



June 8, 1989

**RULEMAKING ISSUE**  
(Notation Vote)

SECY-89-176

For: The Commissioners  
From: Waste Confidence Review Group  
Subject: PROPOSED 1989 WASTE CONFIDENCE DECISION AND CONFORMING AMENDMENTS TO 10 CFR PART 51

Purpose: To obtain Commission approval to publish for public comment: 1) an analysis of the Commission's 1984 Waste Confidence Decision in light of developments since that time; 2) recommended revisions to Findings 2 and 4 of the Decision (regarding the timing of availability of a mined geologic repository and the safety and environmental impacts of extended storage of spent fuel, respectively); and 3) proposed conforming amendments to 10 CFR Part 51.

Summary: This paper seeks Commission approval to publish for public comment the preliminary results of the first five-year review of the Commission's original Waste Confidence Decision. Finding 2 of that Decision stated that the Commission had reasonable assurance that a geologic repository will be available by the year 2007-2009, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of its spent fuel and high-level waste. The proposed revision would state that a repository will be available within the first quarter of the twenty-first century, and that sufficient repository capacity will be available within 30 years beyond the licensed life for operation of that reactor. Finding 4 of the 1984 Decision found reasonable assurance that if necessary, spent fuel from any reactor can be stored safely and without environmental impacts at onsite or offsite installations for at least 30 years beyond the expiration of the reactor's operating license. Revised Finding 4 would clarify that renewal of a reactor's operating license for an additional 30 years would extend its licensed life for operation by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years.

Contacts:  
Rob MacDougall, NMSS x23401  
Karen Cyr, OGC x21637

Public  
8906280246

The Commission's other 1984 Waste Confidence Findings would be reaffirmed.

Background:

On October 25, 1979 the Commission initiated a generic rulemaking "to assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or off-site storage will be available, and to determine whether radioactive wastes can be safely stored on-site past the expiration of existing facility licenses until off-site disposal or storage is available." The Commission issued five findings in its final Waste Confidence Decision on August 31, 1984 (49 FR 34658). The Commission noted that its decision was in the nature of a prediction, and committed to review its conclusions on Waste Confidence "should significant and pertinent unexpected events occur, or at least every five years until a repository for high-level radioactive waste and spent fuel is available."

On August 23, 1988, the Commission requested the staff to establish a group to review the Waste Confidence findings and provide its findings to the Commission. The Waste Confidence Review Group was established that fall, chaired by management of the Office of the General Counsel with members representing management of the Office of Nuclear Reactor Regulation, Office of Nuclear Material Safety and Safeguards, and Office of Nuclear Regulatory Research. On December 15, 1988 the Review Group provided the Commission a "Plan for 5-Year Review of the Waste Confidence Findings" (SECY-88-343). This paper provided a history of the Waste Confidence Proceeding, an outline of issues for consideration in the review of the Waste Confidence Findings, and a proposed schedule for reaching a final 1989 Waste Confidence Decision. On January 27, 1989 the Secretary informed the Review Group that the Commission had approved the proposed plan and schedule, and directed the Review Group to submit a draft decision to the Commission in accordance with the proposed schedule. Enclosed with this paper is the Review Group's Proposed 1989 Waste Confidence Decision and Proposed Conforming Amendments to 10 CFR Part 51. The Review Group recommends that the Commission approve the Proposed Decision and the Proposed Rulemaking for public comment in the Federal Register.

Discussion:

The Commission made five findings in its 1984 proceeding. It found reasonable assurance that:

(1) Safe disposal of high-level radioactive waste and spent fuel in a mined geologic repository is technically feasible.

(2) One or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-2009, and sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

(3) High-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level radioactive waste and spent fuel.

(4) If necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

(5) Safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

The Commission also issued two companion rulemaking amendments at the time it issued the Waste Confidence Decision. 10 CFR Part 50 was amended to require each nuclear power reactor licensee to submit, no later than 5 years prior to expiration of the operating license, plans for managing spent fuel at the reactor site until the spent fuel is transferred to the Department of Energy (DOE) for disposal under the Nuclear Waste Policy Act of 1982 (NWPAA). 10 CFR Part 51, the rule defining NRC's responsibilities under the National Environmental Policy Act (NEPA), was amended to provide that, in connection with the issuance or amendment of a reactor operating license or initial license for an independent spent fuel storage installation, no discussion of any environmental impact of spent fuel storage is required for the period following expiration of the license or amendment applied for.

Since the Commission issued its 1984 Waste Confidence Decision, the Department of Energy's (DOE's) program has

undergone major revisions, and the enactment of the Nuclear Waste Policy Amendments Act of 1987 has resulted in significant redirection of the high-level waste repository program.

In May 1986, DOE announced its intention to postpone site-specific work on the second repository program until the need for a second repository could be better assessed. DOE subsequently noted in the January 1987 Draft Mission Plan Amendment that it considered 25 years to be a conservative estimate of the time needed to progress from site-specific screening to the start of waste acceptance at a second repository. Also in the 1987 Draft Mission Plan Amendment, DOE announced that the schedule for waste acceptance at the first repository was to be extended from 1998 to 2003. In the intervening two years since that 2003 date was set, the revised schedule for the excavation of the exploratory shaft has slipped at least 18 months more. The delay in excavation of the shaft may well affect the 2003 date for repository availability at the Yucca Mountain site.

The NWPAA was enacted on December 22, 1987. The NWPAA suspended site characterization activities for the first repository at sites other than the Yucca Mountain, NV site. The NWPAA also required DOE to suspend all site-specific activities with respect to a second repository. Under the NWPAA, DOE is to report to Congress on the need for a second repository no sooner than 2007 and no later than 2010 on the need for a second repository.

The proposed review of the Waste Confidence decision discusses these and other developments and describes their impact on the Commission's 1984 Findings. As a result of programmatic and legislative changes, and advances in licensing and implementation of dry cask spent fuel storage technology, the Review Group is proposing that Findings 2 and 4 be revised. The statutory prohibition on concurrent characterization of other candidate sites effectively makes it necessary that the Yucca Mountain site be found suitable if the 2007-2009 timeframe for repository availability under the original Finding 2 is to be met. The Review Group believes that in the current review of the 1984 Waste Confidence findings, NRC must consider the possibility that Yucca Mountain will be found unsuitable and that DOE will have to identify and characterize another site for the first repository. To establish a conservative bounding

assumption on the timing of availability of the first repository, the Review Group has developed a reasonable basis to assume that a repository will be available within the first quarter of the 21st century.

The Review Group also proposes to substitute "licensed life for operation" for "expiration of operating license" of a reactor as the beginning point for the 30-year post-operational spent fuel storage period during which sufficient repository capacity is expected to become available. This change would enable Finding 2 to cover continuing spent fuel storage at the four reactors, Dresden 1, Humboldt Bay, Indian Point 1, and LaCrosse, that were retired from operation before their operating licenses expired. For these reactors, whose operating licenses could in effect be considered terminated as of their retirement, a repository available in the year 2025 would not be available within 30 years of the effective end of their operating authority. A repository available in 2025 would, however, be available within 30 years of the end of the expected 40-year operating lifetimes of these reactors when they were originally licensed. The staff believes that this "licensed life for operation" was the concept the Commission had in mind when it issued Finding 2 in 1984.

Accordingly, we recommend that Finding 2 be revised as follows:

Finding 2: The Commission finds reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and that sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

The Review Group is also proposing that Finding 4 concerning the safety and environmental impact of at-reactor storage of spent fuel be revised to reflect the Environmental Assessment (EA) for the 10 CFR Part 72 rulemaking "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (53 FR 31651, August 19, 1988) and other evidence that spent fuel can be stored safely and without significant environmental impact for extended periods. The EA assessed dry cask storage of spent fuel for a period of

70 years after receipt from a reactor, where the spent fuel could have been stored more than 70 years. While storage as long as 140 years is not likely, some utilities are currently planning to seek license renewals for up to 30 more years after the expected expiration of their 40-year operating licenses, which would result in a 70-year life of licensed operation. The proposed revision to Finding 4 states that the Commission has reasonable assurance that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond this extended life, or for at least 100 years.

The revised Finding 4 reads as follows:

Finding 4: The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years.

If the Commission approves publication of the proposed changes to Findings 2 and 4, it will be necessary to issue a proposed conforming amendment to 10 CFR Part 51, the Commission's implementing regulations for the National Environmental Policy Act. The Commission's 1984 Waste Confidence Findings 2 and 4 are incorporated into 10 CFR 51.23(a) as generic findings on the safety and environmental impacts of spent fuel storage following the term of any reactor operating license or amendment, or any initial license or amendment for an independent spent fuel storage installation (ISFSI). Based on these generic findings, 10 CFR 51.23(b) provides that no discussion of these post-operational impacts are required in any environmental report, environmental impact statement, environmental assessment, or other analysis supporting a reactor operating license or license amendment, or an initial license or license amendment for an ISFSI.

The Waste Confidence Review Group therefore recommends that 10 CFR 51.23(a) be revised as follows: "The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without

significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and that sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time."

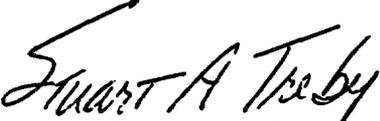
Recommendations:

That the Commission:

1. Approve publication of the Proposed 1989 Waste Confidence Decision, the revised findings and the proposed amendment to 10 CFR §51.23(a) in the Federal Register (Enclosures 1 and 2).
2. Note that:
  - (1) The notice of proposed decision and proposed rulemaking will be published in the Federal Register with a 90-day comment period.
  - (2) The Commission certifies that this rule, if adopted, will not have a significant economic impact on a substantial number of small entities. (Statement contained in Enclosure 2).
  - (3) The Subcommittee on Nuclear Regulation of the Senate Committee on the Environment and Public Works, the Subcommittee on Energy and the Environment of the House Interior and Insular Affairs Committee, and the Subcommittee on Energy and Power of the House Energy and Commerce Committee will be informed of the Commission's action by letter (Enclosure 3).

(4) That a public announcement will be issued when the proposed decision and proposed amendment are filed with the Office of the Federal Register.

(5) The Advisory Committee on Nuclear Waste has reviewed a draft of the proposed decision and provided comments. (Enclosure 4). The proposed decision has been revised to respond to their comments.

  
Stuart A. Treby, Chairman  
Waste Confidence Review Group

Enclosures:

1. Federal Register Notice of Proposed Decision.
2. Federal Register Notice of Proposed Amendment.
3. Draft Congressional Letter.
4. ACNW Comment Letter.

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Friday, June 23, 1989.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Friday, June 16, 1989, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ENCLOSURE 1

NUCLEAR REGULATORY  
COMMISSION

10 CFR Part 51

Waste Confidence Decision Review

AGENCY: Nuclear Regulatory Commission

ACTION: Review and Proposed Revision  
of Waste Confidence Decision

SUMMARY:

On August 31, 1984, the Nuclear Regulatory Commission (NRC) issued a final decision on what has come to be known as its "Waste Confidence Proceeding." The purpose of that proceeding was to: 1) assess generically the degree of assurance now available that radioactive waste can be safely disposed of; 2) determine when such disposal or offsite storage will be available; and 3) determine whether radioactive waste can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available.

The Commission noted at that time that its Waste Confidence Decision was unavoidably in the nature of a prediction, and committed to review its conclusions "should significant and pertinent unexpected events occur or at least every five years until a repository is available."

The Commission has reviewed its five findings and the rationale for them in light of developments since 1984. This proposed revised Waste Confidence Decision supplements those 1984 findings and the environmental analysis supporting them. The Commission proposes that the second and fourth findings in the Waste Confidence Decision be revised as follows:

Finding 2: The Commission finds reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and that sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

Finding 4: The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years.

The Commission proposes to reaffirm the remaining findings. Each finding, any proposed revisions, and the reasons for revising or reaffirming them are set forth in the body of the review below.

The Commission also issued two companion rulemaking amendments at the time it issued the 1984 Waste Confidence Decision. The Commission's reactor licensing rule, 10 CFR Part 50, was amended to require each licensed reactor operator to submit, no later than 5 years prior to expiration of the operating license, plans for managing spent fuel at the reactor site until the spent fuel is transferred to the Department of Energy (DOE) for disposal under the Nuclear Waste Policy Act of 1982 (NWPA). 10 CFR Part 51, the rule defining NRC's responsibilities under the National Environmental Policy Act (NEPA), was amended to provide that, in connection with the issuance or amendment of a reactor operating license or initial license for an independent spent fuel storage installation, no discussion of any environmental impact of spent fuel storage is required for the period following expiration of the license or amendment applied for.

In keeping with the proposed revised Findings 2 and 4, the Commission is providing elsewhere in this issue of the Federal Register proposed conforming amendments to its 10 CFR Part 51 rule providing procedures for considering in licensing proceedings the environmental effects of extended onsite storage of spent fuel.

DATE: The comment period expires , 1989. Comments received after this date will be considered if it is practical to do so, but assurance of consideration cannot be given except to comments received on or before this date.

ADDRESSES: Mail written comments to: Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch. Deliver comments to One White Flint North, 11555 Rockville Pike, Rockville, MD between 7:30 a.m. and 4:15 p.m. weekdays.

FOR FURTHER INFORMATION CONTACT: Rob MacDougall, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (202)492-3401; or John Roberts, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (202)492-0608.

#### SUPPLEMENTARY INFORMATION:

##### Background

In November 1976, the Natural Resources Defense Council (NRDC) petitioned the Nuclear Regulatory Commission (NRC) for a rulemaking to determine whether radioactive wastes generated in nuclear power reactors can be subsequently disposed of without undue risk to the public health and safety. The NRDC also

requested that NRC not grant pending or future requests for operating licenses until the petitioned finding of safety was made.

On June 27, 1977 the NRC denied the NRDC petition. The Commission said that in issuing operating licenses, NRC must have assurance that wastes can be safely handled and stored as they are generated. It also said that it is not necessary for permanent disposal to be available if NRC could be confident that permanent disposal could be accomplished when necessary. NRC added that Congress was aware of the relationship between nuclear reactor operations and the radioactive waste disposal problem, and that NRC would not refrain from issuing reactor operating licenses until the disposal problem was resolved. The Commission also stated that it "would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely."

Also in November 1976, two utility companies requested amendments to their operating licenses to permit expansion in the capacity of their spent nuclear fuel storage pools: Vermont Yankee Nuclear Power Corporation for the Vermont Yankee plant; and Northern States Power Company for its Prairie Island facility. In both cases, the utilities planned to increase storage capacity through closer spacing of spent fuel assemblies in existing spent fuel pools. The New England Coalition on Nuclear Power and the Minnesota Pollution Control Agency intervened. The NRC staff evaluated the requests and found that the modifications would not endanger public health and safety. The staff did not consider any potential environmental effects of storage of spent fuel at the reactors beyond the dates of expiration of their operating licenses. The NRC's Atomic Safety and Licensing Board Panel (ASLBP) adopted the staff's safety and environmental findings and approved the license amendments for the two plants. It too did not consider the effects of at-reactor storage beyond the expiration of the facility operating license.

The Board's decision was appealed to the Atomic Safety and Licensing Appeal Board (ASLAB). The ASLAB affirmed the Licensing Board's decision, citing the Commission's "reasonable confidence that wastes can and will in due course be disposed of safely" in the Commission's denial of the NRDC petition. The decision of the ASLAB was appealed to the U.S. Circuit Court of Appeals. On May 23, 1979 the Court declined to stay or vacate the license amendments, but remanded to NRC the question of "whether there is reasonable assurance that an offsite storage solution will be available by the years 2007-2009, the expiration of the plants' operating licenses, and if not, whether there is reasonable assurance that the fuel can be safely stored at the reactor sites beyond those dates." In its decision to remand to NRC, for consideration in either a generic rulemaking or an adjudicatory proceeding, the Court observed that the issues of storage and disposal of nuclear waste were being considered by the Commission in an ongoing generic proceeding known as the "S-3 Proceeding" on the environmental impacts of uranium fuel cycle activities to support the operation of a light water reactor, and that it was appropriate to remand in light of a pending decision on that proceeding and analysis.

On October 18, 1979, NRC announced that it was initiating a rulemaking proceeding in response to the Appeals Court remand and as a continuation of the NRDC proceeding. Specifically, the purpose of the proceeding was for the Commission "to reassess its degree of confidence that radioactive wastes produced by nuclear facilities will be safely disposed of, to determine when any such disposal will be available, and whether such wastes can be safely stored until they are disposed of."

The Commission recognized that the scope of this proceeding would be broader than the Court's instruction, which required the Commission to address only storage-related questions. The Commission believed, however, that the primary public concern was the safety of waste disposal rather than the availability of an off-site solution to the storage problem. The Commission also committed itself to reassess its basis for confidence that methods of safe permanent disposal for high-level waste would be available when needed. Thus, the Commission chose as a matter of policy not to confine itself exclusively to the narrower issues in the court remand.

In the Notice of Proposed Rulemaking, the Commission also stated that if the proceeding led to a finding that safe off-site storage or disposal would be available prior to expiration of facility operating licenses, NRC would promulgate a rule providing that the impact of onsite storage of spent fuel after expiration of facility operating licenses need not be considered in individual licensing proceedings.

