of concrete liners affecting the pH of ground water or precipitation of minerals due to heat changing hydrologic processes), including appropriate details as to magnitude and timing regarding any exclusions that would significantly change the expected annual dose;

(7) Provide the technical basis for models used in the total systems performance assessment such as comparisons made with outputs of detailed process-level models and/or empirical observations (for example, laboratory testing, field investigations, and natural analogs);

(8) Identify natural features of the geologic setting and design features of the engineered barrier system important to isolating radioactive waste;

(9) Describe the capability of the natural and engineered barriers important to isolating radioactive waste, taking into account uncertainties in characterizing and modeling such barriers;

(10) Provide the technical basis for the description of the capability of the natural and engineered barriers important to isolating radioactive waste;

(11) Use the reference biosphere and group receptor assumptions specified in applicable NRC regulations; and

(12) Conduct appropriate sensitivity studies.

#### **§ 963.17 Postclosure suitability criteria.**

(a) DOE will evaluate the postclosure suitability of a geologic repository at the Yucca Mountain site through suitability criteria that reflect both the processes and the models used to simulate those processes, that are important to the total system performance of the geologic repository. The applicable criteria are:

(1) *Site characteristics*, which include:

(i) Geologic properties of the site—for example, stratigraphy, rock type and physical properties, and structural characteristics;

(ii) Hydrologic properties of the site—for example, porosity, permeability, moisture content, saturation, and potentiometric characteristics;

(iii) Geophysical properties of the site—for example, densities, velocities and water contents, as measured or deduced from geophysical logs; and

(iv) Geochemical properties of the site—for example, precipitation, dissolution characteristics, and sorption properties of mineral and rock surfaces.

(2) *Unsaturated zone flow characteristics*, which include:

(i) Climate—for example, precipitation and postulated future climatic conditions;

(ii) Infiltration—for example, precipitation entering the mountain in excess of water returned to the atmosphere by evaporation and plant transpiration;

(iii) Unsaturated zone flux—for example, water movement through the pore spaces, or flowing along fractures or through perched water zones above the repository;

(iv) Seepage—for example, water dripping into the underground repository openings from the surrounding rock;

(3) *Near field environment characteristics*, which include:

(i) Thermal hydrology—for example, effects of heat from the waste on water flow through the site, and the temperature and humidity at the engineered barriers.

(ii) Near field geochemical environment—for example, the chemical reactions and products resulting from water contacting the waste and the engineered barrier materials;

(4) *Engineered barrier system degradation characteristics*, which include:

(i) Engineered barrier system component performance—for example, drip shields, backfill, coatings, or chemical modifications, and

(ii) Waste package degradation—for example, the corrosion of the waste package materials within the near-field environment;

(5) *Waste from degradation characteristics*, which include:

(i) Cladding degradation—for example, corrosion or break-down of the

cladding on the individual spent fuel pellets;

(ii) Waste from dissolution—for example, the ability of individual radionuclides to dissolve in water penetrating breached waste packages;

(6) *Engineered barrier system degradation, flow, and transport characteristics*, which include:

(i) Colloid formation and stability—for example, the formation of colloidal particles and the ability of radionuclides to adhere to these particles as they may be washed through the remaining barriers; and

(ii) Engineered barrier transport—for example, the movement of radionuclides dissolved in water or adhering to colloidal particles to be transported through the remaining engineered barriers and in the underlying unsaturated zone;

(7) *Unsaturated zone flow and transport characteristics*, which include:

(i) Unsaturated zone transport—for example, the movement of water with dissolved radionuclides or colloidal particles through the unsaturated zone underlying the repository, including retardation mechanisms such as sorption on rock or mineral surfaces;

(ii) Thermal hydrology—for example, effects of heat from the waste on water flow through the site;

(8) *Saturated zone flow and transport characteristics*, which include:

(i) Saturated zone transport—for example, the movement of water with dissolved radionuclides or colloidal particles through the saturated zone underlying and beyond the repository, including retardation mechanisms such as sorption on rock or mineral surfaces; and

(ii) Dilution—for example, diffusion of radionuclides into pore spaces,

dispersion of radionuclides along flow paths, and mixing with non-contaminated ground water;

(9) *Biosphere characteristics*, which include:

(i) Reference biosphere and receptor—for example, biosphere water pathways, location and behavior of receptor; and

(ii) Biosphere transport and uptake—for example, the consumption of ground or surface waters through direct extraction or agriculture, including mixing with non-contaminated waters and exposure to contaminated agricultural products.

(b) DOE will evaluate the postclosure suitability of a geologic repository at the Yucca Mountain site using criteria that consider disruptive processes and events important to the total system performance of the geologic repository. The applicable criteria related to disruptive processes and events include:

(1) *Volcanism*—for example, the probability and potential consequences of a volcanic eruption intersecting the repository;

(2) *Seismic events*—for example, the probability and potential consequences of an earthquake on the underground facilities or hydrologic system;

(3) *Nuclear criticality*—for example, the probability and potential consequences of a self-sustaining nuclear reaction as a result of chemical or physical processes affecting the waste either in or after release from breached waste packages;

(4) *Inadvertent human intrusion*—for example, consequences to repository system performance following a stylized human intrusion scenario.

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