The Waste Confidence Decision was issued on August 31, 1984 (49 FR 34658). In the Decision, the Commission made five findings. It found reasonable assurance that:

- (1) Safe disposal of high-level radioactive waste and spent fuel in a mined geologic repository is technically feasible.
- (2) One or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-2009, and sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.
- (3) High-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level radioactive waste and spent fuel.
- (4) If necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

(5) Safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

On the day the Decision was issued, the Commission also promulgated two rulemaking amendments: (1) an amendment to 10 CFR Part 50 which required that no later than 5 years before expiration of reactor operating licenses, the licensee must provide NRC with a written plan for management of spent fuel onsite until title for the spent fuel is transferred to the Department of Energy; and (2) an amendment to 10 CFR Part 51 which provided that environmental consequences of spent fuel storage following expiration of facility licenses need not be addressed in connection with issuance of or amendment to a reactor operating license.

In issuing the Part 51 amendment, the Commission stated that although it had reasonable assurance that one or more repositories would be available by 2007-2009, it was possible that some spent fuel would have to be stored beyond those dates. The Part 51 amendment was based on the Commission's finding in the Waste Confidence Proceeding that it had reasonable assurance that no significant environmental impacts will result from storage of spent fuel for at least 30 years beyond expiration of reactor operating licenses.

Enactment of the Nuclear Waste Policy Act of 1982 (NWPAct) contributed significantly to the basis for the Commission's 1984 Decision and companion rulemakings. The Act established a funding source and process with milestones and schedules for, among other things, the development of a monitored retrievable storage (MRS) facility and two repositories, one by early 1998 and a second, if authorized by Congress, at a later date, initially planned by DOE for 2006. For each repository, the Act required DOE to conduct in situ investigations of three sites and recommend one from among them to the President and Congress for repository development. The NWPAct also required DOE to recommend from among alternative sites and designs a site and design for an MRS for spent fuel and high-level waste management prior to disposal. The Commission's licensing and regulatory authority over both storage and disposal facilities was preserved by the Act.

In the four years following enactment of the NWPAct, DOE met a number of the Act's early program requirements, but also encountered significant difficulties. It published a final Mission Plan for the overall NWPAct program, and followed with a Project Decision Schedule for DOE and other federal agency actions. It promulgated, with Commission concurrence, a set of guidelines for repository siting and development. It published draft and final environmental assessments for nine candidate repository sites, and recommended three for characterization. It completed and submitted to Congress an environmental assessment, a program plan, and a proposal with a site and design for an MRS. All of these actions followed extensive interactions with interested federal agencies, State, Indian tribal, and local governments, and other organizations. In the course of these activities, however, DOE also slipped its schedule for operation of the first repository by five years, indefinitely postponed efforts

toward a second repository, and had to halt further MRS siting and development activities pending Congressional authorization.

In December, 1987, Congress enacted the Nuclear Waste Policy Amendments Act (NWPAA). The NWPAA redirected the high-level waste program by suspending site characterization activities for the first repository at sites other than the Yucca Mountain site, and by suspending all site-specific activities with respect to a second repository. The Amendments Act also authorized and set schedule and capacity limits on the MRS. The purpose of these limitations, according to sponsors of the legislation, was to assure that an MRS would not become a substitute for a geologic repository.

Consistent with its commitment to revisit its Waste Confidence conclusions at least every five years, the Commission has undertaken the current review to assess the effect of these and other developments since 1984 on the basis for each of its five findings. In this document, the Commission supplements the basis for its earlier findings and the environmental analysis of the 1984 Decision. The Commission proposes to amend its second finding, concerning the timing of initial availability and sufficient capacity of a repository, and its fourth finding, concerning the duration of safe spent fuel storage. These proposed revisions are based on the following considerations:

- 1) the five-year slippage, from 1998 to 2003, in the DOE schedule for repository availability;
- 2) the additional slip of at least 18 months since January 1987 in the DOE schedule for the next step in the repository program, the excavation of the exploratory shaft;
- 3) the need to continue accounting for the possibility that the Yucca Mountain site might be found unsuitable and that DOE would have to initiate efforts to identify and characterize another site for the first repository;
- 4) the statutory suspension of site-specific activities for the second repository;
- 5) DOE's estimate that site screening for a second repository should start about 25 years before the start of waste acceptance; and
- 6) increased confidence in the safety of extended spent fuel storage, either at the reactor or at independent spent fuel storage installations.

The Commission is also proposing elsewhere in this issue of the Federal Register that 10 CFR 51.23(a) be amended to conform with the proposed revisions to Findings 2 and 4.

## Organization and Table of Contents

In conducting this review, the Commission has addressed, for each of its 1984 Findings, two categories of issues. The first category consists of the issues the Commission considered in making each Finding at the time of the initial Waste Confidence Decision. For these issues, the Commission is interested in whether its conclusions, or the Finding these conclusions support, should be changed to address new or foreseeable developments that have arisen since the first Waste Confidence Decision. The second category of issues consists of those the Commission believes should be added to the 1984 issues in light of subsequent developments. To enable the reader to follow more easily the discussions of Findings 1 and 2, the longest of the five, they have been organized to identify by subheadings both the original and the new issues. Findings 3, 4, and 5 do not require as much discussion, and in order to avoid disrupting the flow of the arguments, new and original issues are identified by subheading only in the Table of Contents below. The Commission seeks comment on whether it has identified all the issues relevant to its proposed findings, and on whether its analyses of these issues supports the conclusions and findings proposed.

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#### I. First Commission Finding

##### A. Issues Considered in Commission's 1984 Decision on Finding 1.

1. Identification of acceptable sites
2. Development of effective waste packages
  - (a) considerations in developing waste package
  - (b) effect of reprocessing on waste form and waste package
3. Development of effective engineered barriers for isolating wastes from the biosphere
  - (a) backfill materials
  - (b) borehole and shaft sealants

##### B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 1.

1. Termination of Multiple Site Characterization
2. Relevance to NRC's "S-3 Table" proceeding
3. International developments in spent fuel disposal technology

##### C. Conclusion on Finding 1.

#### II. Second Commission Finding

A. Issues Considered in Commission's 1984 Decision on Finding 2.

1. Technical uncertainties
  - (a) finding technically acceptable sites in a timely fashion
  - (b) timely development of waste packages and engineered barriers
2. Institutional uncertainties
  - (a) measures for dealing with Federal-state-local concerns
  - (b) continuity of the management of the waste program
  - (c) continued funding of the nuclear waste management program
  - (d) DOE's schedule for repository development

B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 2.

1. Potential delay under the program of single site characterization
2. Potential limitations on timing of availability of disposal capacity
  - (a) impact of possible limited disposal capacity at Yucca Mountain, indefinite suspension of second repository program
  - (b) impact of uncertainty in spent fuel projections on need to consider second repository program
3. Impact of slippages in DOE program on availability of a repository when needed for health and safety reasons
4. Effect of NRC emphasis on completeness and quality

C. Conclusion on Finding 2.

III. Third Commission Finding

A. Issues Considered in Commission's 1984 Decision on Finding 3:

Licensee compliance with NRC regulations and license conditions;  
 Safe management of spent fuel past expiration of operating licenses;  
 Availability of DOE interim storage

B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 3:

Responsibility for spent fuel storage beyond 1998;  
 Delay in second repository;  
 Potential for license renewals

IV. Fourth Commission Finding

A. Issues Considered in Commission's 1984 Decision on Finding 4:

Long-term integrity of spent fuel under water pool storage conditions;  
 Structure and component safety for extended facility operation for storage;  
 Safety of dry storage of spent fuel;  
 Potential risks of accidents and acts of sabotage of spent fuel storage facilities

B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 4:

Radiological and non-radiological consequences of extended spent fuel storage;  
 Potential delay in first repository, license renewals, delay in second repository;  
 Environmental assessment and finding of no significant impact of at-reactor storage beyond 30 years after reactor's licensed life for operation

V. Fifth Commission Finding

A. Issues Considered in Commission's 1984 Decision on Finding 5:

Adequacy of NWPA for determining responsibility for timely spent fuel storage;  
 Spent fuel discharge projections;  
 Industry commitment to implement away-from-reactor storage

B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 5:

Responsibility for spent fuel storage beyond 1998;  
 Advances in technology for dry storage;  
 Benefits of monitored retrievable storage facility under NWPA;  
 License renewals;  
 Options for offsite storage under NWPA

Original Finding 1: The Commission finds reasonable assurance that safe disposal of high-level radioactive waste and spent fuel in a mined geologic repository is technically feasible.

Proposed Finding 1: Same as above.

1.A. Issues Considered in Commission's 1984 Decision on Finding 1.

1.A.1. The identification of acceptable sites

Under the Nuclear Waste Policy Act of 1982 (NWPAA), the Department of Energy (DOE) had responsibility for identifying candidate sites for a geologic repository and for repository development. The first requirement leading to recommendation of candidate sites was formal notification of states with one or more potentially acceptable sites for a repository within 90 days of enactment of the NWPAA. In February 1983, the DOE identified nine potentially acceptable sites for the first repository. Four of the sites were in bedded salt formations, three were in salt domes, one in volcanic tuff, and one in basalt.

The NWPAA required that each site nomination be accompanied by an environmental assessment (EA). In December 1984, DOE published Draft EAs for each of the nine sites identified as potentially acceptable and proposed the following sites for nomination: the reference repository location at Hanford, WA; Yucca Mountain, NV; Deaf Smith County, TX; Davis Canyon, UT; and Richton Dome, MS. In May 1986, DOE released Final Environmental Assessments for the 5 sites nominated. At that time, DOE recommended that the Yucca Mountain, Hanford, and Deaf Smith County, sites undergo site characterization. The President approved the recommendation.

The NRC staff provided extensive comments on both the DEAs and the FEAs. NRC concerns on the FEAs related primarily to DOE's failure to recognize uncertainty inherent in the existing limited data bases for the recommended sites, and the tendency of DOE to present overly favorable or optimistic conclusions. The primary intent of the comments was to assist DOE in preparing high-quality Site Characterization Plans (SCPs) for each site as required under the NWPAA prior to excavation of exploratory shafts. NRC concerns can only be addressed adequately through the site characterization process because one of the purposes of this process is to develop the data to evaluate the significance of concerns relative to site suitability.

NRC did not identify any fundamental technical flaw or disqualifying factor which it believed would render any of the sites unsuitable for characterization. Further, NRC did not take a position on the ranking of the sites in order of preference, because this could be viewed as a prejudgment of licensing issues. NRC was not aware of any reason that would indicate that any of the candidate sites was unlicenseable. Nor has NRC made any such finding to date with respect to any site identified as potentially acceptable.

In March 1987, Congress began drafting legislation to amend the repository program. NRC provided comments on a number of these draft amendments. In December 1987, the Nuclear Waste Policy Amendments Act (NWPAA) was enacted. In a major departure from the initial intent of the NWPAA, the new law required that DOE suspend site characterization activities at sites other than the Yucca Mountain site. This decision was not based on a technical evaluation of the three recommended sites or a conclusion that the Hanford and Deaf Smith sites were not technically acceptable. According to sponsors of the legislation, the principal purpose of the requirement to suspend characterization at these sites was to reduce costs. In effect, the NWPAA directed DOE to characterize candidate sites sequentially, if necessary, rather than simultaneously. If DOE determines at any time that the Yucca Mountain site is unsuitable, DOE is to terminate all site characterization activities and report to Congress its recommendations for further actions.

The NRC staff has identified numerous issues regarding the Yucca Mountain site that may have a bearing on the licenseability of that site. These issues will have to be resolved during site characterization. An example of a site issue that may bear on the question of suitability is tectonic activity, the folding or faulting of the earth's crust. In the 1984 Waste Confidence Decision, the NRC noted that "the potential sites being investigated by DOE are in regions of relative tectonic stability." The authority for this statement came from the Position Statement of the US Geological Survey (USGS). NRC has raised concerns regarding tectonic activity at the Yucca Mountain site in the comments on the draft and final EAs, and in the draft and final Point Papers on the Consultation Draft Site Characterization Plan. If it appears during site characterization that the Yucca Mountain site will be unable to meet NRC requirements regarding isolation of waste, DOE will have to suspend characterization at that site and report to Congress.

DOE's program of site screening in different geologic media was consistent with Section 112(a) of the NWPAA, which required that DOE recommend sites in different geologic media to the extent practicable. This strategy was to ensure that if any one site were found unsuitable for reasons that would render other sites in the same geologic medium unacceptable, alternate sites in different host rock types would be available. NRC referred to this policy in its 1984 Waste Confidence Decision when it said in support of its argument on technical feasibility that "DOE's program is providing information on site characteristics at a sufficiently large number and variety of sites and geologic media to support the expectation that one or more technically acceptable sites will be identified."

The NRC recognizes that simultaneous site characterization is not necessary to identify a repository site that would meet NRC's technical criteria for isolating wastes. Sequential site characterization does not necessarily preclude or hinder identification of an acceptable site for a repository. NRC did express concern to Congress on several occasions during deliberations over the proposed legislation that sequential site characterization could delay considerably the schedule for opening a repository if the site undergoing

characterization was found to be unlicenseable. The NRC also indicated that this potential for delay would have to be considered by NRC in reevaluating the findings in its Waste Confidence Decision. The impact of this redirection of the high-level waste program on the Commission's Waste Confidence findings is not on the ability to identify technically acceptable sites, but on the timing of availability of technically acceptable sites. Because characterization of multiple sites appears to be more directly related to the timing of repository availability than to the feasibility of geologic disposal, consideration of the above statement in light of the NWPA program redirection will be discussed under Finding 2.

Another question bearing on whether technically acceptable sites can be found is whether compliance with Environmental Protection Agency (EPA) environmental standards for disposal of spent fuel and high-level waste can be demonstrated. These standards, originally promulgated in final form in September 1985, were remanded by court order in July 1987 for more adequate justification of some of their requirements, and the standards themselves may be revised in a repromulgated EPA rule. As originally promulgated, the standards not only set limits on releases of radioactive materials from the site into the accessible environment over a 10,000-year period following disposal; they also required that there be less than one chance in ten that the release limits will be exceeded in 10,000 years, and less than one chance in 1,000 that releases will exceed ten times the limits over 10,000 years.

In past comments on draft and proposed EPA standards, and in related NRC rulemaking efforts, NRC has expressed concern that probabilistic analyses should not be exclusively relied upon to demonstrate compliance with EPA release limits. NRC believed then, and continues to believe, that it must make qualitative judgments about the data and methodologies on which the numerical probabilities were based. Because of this need to evaluate the reliability of DOE's probabilistic analyses, NRC also believes that it can and should establish "deterministic" requirements not dependent on probabilities in order to assure that DOE derives the statistical part of its technical case for compliance in a way that will support a licensing judgment on whether the standards have been met. Compliance with these standards will be a key element of the Commission's judgment on whether a repository license can be issued with reasonable assurance that public health and safety and the environment will be adequately protected. NRC supported the 1985 final EPA standards in part on the understanding that it could establish deterministic requirements to simplify licensing decisions concerning the probabilistic requirements in the standards.

Some may be concerned that the revised HLW standards will be expressed in a way that could make it difficult or even impossible to evaluate compliance with probabilistic EPA requirements. The Commission does not share this concern, but believes it should be and will be addressed in the course of EPA's rulemaking to repromulgate the standards. Despite initial reservations about its ability to implement the standards, NRC is now of the opinion that such standards can be implemented. The Commission considers that the underlying

basis for evaluating the likelihood of potential disruptions of a proposed repository's waste isolation performance will be the same regardless of whether the evaluations are qualitative or numerical. In either case, there would be no fundamental difference in the information needs or regulatory review process. Both qualitative and numerical estimates would involve substantial uncertainties, and the performance standards for a repository must accommodate those uncertainties. It is the Commission's current view that the wording of the EPA HLW standards recognizes those uncertainties and allows a sound licensing decision to be reached even though the uncertainties are large. It is also the Commission's view that reasonably reliable methodologies to evaluate compliance with the standards can be made available. The staff is working closely with EPA during its development of proposed revisions to the remanded standards to assure that they provide a sufficient basis to evaluate compliance.

The Commission does not currently see a sufficient basis to withdraw its confidence in the feasibility of evaluating compliance with the standards. The Commission will closely monitor concerns about the feasibility of compliance, however, and this question can be reopened at any time the Commission finds that significant and pertinent unexpected events have occurred. The issue will also be reopened when the Commission undertakes its next five-year review of the Waste Confidence Decision. Finally, the Commission notes that there are significant opportunities in EPA's rulemaking process for other interested parties to raise issues of concern for EPA's attention in refining its standards.

In sum, the Commission concludes that, given adequate time and resources, technically acceptable sites for a repository can be identified, regardless of whether more than one site is undergoing simultaneous site characterization. This judgment does not rest on the acceptability of the Yucca Mountain site or any one future candidate site. The Commission further concludes that there is insufficient basis at this time to determine that the EPA standards will be promulgated in a form for which it will be impossible to evaluate compliance. Although the Commission is confident that methodologies for demonstrating compliance are within the current technical state of the art, NRC staff will closely monitor the development of repromulgated standards to assure that EPA methodologies for demonstrating compliance with them can readily be applied by NRC to evaluate a DOE demonstration of compliance.

#### 1.A.2. The development of effective waste packages

##### 1.A.2.a. considerations in developing waste packages

The NWPA required NRC to promulgate technical requirements and criteria to be applied in licensing a repository for high-level radioactive waste. Under Section 121 of the Act, these technical criteria must provide for use of a system of multiple barriers in the design of the repository and such restrictions on the retrievability of waste as NRC deems appropriate. The system of multiple barriers includes both engineered and natural barriers.

The waste package is the first engineered barrier in the system of multiple barriers to radionuclide escape. The waste package is defined as the "waste form and any containers, shielding, packing and other absorbent materials immediately surrounding an individual waste container." Prior to sinking an exploratory shaft for site characterization, DOE is required to prepare an SCP including a description of the waste form or packaging proposed for use at the repository, and an explanation of the relationship between such waste form or packaging and the geologic medium of the site.

The multiple barrier approach to radioactive waste isolation in a geologic repository is implemented in NRC requirements by a number of performance objectives and by detailed siting and design criteria. The NRC performance objective for the waste package requires substantially complete containment for a period of not less than 300 years nor more than 1000 years after permanent closure of the repository. The technical design criteria for the waste package require that interaction of the waste package with the environment not compromise performance of the package, the underground facility or the geologic setting. Therefore, the waste package design must take into account the complex site-specific interactions between host rock, waste package, and groundwater that will affect waste package and overall repository performance.

Under the NWPA, DOE was required to suspend site characterization activities at sites other than the Yucca Mountain, NV site. Consequently, DOE has narrowed the range of waste package designs to a design tailored for unsaturated tuff at the Yucca Mountain site. This aspect of the high-level waste program redirection may facilitate and expedite the waste package design process insofar as it enables DOE to concentrate its efforts on developing a single design for a single site instead of three designs for sites in bedded salt, basalt, and unsaturated tuff.

Currently, DOE is evaluating uncertainties in waste package design related to waste form, container type, and environment. The current conceptual design for the waste package is based on several assumptions. The waste form is presumed to be 10-year old spent fuel or high-level waste in the form of borosilicate glass in stainless-steel canisters. (In addition to spent fuel and high-level waste, the waste form may include greater-than-Class C low-level waste (GTCC). This waste is not routinely acceptable for near surface disposal under NRC regulations for disposal of low-level wastes, but is acceptable for disposal in a repository licensed for disposal of spent fuel and high-level wastes. This waste might include such materials as sealed sources and activated metals from the decommissioning of reactors and production facilities.)

Six materials are being considered for fabrication of containers, including austenitic steel (316L), nickel-based alloys (Alloy 825), pure copper (CDA 102), copper-based alloys (aluminum-bronze, CDA-613, and 70-30 Cu-Ni, CDA-715), and a container with a metal outer shell and ceramic liner. The reference container for the spent fuel and high-level waste is a 1.0-cm thick cylinder to be made of AISI 304L stainless steel. This will be DOE's benchmark material against which other materials are to be compared. DOE currently intends for

spent fuel containers to be filled with an inert gas such as argon before being welded closed.

The reference repository location is in the unsaturated tuff of the Topopah Spring Formation underlying Yucca Mountain. According to DOE, little free-flowing water is thought to be present there to contribute to corrosion of the waste containers, although the degree of saturation in this tuff is estimated to be  $65 \pm 19$  percent of the available void space in the rock. DOE has acknowledged, however, that the greatest uncertainties in assessing waste package performance at Yucca Mountain stem from difficulty in characterizing and modeling the coupled geochemical-hydrologic processes that represent the interactions between the host rock, waste package, and groundwater. The final waste package design will depend on the results of site characterization and laboratory testing to reduce uncertainty in predicting these interactions in the reference repository horizon. The final design will also be shaped by research in understanding the degradation of candidate container materials, and the characteristics of the likely reference waste forms.

Regarding the state of technology for developing long-lived waste package containers, the Swedish Nuclear Fuel and Waste Management Company (SKB), the organization responsible for radioactive waste disposal in Sweden, has described a container for spent fuel rods that consists of a 0.1-m thick copper canister surrounded by a bentonite overpack. The design calls for pouring copper powder into the void spaces in the canisters, compacting the powder using hot-isostatic pressing with an inert gas and sealing the canisters. The copper canister waste package is estimated by the SKB to have a million-year lifetime. (See also 1.B.3. below)

As noted in the NRC's Final Point Papers on the Consultation Draft Site Characterization Plan, the Commission does not expect absolute proof that 100 percent of the waste packages will have 100 percent containment for 300 to 1000 years. Nothing has occurred to diminish the Commission's confidence that as long as DOE establishes conservative objectives to guide a testing and design program, in tuff or in other geologic media if necessary, it is technically feasible to develop a waste package that meets the performance objective for substantially complete containment.

#### 1.A.2.b. effect of reprocessing on waste form and waste package

The Draft 1988 Mission Plan Amendment estimates that a total of about 77,800 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste will be available for disposal by the year 2020. (This estimate is based on a "no new orders" assumption for commercial nuclear reactors and a 40-year reactor lifetime.) Of this 77,800 MTHM, about 9400 MTHM will consist of reprocessed defense waste and a small amount of commercial reprocessed waste from the West Valley Demonstration Project. The decision to locate the defense high-level waste in the repository for wastes from commercial power reactors resulted from the requirement in Section 8 of the

NWPA that the President evaluate the possibility of developing a defense-waste-only repository. In February 1985, DOE submitted a report to the President recommending a combined commercial and defense repository. In April 1985, the President agreed that no basis appeared to exist for a defense-only repository and directed DOE to dispose of defense waste in the commercial repository.

About 8750 MTHM of reprocessed high-level waste from defense facilities at Savannah River, SC, Hanford, WA, and Idaho Falls, ID will be available by 2020 for disposal in the repository, according to the Draft 1988 Mission Plan Amendment. This waste will likely be solidified into a borosilicate glass matrix. About 640 MTHM of reprocessed high-level waste will come from the West Valley Demonstration Project facility for wastes from discontinued commercial reprocessing of spent fuel at that site. This reprocessed waste also will be solidified, probably in a borosilicate glass waste form.

Waste form testing for the Yucca Mountain site is focusing on both spent fuel and reprocessed high-level waste. The performance of the waste form in providing the first barrier to radionuclide migration is being evaluated on the basis of the physical and chemical environment of the waste form after disposal, the performance of the waste container, and the emplacement configuration.

A major limitation on glass waste form testing is that the actual waste glasses to be disposed of are not available and their exact composition will not be established until after further testing. Reference waste glass compositions are being used for studies on the effect of variation in glass composition on performance. These compositions are for glasses designed for high-level waste by Savannah River Laboratory (SRL) for defense high-level waste, and by Pacific Northwest Laboratory (PNL) for the commercial high-level wastes to be vitrified under the West Valley Demonstration Project Act. The reference composition will be revised when better analyses of the composition of the wastes at SRL and West Valley are available. The test program will seek to establish upper bounds on leaching of important radionuclides, and the extent to which glass fracturing increases leach rate. Other factors influencing leach rate are temperature, pH of the leaching solution, formation of solid layers on the surface of the waste glass, irradiation, water volume, and chemistry.

It is possible that renewed reprocessing of spent fuel from nuclear power reactors may result in a greater proportion of reprocessed waste to spent fuel than is currently anticipated. Although such a departure from the current plan to dispose of mostly unreprocessed spent fuel in the repository does not appear likely at this time, the Commission believes it is important to recognize the possibility that this situation could change.

The possibility of disposal of reprocessed waste as an alternative waste form to spent fuel assemblies was recognized by the Commission in the 1984 Waste Confidence Decision. The Commission noted that the disposal of waste from reprocessing had been studied for a longer time than the disposal of spent

fuel, and that the possibility of reprocessing does not alter the technical feasibility of developing a suitable waste package. The Commission went on to say that there is evidence that the disposal of reprocessed high-level waste may pose fewer technical challenges than the disposal of spent fuel. As long as DOE uses conservative assumptions and test conditions for evaluating the performance of different waste forms against NRC licensing requirements, the Commission has no basis to change its finding that there is reasonable assurance that reprocessing does not reduce confidence in the technical feasibility of designing and building a waste package that will meet NRC licensing requirements in a variety of geologic media.

### 1.A.3. The development of effective engineered barriers for isolating wastes from the biosphere

#### 1.A.3.a. backfill materials

At the time of the 1984 Waste Confidence Decision, DOE was developing conceptual designs for backfill in several geologic media. Most candidate sites at that time were in saturated rock, and the conceptual designs included backfilling or packing around waste containers to prevent or delay ground water flow which could enhance corrosion and radionuclide transport near the waste containers. The conceptual design for the engineered barrier system at the Yucca Mountain site has different parameters because the site is unsaturated; instead of backfill or packing around the waste container, there is to be an air gap between sides of the waste canister and the host rock.

Backfill material around the container is not required under NRC regulations for the waste package. NRC regulations require that "containment of high-level waste within the waste packages [which includes the container] will be substantially complete for a period to be determined by the Commission ... provided, that such period shall not be less than 300 years nor more than 1000 years after permanent closure of the repository" [10 CFR 60.113(a)(1)(ii)(B)], and that the entire engineered barrier system meet the release rate performance objective of one part in 100,000 per year.

Backfill is also a component of the borehole, shaft, and ramp seals, which are not part of the engineered barrier system or the underground facility. Boreholes, shafts, and ramps must be sealed when the repository is permanently closed. This aspect of backfilling is discussed below under "Development of Sealants." Backfill may also include crushed rock used to fill openings such as drifts in the underground facility. At the Yucca Mountain candidate site, DOE currently plans to fill openings in the underground facility at closure of the repository. Backfilling is not planned prior to repository closure because it is not needed for structural support for the openings, and it would make waste retrieval more difficult. At closure of the facility, however, openings will be backfilled with coarse tuff excavated for the facility. In the conceptual design provided in the SCP, the selection of coarse tuff as backfill material is based on numerical simulations performed by DOE which suggest that

coarse tuff would be a more effective barrier to capillary flow in the backfill matrix than fine materials.

DOE's design for the engineered barrier system submitted with the license application will have to contain information sufficient for NRC to reach a favorable conclusion regarding the overall system performance objective. Backfill or packing around waste containers is not required by NRC regulations if DOE can demonstrate that applicable performance objectives can be met without it. If, on the basis of testing and experiments during site characterization, DOE decided that backfill would enhance engineered barrier system performance, the design would have to reflect this conclusion. DOE has already conducted research on a wide variety of candidate materials for backfill around waste packages in a variety of geologic media. The Commission continues to have confidence that backfill or packing materials can be developed as needed for the underground facility and waste package to meet applicable NRC licensing criteria and performance objectives.

#### 1.A.3.b. borehole and shaft seals

The engineered barrier system described above is limited to the waste package and the underground facility as defined in 10 CFR Part 60. The underground facility refers to the underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals. Containment and release rate requirements are specified for the engineered barrier system, but not for the borehole and shaft seals. Seals are covered under 10 CFR 60.112, the overall post-closure system performance objective for the repository. Among other things, this provision requires that shafts, boreholes and their seals be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to the EPA's generally applicable standards for radioactivity. Although the criteria for seals given in 10 CFR Part 60 do not specifically mention seals in ramps and the underground facility, it is reasonable to consider them together with borehole and shaft sealants because the seals and drainage design in ramps and the underground facility could also affect the overall system performance of the geologic repository.

Construction of the exploratory shaft facility (ESF) will be the first major site characterization activity. The ESF will consist of two vertical shafts, one for testing and the other for support, and underground excavations for at-depth testing. The repository surface facilities will be connected to the underground facility by two additional shafts (a men-and-materials shaft and the emplacement area exhaust shaft) and two ramps, a waste ramp for bringing radioactive waste and spent fuel into the repository, and a tuff ramp for removing rock from the underground facility to a tuff pile. In addition to these shafts and ramps, there will be exploratory boreholes for obtaining samples of rock, water, and gases in strata at varying depths. Exploratory boreholes have the potential to provide information on hydrologic properties of the Yucca Mountain site with emphasis on movement of water in unsaturated tuff.

Other properties which will be studied using exploratory boreholes are lithologic, structural, mechanical, and thermal properties of the host rock.

When the repository is decommissioned, NRC expects that most, if not all, shafts, ramps, and boreholes will probably have to be sealed to reduce the possibility that they could provide preferential pathways for radionuclide migration from the underground facility to the accessible environment. DOE estimates that as many as 350 shallow and 70 deep exploratory boreholes may be emplaced by the time site characterization has been completed at the Yucca Mountain site. Decommissioning may not occur for up to 100 years following commencement of repository operations. Because the final design for seals will likely have been modified from the initial license application design (LAD), DOE is viewing the seal LAD as serving two primary functions. As set forth in DOE's Site Characterization Plan for the Yucca Mountain candidate site, the seal LAD is to establish that: (1) "technology for constructing seals is reasonably available;" and (2) "there is reasonable assurance that seals have been designed so that, following permanent closure, they do not become pathways that compromise the geologic repository's ability to meet the post-closure performance objectives."

To establish the availability of technology for seal construction, DOE has identified at least 31 site properties that need to be characterized in determining necessary seal characteristics. These properties include saturated hydraulic conductivity of alluvium near shafts, the quantity of water reaching the seals due to surface flooding events, and erosion potential in the shaft vicinity. The SCP also discusses material properties that need to be identified to determine sealing components such as initial and altered hydrologic properties of materials.

The SCP indicates that DOE is planning to use crushed tuff and cements in the sealing program at the Yucca Mountain candidate site. The stated advantages of using tuff include minimizing degradation of seal material and avoiding disruption of ambient ground-water chemistry.

DOE's current design concept for meeting the overall performance objectives includes a combination of sealing and drainage. Seal requirements may be reduced in part by: (1) limiting the amount of surface water that may enter boreholes, shafts, and ramps; (2) selecting borehole, shaft, and ramp locations and orientations that provide long flow paths from the emplaced waste to the accessible environment above the repository; and (3) maintaining a sufficient rate of drainage below the repository horizon level so that water can be shunted past the waste packages without contacting them.

Although DOE's program is focusing on seals for the Yucca Mountain candidate site, the Commission finds no basis for diminished confidence that an acceptable seal can be developed for candidate sites in different geologic media. The Commission finds no evidence to suggest that it can not continue to have reasonable assurance that borehole, shaft, ramp, and repository seals can be developed to meet 10 CFR 60 performance objectives.

## 1.B. Relevant Issues That Have Arisen Since the Commission's Original Decision

- 1.B.1. In support of its argument on technical feasibility, the Commission stated in its 1984 Waste Confidence Decision that "DOE's program is providing information on site characteristics at a sufficiently large number and variety of sites and geologic media to support the expectation that one or more technically acceptable sites will be identified." The Nuclear Waste Policy Amendments Act of 1987 (NWPAA) required, however, that DOE suspend site-specific site characterization activities under the Nuclear Waste Policy Act of 1982 at all sites other than the Yucca Mountain, NV site.

Under the NWPAA, the DOE program has been redirected to characterize candidate repository sites in sequence rather than simultaneously. If the Yucca Mountain site is found to be unsuitable, DOE must terminate site characterization activities there and provide Congress with a recommendation for further action, such as the characterization of another site. Because characterization of multiple sites now appears to be more directly related to the timing of repository availability than to the technical feasibility of geologic disposal as a concept, consideration of the Commission's 1984 statement above in light of the NWPAA will be discussed under Finding 2.

- 1.B.2. What is the relationship, if any, of the "S-3 Proceeding" to the current review of the Commission's 1984 Waste Confidence Findings? Would the planned revision of the S-3 rulemaking be affected if the Commission had to qualify its current confidence in the technical feasibility of safe disposal?

In its decision to remand to NRC the questions of whether safe off-site storage would be available by 2007-2009, or, if not, whether spent fuel could be safely stored on-site past those dates, the U.S. Circuit Court of Appeals observed that the issues of storage and disposal of nuclear waste were being considered by the Commission in an ongoing generic proceeding known as the "S-3" Proceeding.

The S-3 Proceeding was the outgrowth of efforts to address generically the NEPA requirement for an evaluation of the environmental impact of operation of a light water reactor (LWR). Table S-3 assigned numerical values for environmental costs resulting from uranium fuel cycle activities to support one year of LWR operation. NRC promulgated the S-3 rule in April 1974. In July 1976, the U.S. Circuit Court of Appeals found that Table S-3 was inadequately supported by the record regarding reprocessing of spent fuel and radioactive waste management, in part because the Commission in reaching its assessment had relied heavily on testimony of NRC staff that the problem of waste disposal would be resolved.

When the U.S. Circuit Court of Appeals issued the remand on what were to become the "Waste Confidence" issues in May 1979, NRC had pending before it the final

amended S-3 rule. The Court regarded the resolution of the issue of waste disposal in the S-3 proceeding as being related to the issue raised by the petitioners in the appeals of the NRC decisions on the expansion of spent fuel storage capacity. The Court said that the "disposition of the S-3 proceeding, though it has a somewhat different focus, may have a bearing on the pending cases."

The Commission approved the final S-3 rule in July 1979. In October 1979, the Commission issued a Notice of Proposed Rulemaking (NPR) on the Waste Confidence issues in response to the remand by the Court of Appeals. In the NPR, the Commission stated that the proceeding would "draw upon the record compiled in the Commission's recently concluded rulemaking on the environmental impacts of the nuclear fuel cycle, and that the record compiled herein will be available for use in the general fuel cycle rule update discussed in that rulemaking."

In the final Table S-3 rule issued in 1979, the Commission had said that "bedded salt sites can be found which will provide effective isolation of radioactive waste from the biosphere." When the Commission issued the 1984 Waste Confidence Decision, part of the basis for the discussion of waste management and disposal in the August 1979 final S-3 rule had changed. For example, in 1984 the repository program was proceeding under the NWPA, which required that DOE recommend three sites for site characterization.

Although the NRC is preparing to amend the S-3 Table, and add a new appendix to explain the basis for and significance of the data in the Table, it is unlikely that the revision will have any impact on the Commission's generic findings in the Waste Confidence proceeding. Nor is it likely that this reexamination of the Waste Confidence findings will affect the S-3 rule; the Waste Confidence Proceeding is not intended to make quantitative judgments about the environmental costs of waste disposal. Unless the Commission in a future review of the Waste Confidence decision finds that it no longer has confidence in the technical feasibility of disposal in a mined geologic repository, the Commission will not consider it necessary to review the S-3 rule when it reexamines its Waste Confidence findings in the future.

- 1.B.3. To what extent do developments in spent fuel disposal technology outside of the United States (e.g. Swedish waste package designs) enhance NRC's confidence in the technical feasibility of disposal of HLW and spent fuel?

Spent fuel disposal technology is the subject of extensive research investigation in both Europe and North America. Advances in this technology are being communicated to the NRC staff both through bilateral agreements and the presentation of research results at international meetings.

Outside the U.S., studies of spent fuel as a waste form are now being conducted primarily in Canada and Sweden, although both France and West Germany have small programs in this area. The Swedish studies have been mainly concerned

with boiling water reactor (BWR) spent fuel, while the Canadian studies focus on spent fuel from that country's CANDU reactors, which use unenriched uranium in a core immersed in "heavy" water made from deuterium. BWR and CANDU fuel, like pressurized water reactor (PWR) fuel, are uranium dioxide fuels clad in zircaloy. However, the burnup rates for these three fuel types vary considerably. Ongoing research studies on spent fuel include work on the characterization of spent fuel as a waste form, the corrosion of spent fuel and its dissolution under oxidizing and reducing conditions, the radiolysis of groundwater in the near vicinity of the spent fuel and its effects on the dissolution of the fuel, and the development of models to predict the leaching of spent fuel over long time periods. The results of this work are steadily increasing our understanding of spent fuel as a waste form.

High-level radioactive waste, whether it is spent reactor fuel or waste from reprocessing, must be enclosed in an outer canister as part of the waste package. The canister surrounding the waste is expected to prevent the release of radioactivity during its handling at the repository site prior to emplacement. After emplacement in the repository, it is expected to prevent the release of radioactivity for a specified period of time after the repository is closed by providing a barrier to protect the waste from coming into contact with groundwater.

For practical reasons, canister materials may be divided into the following classes: 1) completely or partially thermodynamically stable materials such as copper; 2) passive materials such as stainless steel, titanium, Hastelloy, Inconel, and aluminum; 3) corroding or sacrificial materials such as lead and steel; and 4) non-metallic materials such as alumina and titanium dioxide ceramics and cement.

Sweden has been conducting an extensive canister research program over the past several years. The main canister material of interest is copper, but titanium, carbon steel, and alumina and titanium dioxide are also being studied as reasonable alternatives should unexpected problems be discovered with using pure copper.

The present Swedish canister design is a 100-mm thick copper container as described in Section A.2.a. above, which is claimed to provide containment, in conjunction with an appropriate backfill material, for a period on the order of one million years. The critical factors for the isolation period for copper canisters are: (1) the presence of corrosive substances such as sulphide ions in the groundwater; (2) the possibility of these substances reaching the canister surface; and (3) the degree of inhomogeneity, or pitting, of the resulting corrosion. Studies are continuing to obtain more information on pitting corrosion of copper and on techniques for welding thick-walled copper containers.

Several conceptual designs for canisters for the safe disposal of unprocessed spent fuel have also been developed in Canada. One canister design option is the supported-shell, metal-matrix concept, which involves packing the spent

fuel bundles into a thin corrosion-resistant shell and casting the remaining space with a low melting point metal or alloy. Structural support for the shell would be provided by the resulting metal matrix. Lead is a possible matrix material because of its favorable casting properties, cost, and low melting point.

Other supported shell canister concepts include the packed-particulate and structurally supported designs. In these designs, a thin outer shell is supported by a particulate material packed around a steel internal structure that contains the spent fuel bundles. Several materials have been identified for the fabrication of the corrosion resistant outer shell, including commercially pure and low-alloy titanium, high nickel-based alloys such as Inconel 625, and pure copper. Detailed designs have been produced for all three types of supported shell canisters incorporating either a titanium or nickel alloy shell less than 6 mm thick. A conceptual design has also been produced for a copper-shell structurally supported canister and a metal-matrix container with a relatively thick (25 mm) copper shell and a lead matrix material. This last canister is intended to contain 72 used CANDU fuel bundles in four layers of 18 bundles each.

Both the Canadian and Swedish conceptual designs for the disposal of spent fuel in canisters provide for surrounding the canister with backfill material as part of the waste package when it is emplaced in the repository. This backfill material would be packed around the canister to retard the movement of groundwater and radionuclides. Investigations of backfill material at the Stripa mine in Sweden have shown that bentonite and silica sand can be employed successfully as backfill, both around the canister and in repository tunnels. A bentonite-silica mixture is the recommended backfill material on the basis of its thermal and mechanical properties. Bentonite backfills have been shown to produce hydraulic conductivities that are very similar to the surrounding granite at Stripa. Problems concerning the variability of bentonite samples from different geographic locations can be eliminated if material from a single source is used. The presence of sulfur and some organic material, including bacteria, in many bentonites poses some problems related to microbially-accelerated corrosion. Treatment with hydrogen peroxide may be used to oxidize these organics. Heating the bentonite to 400 degrees C can also be effective, although this may alter the crystal structure of the bentonite.

Many countries intend to dispose of their high-level radioactive waste by first converting the wastes into a solid, vitrified form after reprocessing. Since the leaching of the waste form by circulating groundwater after disposal is the most likely mechanism by which the radionuclides might be returned to the biosphere, the waste form must be composed of a highly stable material with an extremely low solubility in groundwater. Thus, the waste form itself should function as an immobilization agent to prevent any significant release of radionuclides to the biosphere over very long time periods. The two primary materials currently being considered for use as solidified waste forms are borosilicate glass and SYNROC, a man-made titanate ceramic material.

SYNROC was initially developed in Australia as an alternative material to borosilicate glass. It is composed primarily of three minerals (hollandite, zirconolite, and perovskite) which collectively have the capacity to accept the great majority of radioactive high-level waste constituents into their crystal lattice structure. These three minerals, or closely related forms, occur naturally, and have been shown to have survived for many millions of years in a wide range of natural environments. SYNROC has the property of being extremely resistant to leaching by groundwater, particularly at temperatures above 100 degrees C. In addition, the capacity of SYNROC to immobilize high-level wastes is not markedly impaired by high levels of radiation damage.

The high leach-resistance of SYNROC at elevated temperatures increases the range of geologic environments in which it may be used, such as deep geologic repositories in both continental and marine environments.

Research and development work on improving SYNROC production technology is currently being done jointly in Australia and Japan. New methods of utilizing metal alkoxides in the fabrication of SYNROC to obtain high homogeneity and lowered leachability have recently been developed in Australia. The Japanese have recently developed a new method that utilizes titanium hydroxide as a reducing agent to produce SYNROC with a high density and low leach rate. A pilot facility for the production of non-radioactive SYNROC is now in operation in Australia, and a small pilot facility for producing SYNROC with radioactive constituents is being completed in Japan.

On the basis of current information from the foreign studies described above on canisters, spent fuel as a waste form, backfill materials, and alternatives to borosilicate glass waste forms, the Commission concludes that there is no basis for diminished confidence that an acceptable waste package can be developed for safe disposal of HLW and spent fuel.

#### 1.C. Conclusion on Finding 1.

The Commission has reexamined the basis for its First Finding in the 1984 Waste Confidence Decision in light of subsequent program developments, and concludes that Finding 1 should be reaffirmed.

The technical feasibility of a repository rests initially on identification of acceptable sites. At this time, the Commission is not aware of any evidence indicating that Yucca Mountain is not acceptable for site characterization. There are many outstanding questions regarding the licenseability of the site, however, and they must be answered satisfactorily in order for NRC to issue a construction authorization for that site. If data obtained during site characterization indicate that the Yucca Mountain site is not suitable for a repository, DOE is required by the NWPA to terminate site characterization activities and report to Congress. Within six months of that determination, DOE must make a recommendation to Congress for further action to assure the safe, permanent disposal of spent fuel and high-level waste. DOE could

recommend, for example, that Congress authorize site characterization at other sites. Considering DOE's investigations of other potentially acceptable sites prior to its exclusive focus on Yucca Mountain, the Commission has no reason to believe that, given adequate time and program resources, a technically acceptable site can not be found.

The technical feasibility of geologic disposal also depends on the ability to develop effective engineered barriers, such as waste packages. DOE is currently evaluating six candidate materials for waste containers including austenitic steel and copper- and nickel-based alloys, and is planning waste form testing based on both spent fuel and high-level waste in borosilicate glass. On the basis of DOE's program and results from Swedish investigations of a copper waste container, the Commission is confident that, given a range of waste forms and conservative test conditions, the technology is available to design acceptable waste packages.

In addition to the materials testing for the waste container and waste form, there may be additional measures that can be taken to improve the effectiveness of the engineered barriers. It is known, for example, that the heat loading characteristics of the wastes diminish with time. Also, the longer wastes are stored prior to disposal, the smaller will be the quantities of radionuclides available for transport to the accessible environment.

It is also technically feasible to separate from radioactive wastes the radionuclides that constitute the principal source of heat from the nuclides of greatest long-term concern. The former radionuclides, mainly fission products such as cesium-137 and strontium-90, could then be stored for a period of years while the fission products decay to the point where they could be disposed of either in a manner that does not require the degree of confinement provided by a geologic repository, or in a repository with less concern for thermal disturbance of the host rock's expected waste isolation properties. Meantime, the longer-lived remaining radionuclides, such as transuranic wastes with elements heavier than uranium, could be disposed of in a repository away from the fission products and without the high thermal loadings that would otherwise have to be considered in predicting the long-term waste isolation performance of the geologic setting. France, Great Britain, and Japan are currently pursuing this waste management strategy or a variant of it.

The Commission emphasizes here that it does not believe that recycling technologies are required for the safety or feasibility of deep geologic disposal in the United States. Other countries, such as Canada, the Federal Republic of Germany, and Sweden are pursuing disposal strategies based on a similar view. Reprocessing, if employed in its current stage of development, would result in additional exposures to radiation and volumes of radioactive wastes to be disposed of. For the purpose of finding reasonable assurance in the technical feasibility of geologic disposal, however, it is worth noting that technology is currently available to permit additional engineering control of waste forms if, for reasons not now foreseen, such control were deemed desirable at some future time. Meanwhile, the Commission continues to have

confidence that safe geologic disposal is technically feasible for both spent fuel and high-level waste.

DOE's current reference design for the waste package does not include backfill or packing around waste containers in the emplacement boreholes. Neither is required under NRC rules so long as DOE can show that applicable regulatory criteria and objectives will be met. An air gap between the container and the host rock is currently one of the barriers in DOE's design for meeting the performance objective. DOE has conducted investigations on a variety of candidate materials for backfill in a variety of geologic media, and the Commission finds no basis to qualify its past confidence that backfill materials can be developed, if needed, to meet applicable NRC requirements.

The current reference design for sealing boreholes, shafts, ramps and the underground facility at the Yucca Mountain candidate site employs crushed tuff and cement. Regardless of the geologic medium of the candidate site, DOE will have to show that the License Application Design (LAD) meets NRC post-closure performance objectives. The Commission continues to have reasonable assurance that DOE's program will lead to identification of acceptable sealant materials for meeting these objectives.

Overall, the Commission concludes from its reexamination of issues related to the technical feasibility of geologic disposal that there is reasonable assurance that safe disposal of high-level waste and spent fuel in a mined geologic repository is technically feasible.

Original Finding 2: The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level waste and spent fuel will be available by the years 2007-2009, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high-level radioactive waste and spent fuel originating in that reactor and generated up to that time.

Proposed Finding 2: The Commission finds reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and that sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

## 2.A. Issues Considered in Commission's 1984 Decision on Finding 2.

### 2.A.1. Finding Technically Acceptable Sites in a Timely Fashion

In order for the Commission to find that any candidate site for a repository is technically acceptable (that is, in compliance with NRC licensing requirements), the site must undergo comprehensive site characterization to assess its hydrologic, geologic, geochemical, and rock mechanics properties. It is possible that a site may be found unacceptable on the basis of early in-situ testing or other site characterization activities. It will not be possible, however, for the NRC staff to take a position before a licensing board that a site will meet NRC requirements for construction authorization until the results of all site characterization activities are available. Even then, the staff may conclude that the evidence from site characterization does not constitute reasonable assurance that NRC performance objectives will be met. Also, the results of the licensing hearings on construction authorization cannot be predicted. If construction is authorized and when it is substantially complete, DOE is required to obtain a license to receive and possess waste at the geologic repository operations area in addition to the construction authorization permit in order to commence repository operations. These considerations argue for maintaining the ready availability of alternative sites if, after the several years, site characterization or licensing activities bring to light difficulties at the leading candidate site.

In support of its argument on technical feasibility, the Commission stated in its 1984 Waste Confidence Decision that "DOE's program is providing information on site characteristics at a sufficiently large number and variety of sites and geologic media to support the expectation that one or more technically acceptable sites will be identified." At the time, DOE was required under the NWPA to characterize three candidate repository sites.

The Nuclear Waste Policy Act Amendments of 1987 (NWPAA) had a major impact on DOE's repository program, however. Under the NWPAA, DOE was required to suspend site-specific activities at the Hanford, WA and Deaf Smith County, TX sites which had been approved by the President for site characterization for

the first repository. Redirection of the repository program to single site characterization (or, if necessary, sequential site characterization if the Yucca Mountain site is found to be unsuitable) will permit DOE to concentrate its efforts and resources on information gathering at a single site as opposed to spreading out its efforts over a range of sites. The possible scheduler benefits to single site characterization, however, must be weighed for the purposes of this Finding against the potential for additional delays in repository availability if the Yucca Mountain site is found to be unsuitable. By focusing DOE site characterization activities on Yucca Mountain, the Amendments Act has essentially made it necessary for that site to be found suitable if the 2007-09 timeframe for repository availability in the Commission's 1984 Decision is to be met. Clearly, the Commission cannot be certain at this time that the Yucca Mountain site will be acceptable.

Although the Commission has no reason to believe that another technically acceptable site can not be found if the Yucca Mountain site proves unsuitable, several factors raise reasonable doubts as to the availability of even one repository by 2007-2009. These include: (1) the current reliance on a single site with no concurrently available alternatives; (2) the probability that site characterization activities will not proceed entirely without problems; and (3) the history of scheduler slippages since passage of the NWPA. For example, DOE's schedule for the first repository slipped five years (from 1998 to 2003) between January 1983, when the NWPA was enacted, and January 1987, when the first Draft Mission Plan Amendment was issued. The schedule for excavation of the exploratory shaft for the Yucca Mountain site slipped by more than three years since the issuance of the Project Decision Schedule (PDS) in March 1986. DOE has cited numerous reasons for past program slippages, including the need for a consultation process with States and Tribes, Congressional actions (e.g. the barring of funds in the 1987 budget appropriation for drilling exploratory shafts), and DOE's recognition that the environmental impact statement (EIS) and license application would require more technical information than previously planned.

Given this history of delays, and given its understanding of current developments, the Commission can not reasonably find assurance that repository program slippages will not continue, at least in the foreseeable future. For example, DOE has taken the position, with which NRC agrees, that sinking of exploratory shafts should not occur before it has a qualified quality assurance (QA) program in place. The Commission believes that the aggressive, success-oriented schedule for this milestone has not allowed for unexpected developments. Indeed, the effort to develop an approvable QA program has in itself identified problems in design control and other processes that must be resolved in order to establish a fully-qualified program that addresses all applicable NRC licensing requirements.

Thus, although the NWPA is a clear and strong reaffirmation of Congressional support for the timely development of a repository, the Commission in this Waste Confidence review cannot ignore the potential for delay in repository availability if the Yucca Mountain site, or any other single site designated

for site characterization, is found to be unsuitable. Without alternative sites undergoing simultaneous characterization or even surface-based testing, DOE will have to begin characterizing another site if the site currently selected for characterization proves unsuitable. The earlier a determination of unsuitability can be made, the smaller the impact of such a finding would be on the overall timing of repository availability.

DOE has estimated conservatively that it would require approximately 25 years to begin site screening for a second repository, perform site characterization, submit an EIS and license applications, and await authorizations before the repository could be ready to receive waste. In its June 1987 Mission Plan amendment, DOE stated "It ... seems prudent to plan that site-specific screening leading to the identification of potentially acceptable sites should start about 25 years before the start of waste acceptance for disposal." DOE went on to say that it considered this estimate to be conservative because it does not account for expected schedular benefits from the first repository program, including improvements in such areas as site screening, site characterization, and performance assessment techniques.

Although DOE's estimate was premised on the successful completion of a program for the first of two repositories, schedular benefits from improvements in the understanding of waste isolation processes would still be available. The glass waste form from the Defense Waste Processing Facility now under construction at Savannah River SC, for example, will be available for testing under simulated repository conditions well before the turn of the century under current DOE schedules, and improvements in the modelling of spent fuel behavior within waste canisters can be applied in performance assessments largely irrespective of the geology of a site. It may also be pertinent that when DOE made its 25-year estimate for the second repository program in mid-1987, the law at the time required the simultaneous characterization of three sites, so that DOE could not proceed to develop one site for a repository until the completion of characterization at the site that required the most time.

While it is still possible for a repository to be available by 2007-2009 if the current schedule does not incur major additional delays, the Commission does not believe it would be prudent to reaffirm the agency's 1984 finding of reasonable assurance that the 2007-2009 timetable will be met. As the Court of Appeals noted in remanding this issue to NRC, the ultimate determination of whether a disposal facility will be available when needed "can never rise above a prediction." The Commission is in the position of having to reach a definitive finding on events which are almost two decades away. We believe that the institutional timescale for this question can more realistically be framed in decades than in years. As the program proceeds into the next century, it will become easier for NRC to make more definitive assessments, if necessary, of the time a repository will be available.

It should be noted here that the basis for the 2007-2009 timeframe in the Court remand on the "Waste Confidence" issues has changed in the past five years. These dates no longer represent the expected dates of expiration of the Vermont

Yankee and Prairie Island facilities. When the operating licenses were originally issued for nuclear power reactors, license durations were computed on the basis of a 40-year operating lifetime starting from the date of the construction permit (CP) for the facility. For many facilities, five years or more elapsed from the date of issuance of the CP until issuance of the operating license (OL). In response to requests from utilities, the NRC staff has agreed to extend the dates of expiration of the OLs by computing the 40-year period of the license from the date of issuance of the OL instead of from the date of the CP. The NRC staff has already changed the expiration date for Prairie Island Units 1 and 2 from the year 2008 to the years 2013 and 2014. The staff currently expects Vermont Yankee to request a change in its current expiration date of December 11, 2007. On the basis of the date of issuance of the OL for Vermont Yankee, it is eligible for extension of its operating license expiration to March 2012. Therefore, if the remand were to occur today, the NRC would likely be evaluating the availability of a repository by 2012-2014, as these years are expected to represent the timeframe in which the OLs of the Vermont Yankee and Prairie Island facilities are due to expire.

In light of all these considerations, the Commission believes it can have reasonable assurance that at least one repository will be available within the first quarter of the twenty-first century. This estimate is based on the time it would take for DOE to proceed from site screening to repository operation at a site other than Yucca Mountain if this should prove necessary. Assuming for the sake of conservatism that Yucca Mountain would not be found suitable for repository development, it is reasonable to expect that DOE would be able to reach this conclusion by the year 2000. This would leave 25 years for the attainment of repository operations at another site.

#### 2.A.2. Timely Development of Waste Packages and Engineered Barriers

DOE's current conceptual design for the waste package is discussed in the Site Characterization Plan (SCP) for the Yucca Mountain site. As information is obtained from site characterization activities and laboratory studies, the conceptual design will evolve in successive stages into the Advanced Conceptual Design (ACD), the License Application Design (LAD), and the final procurement and construction design. DOE has identified four areas of investigation related to the waste package LAD: (1) waste package environment; (2) waste form and materials testing; (3) design, analysis, fabrication, and prototype testing; and (4) performance assessment. Numerous uncertainties exist in each of these areas. DOE's testing program will attempt to reduce uncertainties in these areas where possible. For example, in-situ testing is expected to decrease significantly uncertainties regarding the repository host rock mass in which the waste packages will be emplaced. In the area of performance assessment, however, where results of relatively short term testing of complex rock-waste-groundwater interactions must be extrapolated over as many as 10,000

years, it may be necessary to rely more heavily on the use of simplifying assumptions and bounding conditions than in other areas of investigation.

As discussed under Finding 1, the Commission continues to have reasonable assurance that waste packages and engineered barriers can be developed which will contribute to meeting NRC performance objectives for the repository. The timing of availability of a complete and high quality waste package and engineered barrier LAD, specifically their availability on a schedule which would permit repository operation by 2007-2009, is more difficult to assess at this time. In contrast with the technical feasibility issues discussed under Finding 1, development of acceptable waste packages and engineered barriers for a repository in the 2007-2009 timeframe does depend on the overall acceptability of the Yucca Mountain site. If the site is found to be unsuitable, waste package and engineered barrier development will have to begin for a different site, because, under the NWPA, DOE may not carry out site characterization and waste package development work at sites other than the Yucca Mountain site.

Although much of the work related to waste form, materials, and performance assessment for the waste package can proceed independently of in-situ testing, the investigations related to waste package environment are dependent on the schedule for this testing. DOE's current schedule calls for completing the ACD for the waste package in 1992, and the waste package LAD in 1994. The ability to meet these dates will depend on whether DOE is able to resolve outstanding QA issues which have impeded shaft sinking and in-situ testing.

In sum, the Commission is not aware of any scientific or technical problems so difficult as to preclude development of a waste package and engineered barrier for a repository at Yucca Mountain to be available within the first quarter of the twenty-first century. Moreover, even given the uncertainty regarding the ultimate finding of site acceptability, and the uncertainty concerning the range of site-related parameters for which the engineered facility and waste package will have to be designed, the Commission finds reasonable assurance that waste package and engineered barrier development can be completed on a schedule that would permit repository operation within the first quarter of the twenty-first century. If necessary (that is, if Yucca Mountain were found unsuitable late in the program), DOE could initiate site characterization and develop waste packages and engineered barriers at another site or sites and still commence operation before the end of the first quarter of that century.

### 2.A.3. Institutional Uncertainties

#### 2.A.3.a. Measures for dealing with Federal-state-local concerns

In its 1984 Waste Confidence Decision, the Commission found that the NWPA should help to minimize the potential that differences between the Federal government and states and Indian tribes will substantially disrupt or delay the repository program. The Commission noted that the NWPA reduced uncertainties

regarding the role of affected states and tribes in repository site selection and evaluation. The Commission also said that the decision-making process set up by the NWPA provides a detailed, step-by-step approach that builds in regulatory involvement which should also provide confidence to states and tribes that the program will proceed on a technically sound and acceptable basis. Despite the expected and continuing state opposition to DOE siting activities, the Commission has found no institutional developments since that time that would fundamentally disturb its 1984 conclusions on this point.

NRC regulatory involvement, for example, has indeed been built into the process. DOE has continued its interactions with NRC regarding repository program activities since the Commission's 1984 Waste Confidence decision was issued. NRC provided comments to DOE on major program documents such as the Siting Guidelines and the Project Decision Schedule as required by the NWPA, and NRC concurred on those documents. NRC also reviewed and provided comments to DOE on the Draft and Final Environmental Assessments (DEAs and FEAs). In the December 22, 1986 letter to DOE on the FEAs, the NRC staff noted that "significant efforts were made by DOE to respond to each of the NRC staff major comments on the DEAs, and in fact, many of these comments have been resolved." NRC provided comments to DOE on the 1987 Draft Mission Plan Amendment, and DOE responded to most of these comments in the Final Mission Plan Amendment provided to Congress on June 9, 1987.

Since enactment of the NWPAA in December 1987, DOE-NRC interactions have focused on the Yucca Mountain site. In January 1988, DOE issued the Consultation Draft Site Characterization Plan (CDSCP) for the Yucca Mountain site. The NRC staff provided comments in the form of draft and final "point papers" on the CDSCP. The NRC comments included several objections related to: (1) the failure to recognize the range of alternative conceptual models of the Yucca Mountain site; (2) the status of the quality assurance (QA) plans for site characterization activities; and (3) concerns related to the exploratory shaft facility. DOE, NRC, and representatives of the State of Nevada have participated in workshops to discuss the NRC comments. DOE is committed to having a qualified QA program in place before sinking the exploratory shaft at the Yucca Mountain site.

DOE has also taken measures to clarify and institutionalize the roles of other Federal agencies in addition to NRC. In the Draft 1988 Mission Plan Amendment, DOE described interactions with these agencies. DOE has a Memorandum of Understanding (MOU) with the Mine Safety and Health Administration of the Department of Labor for technical support and oversight for shaft construction and other site characterization activities, and with the Department of Transportation to define the respective responsibilities of the two agencies in the waste disposal program. DOE also has interagency agreements with the Bureau of Mines and the U.S. Geological Survey of the Department of the Interior.

DOE's efforts to address the concerns of States, local governments, and Indian tribes have met with mixed results. For example, DOE has not succeeded in

finalizing any consultation and cooperation (C&C) agreements as required under Section 117(c) of the NWPA, as amended. These agreements were to help resolve State and Tribal concerns regarding public health and safety, environmental, and economic impacts of a repository. Publication of the Siting Guidelines under Section 112(a) of the NWPA resulted in numerous lawsuits challenging the validity of the Guidelines. Similarly, the FEAs were challenged in the Ninth Circuit by affected States and Tribes.

The NWPAA did not curtail financial assistance to affected states and tribes except to redefine and redistribute it if DOE and a State or tribe enter into a benefits agreement. The State of Nevada and affected local governments are currently receiving financial assistance. DOE has attempted to negotiate an agreement with the State of Nevada for monetary benefits under Section 170 of the NWPAA. This Section would provide for payments of \$10 million per year prior to receipt of spent fuel and \$20 million per year after receipt of spent fuel until closure of the repository. These payments would be in addition to certain monetary benefits for which the State is eligible under the NWPA, as amended. Also under a benefits agreement, a Review Panel would be constituted for the purpose of advising DOE on matters related to the repository, and for assisting in the presentation of State, tribal, and local perspectives to DOE. The beneficiary to a benefits agreement must waive its right to disapprove the recommendation of the site for a repository and its rights to certain impact assistance under Sections 116 and 118 of the NWPA, as amended. To date, the State of Nevada has declined DOE's offer to negotiate a benefits agreement.

The NWPAA introduced several new organizational entities to the repository program with responsibilities that may contribute to resolving concerns of Federal, State, and local governments involved in the program. Under Section 503 of the NWPAA, the Nuclear Waste Technical Review Board (NWTRB) is to evaluate the technical and scientific validity of DOE activities under the NWPAA, including site characterization and activities related to packaging or transportation of spent fuel. The NWPAA also established the Office of Nuclear Waste Negotiator who is to seek to negotiate terms under which a State or Indian tribe would be willing to host a repository or monitored retrievable storage (MRS) facility at a technically qualified site. Among the duties of the Negotiator is consultation with Federal agencies such as NRC on the suitability of any potential site for site characterization.

At the time of this writing, the Negotiator has not been appointed by the President. On February 24, 1989 Congressman Morris K. Udall and Senator J. Bennett Johnston requested that the President take action to appoint an individual to this office. A Negotiator could contribute to the timely success of the repository program by providing an alternative site to the Yucca Mountain site that would still have to be technically acceptable but would enjoy the advantage of reduced institutional uncertainties resulting from opposition of State or affected Indian tribes.

An additional measure which may facilitate documentation and communication of concerns related to a repository is the Licensing Support System (LSS). The

LSS is to provide full text search capability of and easy access to documents related to the licensing of the repository. Although the purpose of the LSS is to expedite NRC's review of the construction authorization application for a repository by reducing the time required for document discovery, it will be an effective mechanism by which the State of Nevada and local governments can acquire early access to all DOE and NRC documents (not including interactive data bases) that may be used in a repository licensing proceeding. DOE has the responsibility for designing the LSS and bearing the costs associated with it, and NRC will be responsible for implementing it.

Procedures for the use of the LSS are part of revisions to 10 CFR Part 2, NRC's Rules of Practice for the adjudicatory proceeding on the application to receive and possess waste at a repository. These revisions were the result of a "negotiated rulemaking" process in which affected parties meet to reach consensus on the proposed rule. The members of the negotiating committee included: DOE; NRC; State of Nevada; coalition of Nevada local governments; coalition of industry groups; and a coalition of national environmental groups. The coalition of industry groups dissented on the final text of the proposed rule, so a consensus was not actually reached, but the negotiating process enabled NRC to produce a proposed rule reflecting the consensus of most of the interested parties on an important repository licensing issue.

The NRC is committed to safe disposal of radioactive waste and the protection of public health and safety and the environment. Any state with a candidate site for a repository should be assured that a repository will not be licensed if it does not meet NRC criteria. NRC has its own program for interaction with the State of Nevada and affected units of local government, and will continue to provide information to Nevada and consider State concerns as requested.

Given the difficult nature of siting a repository, the Commission believes that the NWPAA, as amended, has achieved the proper balance between providing for participation by affected parties and providing for the exercise of Congressional authority to carry out the national program for waste disposal. The NWPAA provides adequate opportunity for interaction between DOE and other Federal agencies, States, tribes, and local governments such that concerns can be presented to DOE for appropriate action. Both the NRC and the State or tribe can exercise considerable prerogative regarding repository development. The State or tribe may disapprove the recommendation that the site undergo repository development. This disapproval can be overridden only by vote of both houses of Congress within 90 days of continuous session. If the State disapproval is overridden, DOE may submit an application for authorization to construct the repository, and, if approved, a subsequent application to receive and possess waste for emplacement. NRC will make decisions on the license applications according to the requirements of its statutory mission. Despite the complexity of the overall process and the strong views of the participants in it, the Commission sees no compelling reason to conclude that current institutional arrangements are inadequate to the task of resolving State, federal, and local concerns in time to permit a repository to be available within the first quarter of the twenty-first century.

### 2.A.3.b. Continuity of the management of the waste program

At the time the Commission issued its 1984 Waste Confidence Decision, the possibility that the functions of the Department of Energy would be transferred to another Federal agency was cited as the basis for concerns that the resolution of the radioactive waste disposal problem would likely undergo further delays. The Commission responded that in the years since the Administration had proposed to dismantle DOE in September 1981, Congress had not acted on the proposal. The Commission further stated that even if DOE were abolished, the nuclear waste program would simply be transferred to another agency. The Commission did not view the potential transfer in program management as resulting in a significant loss of momentum in the waste program. The Commission also concluded that the enactment of the NWPA, which gave DOE lead responsibility for repository development, further reduced uncertainties as to the continuity of management of the waste program.

Section 303 of the NWPA did, however, require the Secretary of Energy to "undertake a study with respect to alternative approaches to managing the construction and operation of all civilian radioactive waste facilities, including the feasibility of establishing a private corporation for such purpose." To carry out this requirement, DOE established the Advisory Panel on Alternative Means of Financing and Managing Radioactive Waste Facilities, which came to be known as the "AMFM" Panel. The Panel's final report issued in December 1984 concluded that several organizational forms are more suited than DOE for managing the waste program, including an independent Federal agency or commission, a public corporation, and a private corporation. The report identified a public corporation as the preferred alternative on the basis of criteria developed by the Panel for an acceptable waste management organization. In particular, the report indicated that a public corporation would be stable, highly mission-oriented, able to maintain credibility with stakeholders, and more responsive to regulatory control than a Federal executive agency.

Commenting on the AMFM Panel's report in April 1985, DOE recommended retaining the present management structure of the waste program at least through the siting and licensing phase of the program. Congress did not take action to implement the Panel's recommendations, and DOE's management of the waste program has remained uninterrupted.

By enacting the Nuclear Waste Policy Amendments Act of 1987, Congress effectively reaffirmed DOE's continued management of the waste program. Congress did not revise DOE's role as the lead agency responsible for development of a repository and monitored retrievable storage facility. Congress did establish several new entities for the purpose of advising DOE on matters related to the waste program, such as the Nuclear Waste Technical Review Board and the Review Panel to be established if DOE and a State or Tribe enter into a benefits agreement under Section 170 of the NWPA. Congress provided further indication of its intent that DOE maintain management control of the waste program for the foreseeable future in requiring under Section 161

that the Secretary of DOE "report to the President and to Congress on or after January 1, 2007, but not later than January 1, 2010, on the need for a second repository."

This is not to say, however, that there have been no management problems in the DOE program. Since the enactment of the NWPA in 1983, only one of the five Directors of DOE's Office of Civilian Radioactive Waste Management (OCRWM) has held the position on a permanent basis. Inadequate progress toward an operating repository has concerned several Congressional observers, including Senator J. Bennett Johnston, Chairman of the Senate Energy and Natural Resources Committee. In February 1989 confirmation hearings for then-Secretary of Energy-designate James Watkins, Senator Johnston strongly criticized mounting cost projections and lack of progress in the program, and called for new and stronger management.

Whether the management structure of the repository development program should in fact be changed is a decision best left to others. The Commission believes that a finding on the likely availability of a repository should take management problems into account, but finds no basis to diminish the degree of assurance in its 1984 conclusion on this issue. Events since the submission of the AMFM Panel report do not indicate that there will be a fundamental change in the continuity of the management structure of the program any time soon. In addition, it cannot be assumed that the program would encounter significantly less difficulty with a new management structure than it would continuing under the present one. Under either scenario, however, the Commission believes it would be more prudent to expect repository operations after the 2007-09 timeframe than before it. Neither the problems of a new management structure nor those of the existing one is likely to prevent the achievement of repository operations within the first quarter of the next century, however.

#### 2.A.3.c. Continued funding of the nuclear waste management program

Section 302 of the Nuclear Waste Policy Act authorized DOE to enter into contracts with generators of electricity from nuclear reactors for payment of 1.0 mill (0.1 cent) per kilowatt-hour of net electricity generated in exchange for a Federal government commitment to take title to the spent fuel from those reactors. In the 1984 Waste Confidence Decision, the Commission noted that all such contracts with utilities had been executed. After the 1984 Decision, then-President Reagan decided that defense high-level wastes are to be collocated with civilian wastes from commercial nuclear power reactors. DOE's Office of Defense Programs is to pay the full cost of disposal of defense waste in the repository.

DOE is required under Section 302(a)(4) of the NWPA, as amended, "annually [to] review the amount of the fees...to evaluate whether collection of the fees will provide sufficient revenues to offset the costs...." In the June 1987 Nuclear Waste Fund Fee Adequacy Report, DOE recommended that the 1.0 mill per kilowatt-hour fee remain unchanged. This assessment was based on the

assumption that an MRS facility would open in 1998, the first repository would open in 2003, and the second repository in 2023. These assumptions do not reflect changes in the waste program brought about by the NWPAA enacted in December 1987. Two such changes with significant potential impacts were the suspension of site-specific activities related to the second repository until at least 2007, and the linkage between MRS construction and operation and the granting of a repository construction authorization, which will probably occur no earlier than 1998.

According to the Draft 1988 Mission Plan Amendment, DOE should currently be preparing the 1988 fee-adequacy analysis on the basis of the changes to the waste program brought about by the NWPAA. The new fee adequacy report will reflect overall program cost savings to the utilities resulting from: (1) limiting site characterization activities to a single site at Yucca Mountain, NV; and (2) the DOE Office of Defense Programs' sharing other program costs with generators of electricity "on the basis of numbers of waste canisters handled, the portion of the repository used for civilian or defense wastes, and the use of various facilities at the repository" in addition to paying for activities solely for disposing of defense wastes. An additional factor which may eventually also contribute to the overall adequacy of Nuclear Waste Fund fees is the likelihood that a significant number of utilities will request renewals of reactor operating lifetimes beyond their current OL expiration dates. Operating license renewal would provide additional time during which Nuclear Waste Fund fees could be adjusted, if necessary, to cover any future increase in per-unit costs of waste management and disposal.

The Commission recognizes the potential for program cost increases over estimates in the 1987 Nuclear Waste Fund Fee Adequacy Report. If there is a significant delay in repository construction, for example, it is reasonable to assume that construction costs will escalate. There may also be additional costs associated with at-reactor dry cask storage of spent fuel if DOE does not have a facility available to begin accepting spent fuel by the 1998 date specified in the NWPAA. These costs would be further increased if one or more licensees were to become insolvent and DOE were required to assume responsibility for storage at affected reactors before 1998.

The full impact of the program redirection resulting from the NWPAA and the outlook for the timing of repository availability will continue to be assessed annually. If it does appear that costs will exceed available funds, there is provision in the NWPAA for DOE to request that Congress adjust the fee to ensure full cost recovery. Thus, the Commission finds no reason for changing its basic conclusion that the long-term funding provisions of the Act should provide adequate financial support for the DOE program.

#### 2.A.3.d. DOE's schedule for repository development

At the time that the 1984 Waste Confidence Decision was issued, the Nuclear Waste Policy Act of 1982, enacted in January 1983, had been in effect for less than 20 months. The NWPA had established numerous deadlines for various repository program milestones. Under Section 112(b)(1)(B), the NWPA set the schedule for recommendation of sites for characterization no later than January 1, 1985. Section 114(a)(2) specified that no later than March 31, 1987, with provision for a 12-month extension of this deadline, the President was to recommend to Congress one of the three characterized sites qualified for an application for repository construction authorization. Under Section 114(d), NRC was to issue its decision approving or disapproving the issuance of a construction authorization not later than January 1, 1989, or the expiration of three years after the date of submission of the application, whichever occurs later. Section 302(a)(5)(B) required that contracts between DOE and utilities for payments to the Waste Fund provide that DOE will begin disposing of spent fuel or high-level waste by January 31, 1998.

In little more than a year after enactment, the schedule established by the NWPA began proving to be optimistic. In the reference schedule for the repository presented in the April 1984 Draft Mission Plan, for example, DOE showed a slip from January 1989 to August 1993 for the decision on construction authorization.

In the 1984 Waste Confidence Decision, the Commission recognized the possibility of delay in repository availability beyond 1998, and did not define its task as finding confidence that a repository would be available by the 1998 milestone in the NWPA. The Commission focused instead on the question of whether a repository would be available by the years 2007-2009, the date cited in the court remand as the expiration of the operating licenses for the Vermont Yankee and Prairie Island reactors. The NRC believed that the NWPA increased the chances for repository availability within the first few years of the twenty-first century by specifying the means for resolving the institutional and technical issues most likely to delay repository completion, by establishing the process for compliance with NEPA, and by setting requirements for Federal agencies to cooperate with DOE in meeting program milestones. Finding that no fundamental technical breakthroughs were necessary for the repository program, the Commission predicted that "selection and characterization of suitable sites and construction of repositories will be accomplished within the general time frame established by the Act [1998] or within a few years thereafter."

In January 1987, DOE issued a Draft Mission Plan Amendment to apprise Congress of significant developments and proposed changes in the repository program. In the Draft Amendment, DOE announced a five-year delay in its schedule for repository availability from the first quarter of 1998 to the first quarter of 2003. DOE's reasons for the delay included the need for more time for consultation and interaction with States and Tribes, the requirement in DOE's 1987 budget that funds not be used for drilling exploratory shafts in 1987, and the need for more information than previously planned for site-selection and the license application. The 1987 Draft Mission Plan Amendment set the second

quarter of 1988 as the new date for exploratory shaft construction at the Yucca Mountain site. When the final 1987 Mission Plan Amendment was submitted to Congress in June 1987, the schedule for shaft sinking at the Yucca Mountain site had slipped six months to the fourth quarter of 1988. Congress did not take action to approve the June 1987 Mission Plan Amendment as DOE had requested.

On December 22, 1987, the Nuclear Waste Policy Amendments Act (NWPAA) was enacted. The NWPAA had its major impact on the repository program in suspending site characterization activities at the Hanford and Deaf Smith County sites and authorizing DOE to characterize the Yucca Mountain site for development of the first repository.

DOE subsequently issued the Draft 1988 Mission Plan Amendment in June 1988 to apprise Congress of its plans for implementing the provisions of the NWPAA. In the Draft 1988 Mission Plan Amendment, DOE's schedule for shaft sinking at Yucca Mountain had slipped another six months to the second quarter of 1989. At this writing, the schedule for shaft sinking is November 1989, but NRC and DOE have agreed that DOE must first have a qualified quality assurance (QA) program in place. DOE efforts to date to qualify its QA program have revealed issues requiring DOE attention before shaft excavation can begin, and it is possible that additional issues affecting DOE's readiness will come to light.

Realistically, as the date for shaft sinking slips, the date for repository operation must be adjusted to reflect this slip. This might not be the case if the original schedule had provided for periods of time between critical milestones that could absorb delays without affecting the schedule for repository operation. This is not the case with the schedule for the repository. The repository schedule has always been aggressive and highly success-oriented. In comments on the Draft 1988 Mission Plan Amendment, the Commission noted that the schedule has not allowed adequately for contingencies, and that, given the compression in the schedule for near-term program milestones, DOE has not shown how it will be able to meet the 2003 milestone for repository operation.

Another potential source of delay in repository availability may arise from NRC regulations. The Commission believes that current NRC rules are fully adequate to permit DOE to proceed to develop and submit a repository license application, but further clarification of these rules is desirable to reduce the time needed to conduct the licensing proceeding itself. In order to meet the three-year schedule provided in the NWPA for a Commission decision on repository construction authorization, the NRC staff has undertaken to refine its regulatory framework on a schedule that would still permit DOE to prepare and submit an application for repository construction authorization under its current schedule. The Commission fully expects to avoid delaying DOE's program while working to reduce the uncertainties in NRC regulatory requirements that could become contentions in the licensing proceeding. Even if there are any delays resulting from a need for DOE to accommodate more specific regulatory requirements in its site characterization or waste package development

programs, however, the Commission is confident that the time savings in the licensing proceeding will more than compensate for them.

In view of the delays in exploratory shaft excavation since the 2003 date for repository availability was set, it may be optimistic to expect that Phase 1 of repository operations will be able to begin by 2003. As DOE's schedule for repository availability has slipped a year and a half since the date was changed from 1998 to 2003, the earliest date for repository availability would probably be closer to 2005.

An institutional issue that may further affect DOE's schedule is the status of EPA standards for disposal of spent fuel and high-level waste. These standards are required under Section 121(a) of the NWPA. Under 10 CFR 60.112, the NRC's overall postclosure system performance objective, the geologic setting shall be selected and the engineered barrier system, which includes the waste package, must be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to EPA's standards. 40 CFR 191, the EPA standards, first became effective in November 1985. In July 1987, the U.S. Court of Appeals for the First Circuit vacated and remanded to EPA for further proceedings Subpart B of the high-level radioactive waste disposal standards. As noted under 1.A.1. above, the standards have not been reissued.

A significant modification in the reissued EPA standard may affect the schedule for completing the design of the waste package and engineered barrier to the extent that design testing is planned to demonstrate compliance with the standards. DOE's current site characterization plans for demonstrating compliance with 40 CFR 191 are based on the standards as promulgated in 1985. DOE is proceeding to carry out its testing program developed for the original EPA standards. DOE has stated that if the EPA standards are changed significantly when they are reissued, DOE will reevaluate the adequacy of its testing program.

The Commission believes that DOE's approach is reasonable. Much of the information required to demonstrate compliance with the EPA standards is expected to remain the same regardless of the numerical level at which each standard is set. Considering the importance of developing the repository for waste disposal as early as safely practicable, it would be inappropriate for DOE to suspend work on development of engineered barriers pending reissuance of the standards unless EPA had given clear indications of major changes in them.

Another possibility is that, regardless of any changes in the repromulgated EPA standards, they will be litigated in federal court. Even if this proves to be the case, however, the Commission believes that any such litigation will still permit EPA to promulgate final standards well within the time needed to enable DOE to begin repository operations at any site within the first quarter of the twenty-first century.

Given the current pace of the DOE program, and assuming that the QA program can be qualified and shaft excavation begun within the next year, the Commission finds it is still possible, though less likely, that a repository at Yucca Mountain will be available by 2007-2009. To the extent that the expiration of the OLS for Prairie Island and Vermont Yankee continue to be relevant in this proceeding, the Commission believes it is more likely that a repository will be available by the anticipated dates of extension of the OLS for those plants in 2012-2014. If the Yucca Mountain site is determined to be unsuitable, the Commission considers it reasonable to expect that DOE could make this determination by the year 2000 and have a repository at another site available within the first quarter of the next century.

## 2.B. Relevant Issues That Have Arisen Since the Commission's Original Decision

2.B.1. NRC stated in 9-14-87 correspondence to Sen. Breaux on pending nuclear waste legislation that under a program of single site characterization "there may be a greater potential for delay of ultimate operation of a repository than there is under the current regime where three sites will undergo at-depth characterization before a site is selected." To what extent does the NWPAA raise uncertainty about the identification of a technically acceptable site and potential delay in repository availability by limiting site characterization to a single candidate site (Yucca Mt.) and by raising the possibility that a negotiated agreement might influence repository site selection? Does this uncertainty affect confidence in the availability of a repository by 2007-2009?

In providing comments to Congress on proposed amendments to the Nuclear Waste Policy Act of 1982, NRC took the position that simultaneous site characterization of three sites as required by the NWPA was not necessary to protect public health and safety. NRC further stated that the adequacy of a site for construction authorization would ultimately be determined in a licensing proceeding, and that NRC would only license a site that satisfied NRC licensing requirements. As described below, the Commission believes that the NWPAA contains numerous provisions to ensure that a technically acceptable site will be identified.

The NWPAA does not reduce the scope of site characterization activities that DOE is authorized to undertake. The Amendments Act establishes a Nuclear Waste Technical Review Board composed of individuals recommended by the National Academy of Sciences and appointed by the President to evaluate the scientific validity of DOE activities, including site characterization activities, and to report its findings at least semiannually to Congress and the DOE. The Amendments Act also provides funding for technical assistance to States, tribes, and affected units of local government. Finally, Section 160(1) of the NWPAA provides that "Nothing in this Act shall be construed to amend or otherwise detract from the licensing requirements of the NRC established in Title II of the Energy Reorganization Act of 1974 (42 U.S.C. 5841 et seq.)."

In providing for these reviews and in reaffirming NRC's licensing authority, the NWPAA ensures that a candidate site for a repository must satisfy all NRC requirements and criteria for disposal of high-level radioactive wastes in licensed geologic repositories.

Section 402 of the NWPAA establishes the Office of the Nuclear Waste Negotiator. The duty of the Negotiator is to attempt to find a State or Tribe willing to host a repository or MRS at a technically qualified site. The Negotiator may solicit comments from the NRC or any other Federal agency on the suitability of any potential site for site characterization. Section 403(d)(4) strengthens the Commission's confidence that a technically acceptable site will be identified by providing that DOE may construct a repository at a negotiated site only if authorized by NRC. Given these safeguards on selection of a technically acceptable site, the Commission does not consider that the possibility of a negotiated agreement reduces the likelihood of finding a technically qualified site.

The Commission raised the concern as early as April 1987 that under a program of single site characterization, there could be considerable delay while characterization was completed at another site or slate of sites if the initially chosen site were found inadequate. By terminating site characterization activities at alternative sites to the Yucca Mountain site, the NWPAA has had the effect of increasing the potential for delay in repository availability if the Yucca Mountain site proves unsuitable. The provision in the NWPAA for a Negotiator could reduce the uncertainty and associated delay in restarting the repository program by offering an alternate to the Yucca Mountain site, but at the time of this writing, a Negotiator has not been appointed.

It should be noted here that the repository program redirection under the NWPAA does not, per se, have a significant impact on the Commission's assurance of repository availability by 2007-2009. The Commission's reservations about reaffirming this timeframe derive from other considerations, including delays in sinking shafts and the potential for other delays in meeting program milestones, that would have arisen without the NWPAA.

The Amendments Act does, however, effectively make it necessary that Yucca Mountain be found suitable if the 2007-09 timeframe is to be met; this target period would almost certainly be unachievable if DOE had to begin screening to characterize and license another site. Thus, confidence in repository availability by 2007-09 implies confidence in the suitability of Yucca Mountain. The Commission does not want its findings here to constrain in any way its regulatory discretion in a licensing proceeding. The Commission has therefore concluded that even if the program were on schedule, it would be inappropriate to reaffirm the 2007-09 timeframe in the 1984 Decision.

2.B.2. In the Draft 1988 Mission Plan Amendment, DOE stated that "the data

indicate that the Yucca Mountain site has the potential capacity to accept at least 70,000 MTHM [metric tons heavy metal equivalent] of waste, but only after site characterization will it be possible to determine the total quantity of waste that could be accommodated at this site."

a. Do the issues of limited spent fuel capacity at Yucca Mountain, indefinite suspension of the second repository program, and the likelihood that no more than one repository will be available by 2007-2009 undermine the NRC's 1984 assurance that "sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high level radioactive waste and spent fuel originating in such reactor and generated up to that time"?

b. Is there sufficient uncertainty in total spent fuel projections (e.g., from extension-of-life license amendments, renewal of operating licenses for an additional 20 to 30 years, or a new generation of reactor designs) that this Waste Confidence review should consider the institutional uncertainties arising from having to restart a second repository program?

#### 2.B.2.a.

Although it will not be possible to determine whether Yucca Mountain can accommodate 70,000 MTHM or more of spent fuel until after site characterization, the Commission does not believe that the question of repository capacity at the Yucca Mountain site should be a major factor in the analysis of Finding 2. This is because it cannot be assumed that Yucca Mountain will ultimately undergo development as a repository. The generic issue of repository capacity does add to the potential need for more than one repository, however.

As noted earlier, the NWPA established deadlines for major milestones in the development of the first and the second repository programs. The Act also required NRC to issue a final decision on the construction authorization application by January 1, 1989 for the first repository, and January 1, 1992 for the second (or within three years of the date of submission of the applications, whichever occurred later). The July 1984 Draft DOE Mission Plan set January 1998 and October 2004 as the dates for commencement of waste emplacement in the first and second repositories, assuming that Congressional authorization was obtained to construct the second repository.

Thus, at the time the 1984 Waste Confidence decision was issued, DOE was authorized and directed to carry out two repository programs under a schedule to make both facilities operational by 2007-2009. DOE and NRC were also working under the constraint, still in force under the NWPA as amended, that no more than 70,000 MTHM may be emplaced in the first repository before the second

is in operation. Because DOE estimated at the time that commercial U.S. nuclear power plants with operating licenses or construction permits would discharge a total 160,000 MTHM of spent fuel, it appeared that at least two repositories would be needed.

In the 1984 Waste Confidence Decision, reactors were assumed to have a 40-year operating lifetime, and because the earliest licenses were issued in 1959 and the early 1960's, the oldest plants' licenses were due to expire as early as 1999 and 2000, as discussed in more detail below. Although it was expected that at least one repository would be available by this time, there was also a limit as to how quickly spent fuel could be accepted by the repository. DOE had estimated that waste acceptance rates of 3400 MTHM per year could be achieved after the completion of Phase 2 of the first repository. This rate could essentially double if two repositories were in operation. At 6000 MTHM/year, it was estimated that all the anticipated spent fuel could be emplaced in the two repositories by about the year 2026. This was the basis for the Commission's position that sufficient repository capacity would be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high level waste and spent fuel originating in such reactor and generated up to that time.

In May 1986, however, DOE announced an indefinite postponement of the second repository program. The reasons for the postponement included decreasing forecasts of spent fuel discharges, as well as estimates that a second repository would not be needed as soon as originally supposed. With enactment of the NWPAA in December 1987, DOE was required to terminate all site-specific activities with respect to a second repository unless such activities were specifically authorized and funded by Congress. The NWPAA required DOE to report to Congress on the need for a second repository on or after January 1, 2007, but not later than January 1, 2010.

Current DOE spent fuel projections, based on the assumption of no new reactor orders, call for 87,000 MTHM to have been generated by the year 2036, including approximately 9000 MTHM of defense high-level waste. With the likelihood that there will be reactor lifetime extensions and renewals, however, the no-new-orders case probably underestimates total spent fuel discharges. Also, the requirement that no more than 70,000 MTHM could be emplaced in the first repository prior to operation of the second repository was not changed by the NWPAA. It therefore appears likely that two repositories will be needed to dispose of all the spent fuel and high-level waste from the current generation of reactors, unless Congress provides statutory relief from the 70,000 MTHM limit and the first site has adequate capacity to hold all of the spent fuel and high-level waste generated. The Commission believes that if the need for an additional repository is established, Congress will provide the needed institutional support and funding as it has for the first repository.

For all but a few licensed nuclear power reactors, operating licenses will not expire until some time in the first three decades of the twenty-first century. Several utilities are currently planning to have their OLS renewed for ten to

30 years beyond the original license expiration. At these reactors, currently available spent fuel storage alternatives effectively remove storage capacity as a potential restriction for safe operations. For these reasons, a repository is not needed by 2007-2009 to provide disposal capacity within 30 years beyond expiration of most operating licenses. If work is begun on the second repository program in 2010, the repository could be available by 2035, according to DOE's estimate of 25 years for the time it will take to carry out a program for the second repository. Two repositories available in approximately 2025 and 2035, each with acceptance rates of 3400 MTHM/year within several years after commencement of operations, would provide assurance that sufficient repository capacity will be available within 30 years of OL expiration for reactors to dispose of the spent fuel generated at their sites up to that time.

There are several reactors, however, whose OLs have already expired or are due to expire within the next few years, and which are now licensed or will be licensed only to possess their spent fuel. For these reactors, if a repository is not available until about 2025, they may be exceptions to the second part of the Commission's 1984 Finding 2, which was that sufficient repository capacity will be available within 30 years beyond the expiration any reactor operating license to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time.

The basis for this second part of Finding 2 has two components: 1) a technical or hardware component; and 2) an institutional component. The technical component relates to the reliability of storage hardware and engineered structures to provide for the safe storage of spent fuel. An example would be the ability of spent fuel assemblies to withstand corrosion within spent fuel storage pools, or the ability of concrete structures to maintain their integrity over long periods. In the 1984 Decision, the Commission found confidence that available technology could in effect provide for safe storage of spent fuel for at least 70 years.

The Commission's use of the expression "30 years beyond expiration of any reactor operating license" in the 1984 Finding was based on the understanding that the license expiration date referred to the scheduled expiration date at the time the license was issued. It was also based on the understanding that, in order to refuel the reactor, some spent fuel would be discharged from the reactor within twelve to eighteen months after the start of full power operation.

Thus, the Commission understood that, depending on the date of the first reactor outage for refueling, some spent fuel would be stored at the reactor site for most of the 40-year term of the typical operating license. In finding that spent fuel could be safely stored at any reactor site for at least 30 years after expiration of the operating license for that reactor, the Commission indicated its expectation that the total duration of spent fuel storage at any reactor would be about 70 years.

Taking the earliest licensed power reactor, the Dresden 1 facility licensed in 1959, and adding the full 40-year operating license duration for a scheduled license expiration in the year 1999, the Commission's finding would therefore entail removal of all spent fuel from that reactor to a repository within the succeeding 30 years, or by 2029. Even if a repository were not available until the end of the first quarter of the twenty-first century, DOE would have at least four years to ship the reactor's 683 spent fuel assemblies, totalling 70 metric tons initial heavy metal, from Dresden 1 without exceeding the Commission's 30-year estimate of the maximum time it would take to dispose of the spent fuel generated in that reactor up to the time its operating license expired. (Metric tons initial heavy metal, or MTHM, is a measure of the mass of the uranium in the fuel (or uranium and plutonium if it is a mixed oxide fuel) at the time the fuel is placed in the reactor for irradiation.)

Considering the experience from the 1984 and 1985 campaigns to return spent fuel from the defunct West Valley reprocessing facility to the reactors of origin, 70 metric tons of boiling water reactor (BWR) spent fuel can easily be shipped within four years. The first campaign, involving truck shipments of 20 metric tons from West Valley, NY, to Dresden 1 in Morris, IL, took eleven months. The second, involving truck shipments of 43 tons from West Valley to the Oyster Creek reactor in Toms River, NJ, took six months. (See Case Histories of West Valley Spent Fuel Shipments, Final Report, NUREG/CR-4847 WPR-86(6811)-1, p. 2-2.) This estimate assumes, moreover, that no new transportation casks, designed to ship larger quantities of older, cooler spent fuel, for example, would be available by 2025.

The institutional part of the question concerning the availability of sufficient repository capacity required the Commission to make a finding as to whether spent fuel in at-reactor storage would be safely maintained following the expiration of the facility operating license. This question related to the financial and managerial capability for continued safe storage and monitoring of spent fuel rather than to the capability of the hardware involved. The Commission determined in Finding 3 of its 1984 Decision that spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure safe disposal, which was expected under Finding 2 to be about 30 years following the expiration of any reactor's operating license. (See discussion of Finding 3 below for additional discussion of the institutional aspects of spent fuel storage pending the availability of sufficient disposal capacity.)

The availability of a repository within the first quarter of the twenty-first century holds no significant adverse implications for the Commission's institutional concern that there be an organization with adequate will and wherewithal to provide continued long-term storage after reactor operation. This could be a concern if a significant number of reactors with significant quantities of spent fuel on site were to discontinue operations indefinitely between now and 1995, and the utility-owners of these reactors did not appear to have the resources to manage them safely for up to 30 years pending the assumed availability of a repository in 2025.

No such development is likely. No licenses for currently operating commercial nuclear reactors are scheduled to expire until the year 2000, and most such licenses will expire during the first two decades after 2006. (See Nuclear Regulatory Commission 1989 Information Digest, NUREG-1350, Vol. 1, p. 33.) The availability of the first repository by 2025, and of a second repository within one or two decades thereafter, would provide adequate disposal capacity for timely removal of the spent fuel generated at these reactors.

There are several licensees, however, whose authority to operate their commercial reactors has already been terminated. These are Indian Point 1, Dresden 1, Humboldt Bay, and Lacrosse. They are also the only licensed power reactors that are retired with spent fuel being stored onsite. Assuming conservatively that a repository does not become operational until 2025, it appears likely that spent fuel will remain at these sites for more than 30 years beyond the time their reactors were indefinitely shut down, at which point their operating licenses could be considered to have effectively expired, although they will continue to hold a possession license for the storage of the spent fuel.

In considering the means and motivation of the owner of an indefinitely retired reactor to provide safe long-term storage, the Commission believes it is useful to distinguish between the owner with only one reactor and the owner of a reactor at a multi-unit site or an owner with operating reactors at other sites. In the case of a retired reactor at a multi-unit site, the owner would have a clear need to maintain the safety of storage at the retired reactor sufficiently to permit continued generation at the site. If the owner of the retired reactor also owned other reactors at other sites, the spent fuel at the retired reactor could be transferred, if necessary, to the storage facilities of other units still under active management. Of the four reactors cited above, Indian Point 1 and Dresden 1 fit this description, and the sibling reactors at their sites are operating under licenses that do not expire until well beyond the year 2000 -- that is, well within the post-OL period during which the Commission has found that spent fuel could be safely stored pending the availability of a repository.

For the Lacrosse and Humboldt Bay reactors, the Commission is confident that, even if a repository is not available within 30 years following their retirement, the overall safety and environmental acceptability of extended spent fuel storage will also be maintained for these exceptional cases. Because there will still be an NRC possession license for the spent fuel at these facilities, the Commission will retain ample regulatory authority to require any measures, such as removal of the spent fuel remaining in storage pools to passive dry storage casks, that might become necessary until the time that DOE assumes title to the spent fuel under contracts pursuant to the NWPA. It should also be borne in mind that Humboldt Bay and Lacrosse are both small early reactors, and their combined spent fuel inventory totals 67 metric tons of initial heavy metal. (See Spent Fuel Storage Requirements (DOE/RL 88-34) October 1988, Table A.3b., pp. A.15-A.17.) If for any reason not now foreseen, this spent fuel can no longer be managed by the owners of these reactors, and

DOE must assume responsibility for its management earlier than currently planned, this quantity of spent fuel is well within the capability of DOE to manage onsite or offsite with available technology financed by the utility either directly or through the Nuclear Waste Fund.

Nor does the Commission see a significant safety or environmental problem with premature retirements of additional reactors. To exceed the Commission's original expectation of a 30-year post-operational storage timeframe for spent fuel awaiting a repository assumed to be available in 2025, these reactors would have to be indefinitely shut down between now and the end of 1995. With the exception of the Fort St. Vrain high-temperature gas-cooled reactor, which has a total inventory of 9 MTIHM, the Commission is unaware of any firm utility plans for such shutdowns in the near future. Based on the past history of such premature shutdowns, the Commission has reason to believe that their likely incidence during the next six years will be small as a proportion of total reactor-years of operation.

Considering that 14 of the 125 power reactors that have operated in the U.S. over the past 30 years have been retired before the expiration of their operating licenses, the same statistical proportion over the next six years would result in 2.8 such shutdowns. This projection does not account for the fact that a disproportionate number of the early reactors have been shut down prematurely. Assuming that the three reactors with the largest projected inventory of spent fuel in 1995 were shut down at the end of that year, their total spent fuel storage requirement would be less than 1500 MTIHM. This is less than the 1900-MTHM federal interim storage capacity that DOE would have been required to provide under the NWPA if enough utilities had requested it within the time limits provided. It is also well within the financial and managerial capability of DOE to provide even if, under an additional worst-case scenario, all such spent fuel were required to be removed to dry cask storage. (See Spent Fuel Storage Requirements (DOE/RL 88-34) October 1988, Table A.3b., pp. A.15-A.17)

Licensed non-power research reactors provide an even more manageable case. DOE owns the fuel for almost all of these reactors, many of which have been designed with lifetime cores that do not require periodic refueling. For those reactors that do discharge spent fuel, DOE accepts it for storage or reprocessing, and that not more than an estimated 50 kilograms of such spent fuel are generated annually.

Thus, given these worst-case projections, which are not expectations but bounding estimates, the Commission finds that a delay in repository availability to 2025 will not result in significant safety or environmental impacts due to extended post-operational spent fuel storage. To put it another way, the Commission is confident that even if a repository were not available within 30 years following the effective expiration of the operating licenses for both currently retired reactors and potential future reactor retirements through 1995, the overall safety and environmental impacts of extended spent fuel storage would be insignificant.

## 2.B.2.b.

Although it is clear that there is uncertainty in projections of total future spent fuel discharges, it is not clear that the institutional uncertainties arising from having to restart a second repository program should be considered in detail in the current Waste Confidence Decision review.

License renewals would have the effect of increasing requirements for spent fuel storage. The Commission understands that some utilities are currently planning to seek renewals for 30 years. Assuming for the sake of establishing a conservative upper bound that the Commission does grant 30-year license renewals, the total operating life of some reactors would be 70 years, so that the spent fuel initially generated in them would have to be stored for about 100 years if a repository were not available until 30 years after the expiration of their last operating licenses.

Even under the conservative bounding assumption of 30-year license renewals for all reactors, however, if a repository were available within the first quarter of the twenty-first century, the oldest spent fuel could be shipped off the sites of all currently operating reactors well before the spent fuel initially generated in them reached the age of 100 years. Thus, a second repository, or additional capacity at the first, would be needed only to accommodate the additional quantity of spent fuel generated during the later years of these reactors' operating lives. The availability of a second repository would permit spent fuel to be shipped offsite well within 30 years after expiration of these reactors' Ols. The same would be true of the spent fuel discharged from any new generation of reactor designs.

In sum, although some uncertainty in total spent fuel projections does arise from such developments as utilities' planning renewal of operating licenses for an additional 20-30 years, the Commission believes that this Waste Confidence review need not at this time consider the institutional uncertainties arising from having to restart a second repository program. Even if work on the second repository program is not begun until 2010 as contemplated under current law, there is sufficient assurance that a second repository will be available in a timeframe that would not constrain the removal of spent fuel from any reactor within 30 years of its licensed life for operation.

2.B.3. Are early slippages in the DOE repository program milestones significant enough to affect the Commission's confidence that a repository will be available when needed for health and safety reasons?

The 2007-2009 timeframe imposed on the Commission by the May 23, 1979 remand by the Court of Appeals was based on the scheduled expiration of the Ols for the Vermont Yankee and Prairie Island nuclear reactors. The specific issues remanded to the Commission were: 1) whether there is reasonable assurance that an offsite storage solution will be available by the years 2007-2009, the

expiration of the plants' operating licenses; and, if not, 2) whether there is reasonable assurance that the fuel can be stored safely at the sites beyond those dates.

There was no finding by the Court that public health and safety required offsite storage or disposal by 2007-2009. In directing the Commission to address the safety of at-reactor storage beyond 2007-2009, the Court recognized the possibility that an offsite storage or disposal facility might not be available by then. In any case, the years 2007-2009 no longer have the same meaning for this proceeding as they had in 1984; the OLs for Prairie Island and Vermont Yankee have been or will soon be extended to 2012-2014 on the basis of the NRC's past willingness to approve a 40-year operating lifetime from the date of issuance of the OL.

The Commission has not identified a date by which a repository must be available for health and safety reasons. Taking into account institutional requirements for spent fuel storage, the Commission found in the 1984 Waste Confidence Decision that, under Finding 3, spent fuel would be safely managed until sufficient repository capacity is available. The Commission also found, however, that in effect, under the second part of Finding 2, safe management would not need to continue for more than 30 years beyond expiration of any reactor's OL, because sufficient repository capacity was expected to become available within those 30 years. Considering that spent fuel would not have to be stored more than 30 years after any reactor's 40-year OL expiration, and taking into account the technical requirements for such storage, the Commission went on to determine under Finding 4 that, in effect, spent fuel could be safely stored for at least 70 years after discharge from a reactor. Thus, the Commission's 1984 Decision did not establish a time when sufficient repository capacity would be required; it established a minimum period during which storage would continue to be safe and environmentally acceptable pending the expected availability of sufficient repository capacity.

Bearing in mind that reactor facilities were originally designed and operating licenses issued for a licensed life for operation of 40 years, the Commission is proposing elsewhere in this Federal Register notice a clarifying revision of Finding 4 to say that spent fuel can be safely stored at a reactor for at least 30 years after the "licensed life for operation" of that reactor. Implicitly, the proposed use of the phrase "licensed life for operation" clarifies that the Commission found in 1984 that NRC licensing requirements concerning reactor facility design, construction, and operation provide reasonable assurance that spent fuel can be stored safely and without significant environmental impacts for at least the first 40 years of the reactor's life, and that, barring any significant and pertinent unexpected developments, neither technical nor institutional constraints would adversely affect this assurance for at least another 30 years after that first 40 years. Another implication of this revised finding is that, where a utility is able to meet NRC requirements to extend that reactor's operating lifetime by license renewal, spent fuel storage for at least 30 years beyond the end of the period of extended life will also be safe and without significant environmental impacts.

In assessing the effect of early slippages in DOE repository program milestones, therefore, the most important consideration is not the earliest date that an operating license actually expired, but the earliest date that an OL was issued. The earliest OL to be issued was for Dresden 1 in 1959, followed by a number of reactors licensed for operation in 1962. The OLs for all of the 111 power reactors now licensed to operate are currently scheduled to expire sometime within the first three decades of the twenty-first century, which is also the period in which their currently licensed life for operation would end. (See Nuclear Regulatory Commission 1989 Information Digest, NUREG-1350, Vol. 1, p. 33.) Thus, conservatively assuming here that there will be no license renewals, the earliest timeframe when a repository might be needed to dispose of spent fuel from the majority of reactors is 2029-2050.

As proposed in the first part of Finding 2, the Commission has reasonable assurance that a repository will be available within the first quarter of the twenty-first century. Even if a repository were not available until 2025, this would be several years before the beginning of the earliest timeframe within which, based on an assumed 30-year storage after an assumed 40-year licensed life of reactor operation, a repository might be needed for spent fuel disposal. Thus, early slippages in DOE's program milestones do not affect the Commission's confidence that a repository will be available within that timeframe.

2.B.4. NRC has stated that the 3- to 4-year license application review schedule is optimistic, and that for NRC to meet this schedule, DOE must submit a complete and high-quality license application. In the September 16, 1988 NRC comments to DOE on the Draft 1988 Mission Plan Amendment, the Commission requested that DOE acknowledge its commitment to develop this complete and high-quality application, "even if this would result in longer times to collect the necessary information and subsequent delays in submitting the license application."

Will NRC's emphasis on the completeness and quality of the license application have a significant effect on the timing of the submittal of the license application and subsequent licensing proceeding to grant construction authorization in time for repository availability by 2007-2009?

As the NRC indicated to DOE in NRC's October 25, 1985 comments on the draft Project Decision Schedule (PDS), the 3-year statutory schedule for the NRC licensing proceeding on the application for construction authorization is optimistic. The Commission has sought ways to improve the prospects for meeting this schedule, for example by developing the Licensing Support System (LSS) for expedited document discovery during the licensing proceeding.

The NRC also stated in the same correspondence on the PDS that the adequacy of the 3-year review period is dependent on the submittal by DOE of a complete and

high-quality application. A license application supported by inadequate data may lead to findings during the licensing proceeding that the results of certain tests cannot be admitted as part of the license application. If it is not possible to repeat the tests in question, NRC may have no alternative but to deny the application -- with a consequent loss of program momentum and considerable financial cost.

NRC recognizes that emphasis on a complete and high-quality license application may cause some near-term delays that could make it difficult to achieve the current schedule calling for submittal of the construction authorization application in 1995. Notwithstanding any such delays, the Commission has reasonable assurance that if the Yucca Mountain site is not found unsuitable, a repository at that site could be available by the 2012-2014 timeframe consistent with the rescheduled OL expiration dates for Prairie Island and Vermont Yankee. For reasons discussed previously, this timeframe now appears more relevant to the Waste Confidence proceeding than the 2007-2009 timeframe.

In any case, the Commission remains convinced that the benefits to the repository program of submitting a high-quality license application would outweigh the cost of delay in preparing the application. NRC has always placed great emphasis on early resolution of potential licensing issues in the interest of expeditious review of the license application and timely repository availability. It is in the same spirit of timely repository operation that the Commission is urging greater attention to quality than to meeting the schedule for submittal of the license application. NRC believes that a complete and high-quality license application offers the best available assurance that timely repository licensing and operation can be achieved.

In addition to expediting the review of the application, a high-quality license application and site characterization program should enhance overall confidence that any site granted a construction authorization will prove to be reliable during the period of performance confirmation. It will also increase public confidence that the program is being carried out in a thorough and technically sound manner.

### 2.C. Conclusion on Finding 2.

In reexamining the technical and institutional uncertainties surrounding the timely development of a geologic repository since the 1984 Waste Confidence Decision, the Commission has been led to question the conservatism of its expectation that a repository would be available by 2007-2009.

At the time of the 1984 Decision, the Commission said that timely attainment of a repository did not require DOE to adhere strictly to the milestones set out in the NWPA, and there would be delays in some milestones. It did not appear to the Commission at the time that delays of a year or so in meeting any of the milestones would delay the date of repository availability by more than a few years beyond the 1998 deadline specified in the Act.

Since then, however, a number of developments have made it apparent that delays of more than a few years are to be the norm rather than the exception in the early years of this program. There has been a five-year slip in DOE's estimate of repository availability from 1998 to 2003, and DOE has been unable to meet such near-term repository program milestones as excavation of the exploratory shaft and the start of in-situ testing. There remains the possibility that potential repository availability at the Yucca Mountain site will be further delayed due to unforeseen problems during site characterization. These developments do not in themselves rule out the possibility that DOE will still be able to achieve repository operation by 2007-09, but they do suggest that to expect repository operation by then may be optimistic.

In the Commission's view, 2012-2014 is now a more relevant timeframe than 2007-2009. When the Court issued its 1979 remand, 2007-2009 was when the operating licenses for Vermont Yankee and Prairie Island were scheduled to expire. The operating licenses for the two Prairie Island units have since been extended to 2013 and 2014, and the operating license for Vermont Yankee is eligible for extension to 2012. These extensions have been made available under the Commission's policy that the allowable operating life of a licensed reactor should not be foreshortened because of construction delays. It therefore seems reasonable for NRC to make its finding on the timing of repository availability by 2012-2014 rather than by 2007-2009. The Commission has a greater degree of assurance that if the Yucca Mountain site is suitable, a repository would be available there by 2012-2014.

For the sake of conservatism, however, the suitability of Yucca Mountain should not be assumed. Yucca Mountain is now the only candidate site available; the NWPAA required that DOE terminate site characterization activities at all sites other than the Yucca Mountain site. In effect, the 2007-09 schedule for repository availability could be met only if Yucca Mountain survived the repository development process as a licensed site. If this site were found to be unlicenseable or otherwise unsuitable, characterization would have to begin at another site or suite of sites, with consequent further delay in repository availability. The final decision on the suitability of the site to proceed to licensing and repository development will rest with DOE, but the position of the NRC staff will figure in that decision. The staff will not be able to make a recommendation to a licensing board to authorize repository construction at Yucca Mountain until all site characterization activities have been completed. DOE might thus be unable for several more years to determine whether there will in fact have to be a delay to find and characterize another site.

Another reason the Commission is unwilling to assume the suitability of Yucca Mountain is that NRC must be mindful of preserving all its regulatory options -- including a recommendation of license application denial -- to assure adequate protection of public health and safety from radiological risk. In our view, it is essential to dispel the notion that for schedular reasons there is no alternative to the currently preferred site. This view is consistent with past Commission statements that the quality of DOE's preparations for a license application should take precedence over timeliness where the two conflict. It

is also consistent with the view that because we are making predictions about completion dates for a unique and complex enterprise at least some 20 years hence, it is more reasonable to express the timescale for completion in decades rather than years.

In order to obtain a conservative upper bound for the timing of repository availability, the Commission has made the assumption that the Yucca Mountain site will be found to be unsuitable. If DOE were authorized to initiate site screening for a repository at a different site in the year 2000, the Commission believes it reasonable to expect that a repository would be available by the year 2025. This estimate is based on the DOE position that site screening for a second repository should begin 25 years prior to the start of waste acceptance. The consideration of technical and institutional issues presented here has found none that would preclude the availability of a repository within this timeframe.

For the second part of its 1984 finding on repository availability, the Commission found reasonable assurance that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high level waste and spent fuel originating in that reactor and generated up to that time. The Commission believes that this finding should also be modified in light of developments since 1984.

When the Commission made this finding, it took into consideration both technical and institutional concerns. The technical concern centered on the ability of the spent fuel and the engineered at-reactor storage facilities to meet the requirements for extended post-operational storage prior to shipment for disposal. The institutional question concerned whether the utility currently responsible for post-operational at-reactor storage, or some substitute organization, would be able to assure the continued safety of this storage.

The principal new developments since 1984 that bear on these questions are: 1) that dry spent fuel storage technologies have become operational on a commercial scale; and 2) that several utilities are proceeding with plans to seek renewals of their operating licenses, with appropriate plant upgrading, for an additional period up to 30 years beyond the 40-year term of their current licenses. The accumulation of operating experience with dry cask storage, a technology requiring little active long-term maintenance, provides additional assurance that both the technical and institutional requirements for extended post-operational spent fuel storage will be met. License renewals, however, would have the effect of increasing requirements for both the quantity and possibly the duration of storage. If the Commission were to grant 30-year license renewals, the total operating life of some reactors could be 70 years, so that the spent fuel initially generated in such reactors would have to be stored for about 100 years if a repository were not available until 30 years after the expiration of their last operating licenses. This raises the question as to whether that spent fuel, and the hardware and civil engineering

structures for storing it, can continue to meet NRC requirements for an additional 30 years beyond the period the Commission supported in 1984.

For all the reasons cited in the discussion of Finding 4, the Commission believes there is ample technical basis for confidence that spent fuel can be stored safely and without significant environmental impact at these reactors for at least 100 years. If a repository were available within the first quarter of the twenty-first century, the oldest spent fuel could be shipped off the sites of all currently operating reactors well before the spent fuel initially generated in them reached the age of 100 years.

The need to consider the institutional aspects of storage beyond 30 years after OL expiration was not in evidence in 1984 because the Commission was confident that at least one repository would be available by 2007-2009. On that schedule, waste acceptance of spent fuel from the first reactor whose operating license had expired (Indian Point 1, terminated in 1980) could have begun within 30 years of expiration of that license. If a repository does not prove to be available until 2025, however, it would not be available within 30 years of the time that OLs could be considered effectively to have expired for Indian Point 1 and the three other plants with spent fuel onsite that were retired before the end of their licensed life for reactor operation. The same would be true of any additional reactors prematurely retired between now and 1995, when the 30-year clock starts for the availability of a repository by 2025. Premature shutdowns notwithstanding, the Commission has reasons to be assured that the spent fuel at all of these exceptional reactors will be stored safely and without significant environmental impact until sufficient repository capacity becomes available.

Considering first the technical reasons for this assurance, it is important to recognize that each of these reactors and its spent fuel storage installation was originally licensed in part on the strength of the applicant's showing that the systems and components of concern were designed and built to assure safe operation for 40 years under expected normal and transient severe conditions.

All of the currently retired reactors have a significant portion of that 40-year expected life remaining, and all have only small quantities of spent fuel onsite. The two reactors that are currently the subject of intensive legal efforts to shut them down, Shoreham and Seabrook, are most likely to be shut down in the first year or two of licensed operation, leaving almost 40 years of useful life for storage installations that were licensed to withstand considerably larger thermal and radiation loadings from much greater quantities of spent fuel. Of the four reactors currently retired with spent fuel onsite, the two with far the longest terms of operation, Lacrosse and Dresden, were operated for 19 and 18 years, respectively.

For the continued safe management of the spent fuel and storage installations at any existing or potential prematurely retired plant, the Commission believes it can reasonably rely on the continued structural and functional integrity of the plant's engineered storage installations for at least the balance of its

originally licensed life as if the operating license were still in effect. This is to say that for the purposes of Finding 2, no foreseeable technical constraints have arisen to disturb the Commission's assurance that spent fuel storage at any reactor will remain safe and environmentally acceptable for at least 30 years after its licensed life for operation, regardless of whether its operating license has been terminated at an earlier date.

The Commission also sees no insurmountable institutional obstacles to the continued safe management of spent fuel during the remainder of any shutdown reactor's initially licensed life for operation, or for at least 30 years thereafter. Because there will still be an NRC possession license for the spent fuel at any reactor that has indefinitely suspended operations, the Commission will retain ample regulatory authority to require any measures, such as removal of the spent fuel remaining in storage pools to passive dry storage casks, that might appear necessary after an operating license expires. Even if a licensed utility were to become insolvent, and responsibility for spent fuel management were transferred to DOE earlier than is currently planned, the Commission has no reason to believe that DOE would have insufficient Nuclear Waste Fund resources or otherwise be unable to carry out any safety-related measures NRC considers necessary. Thus, in the case of a premature reactor retirement, the Commission has an adequate basis on both technical and institutional grounds for reasonable assurance that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond not only the actual end of that reactor's operating license, but the end of its originally licensed life for operation.

In sum, considering developments since 1984 in the repository development program, in the operating performance of U.S. power reactors, and in spent fuel storage technology, the Commission finds that: (1) the overall public health, safety, and environmental impacts of the possible unavailability of a repository by 2007-2009 would be insignificant; and (2) neither 30-year renewals of reactor licenses nor a delay in repository availability to 2025 will result in significant safety or environmental impacts from extended post-operational spent fuel storage.

The Commission finds ample grounds for its proposed revised findings on the expected availability of a repository. The institutional support for the repository program is well-established. A mechanism for funding repository program activities is in place and there is a provision in the NWPA for adjusting if necessary the fee paid by utilities into this fund. Congress has continued to provide support for the repository program in setting milestones, delineating responsibilities, establishing advisory bodies, and providing a mechanism for dealing with the concerns of States and affected Indian Tribes.

Technical support for extended spent fuel storage has improved since 1984. Considering the growing availability, reasonable cost, and accumulated operating experience with new dry cask spent fuel storage technology since then, the Commission now has even greater assurance that spent fuel can be stored safely and without significant environmental impact for at least 30

years after the expected expiration of any reactor's operating license. Where a reactor's OL has been terminated before the expected expiration date, the Commission has an adequate basis to reaffirm what was implicit in its initial concept, namely: that regardless of the actual date when the reactor's operating authority effectively ended, spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond that reactor's licensed life for operation.

There is thus no foreseeable health and safety or environmental requirement that a repository be made available within the 2007-09 timeframe at issue in the Commission's original proceeding. Nor does the Commission see a radiological safety or environmental requirement for repository availability at the end of the expected revised timeframe of 2012-14 for the expiration of the Prairie Island and Vermont Yankee operating licenses.

Indeed, the Commission sees important NRC mission-related grounds for avoiding any statement that repository operation by 2007-2009 is required. Geologic disposal of high-level radioactive wastes is an unprecedented endeavor. It requires reliable projections of the waste isolation performance of natural and engineered barriers over millennia. After the repository is sealed, retrieval of the emplaced wastes will no longer be practicable, and the commitment of wastes to that site will, by design, be irreversible. In DOE's testing, both in the laboratory and at the candidate repository site, in its development of facility and waste package designs, and in all other work to demonstrate that NRC requirements will be met for a repository at Yucca Mountain, the Commission believes that the confidence of both the NRC and the public depends less on meeting the schedule for repository operation than on meeting safety requirements and doing the job right the first time. Thus, given the Commission's assurance that spent fuel can safely be stored for at least 100 years if necessary, it appears prudent for all concerned to prepare for the better-understood and more manageable problems of storage for a few more years in order to provide additional time to assure the success of permanent geologic disposal.

This is not to say that the Commission is unsympathetic to the need for timely progress toward an operational repository. It is precisely because NRC is so confident of the national commitment to achieve early repository operation that the Commission believes it no longer need add its weight to the considerable pressures already bearing on the DOE program. There is ample institutional impetus on the part of others, including the Congress, the nuclear power industry, State utility rate regulatory bodies, and consumers of nuclear-generated power, toward DOE achievement of scheduled program milestones. With continuing confidence in the technical feasibility of geologic disposal, the Commission has no reason to doubt the institutional commitment to achieve it in a timeframe well before it might become necessary for safety or environmental reasons. Indeed, the Commission believes it advisable not to attempt in this review a more precise NRC estimate of the point at which a repository will be needed for radiological safety or environmental reasons, lest this estimate itself undermine the commitment to

earlier achievement of repository operations. The Commission continues to hope that a repository will in fact be available by 2007-09, and has found nothing to date that would conclusively prevent this achievement.

To find reasonable assurance that a repository will be available by 2007-09, however, is a different and more consequential proposition in the context of this review. In light of the delays the program has encountered since its inception, and the regulatory need to avoid a premature commitment to the Yucca Mountain site, the Commission cannot prudently describe a basis for assurance that the current DOE schedule for repository operation in 2003 will not slip another four to six years under any reasonably foreseeable circumstances. The Commission could more easily substantiate a finding that a repository will be available within the revised 2012-14 timeframe that would be created by extending the operating licenses of the reactors in question when the Waste Confidence proceeding began. Even this revised estimate, however, could too easily be misinterpreted as an NRC estimate of the time at which continued spent fuel storage at these sites would be unsafe or environmentally significant. The Commission's enhanced confidence in the safety of extended spent fuel storage provides adequate grounds for the view that NRC need not at this time define more precisely the period when, for reasons related to NRC's mission, a permanent alternative to post-operational spent fuel storage will be needed. The Commission therefore proposes the following revision of its original Finding on when sufficient repository capacity will be available:

The Commission finds reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

Original Finding 3: The Commission finds reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level waste and spent fuel.

Proposed Finding 3: Same as above.

### 3.A. Issues Considered in Commission's 1984 Decision on Finding 3.

In the Commission's discussion of Finding 3 in its Waste Confidence Decision (49FR 34658, August 31, 1984), in Section 2.3 'Third Commission Finding,' the Commission stated,

Nuclear power plants whose operating licenses expire after the years 2007-09 will be subject to NRC regulation during the entire period between their initial operation and the availability of a waste repository. The Commission has reasonable assurance that the spent fuel generated by these licensed plants will be managed by the licensees in a safe manner. Compliance with the NRC regulations and any specific license conditions that may be imposed on the licensees will assure adequate protection of the public health and safety. Regulations primarily addressing spent fuel storage include 10 CFR Part 50 for storage at the reactor facility and 10 CFR Part 72 for storage in independent spent fuel storage installations (ISFSIs). Safety and environmental issues involving such storage are addressed in licensing reviews under both Parts 50 and 72, and continued storage operations are audited and inspected by NRC. NRC's experience in more than 80 individual evaluations of the safety of spent fuel storage shows that significant releases of radioactivity from spent fuel under licensed storage conditions are extremely remote.

Some nuclear power plant operating licenses expire before the years 2007-09. For technical, economic or other reasons, other plants may choose, or be forced to terminate operation prior to 2007-09 even though their operating licenses have not expired. For example, the existence of a safety problem for a particular plant could prevent further operation of the plant or could require plant modifications that make continued plant operation uneconomic. The licensee, upon expiration or termination of its license, may be granted (under 10 CFR Part 50 or Part 72) a license to retain custody of the spent fuel for a specified term (until repository capacity is available and the spent fuel can be transferred to DOE under Sec. 123 of the Nuclear Waste Policy Act of 1982) subject to NRC regulations and license conditions needed to assure adequate protection of the public. Alternatively, the owner of the spent fuel, as a last resort, may apply for an interim storage contract with DOE, under Sec. 135(b) of the Act, until not later than 3 years after a repository or monitored retrievable storage facility is available for spent fuel. For the reasons discussed above, the Commission is confident that in every case the spent fuel generated by those plants will be managed safely during the period

between license expiration or termination and the availability of a mined waste repository for disposal.

Even if a repository does not become available until 2025, nothing has occurred during the five years since its original Decision to diminish the Commission's confidence that high-level waste and spent fuel will be managed in a safe manner until a repository is available. The same logic stated above continues to apply through the first quarter of the twenty-first century.

NRC regulations remain adequate to assure safe storage of spent fuel and radioactive high-level waste at reactors, at independent spent fuel storage installations (ISFSIs), and in a monitored retrievable storage facility (MRS) until sufficient repository capacity is available. (Radioactive high-level waste from early reprocessing of a limited amount of commercial spent fuel is already in DOE possession at the West Valley NY facility where it is to be vitrified and canned. It is unlikely to be stored in an NRC-licensed MRS facility.)

10 CFR Part 72.42(a) provides for renewal of licensed storage at ISFSIs for additional 20-year periods for interim storage or for additional 40-year periods for monitored retrievable storage of spent fuel and solidified radioactive high-level waste (if an MRS facility is constructed, licensed, and operated). This would ensure that spent fuel and solidified high-level waste, if any were to be delivered to an MRS facility, would remain in safe storage under NRC regulation throughout its storage. The Commission has also considered, and recently voted to publish for public comment, a proposed amendment to Part 72 to issue a general license to reactor operating licensees to use approved spent fuel storage casks at reactor sites. No specific Part 72 license would be required. Operating license holders would register with NRC to use approved casks on their sites.

Spent fuel may continue to be stored in the reactor spent fuel pool under a Part 50 "possession only" license after the reactor has ceased operating. In addition, DOE's policy of disposing of the oldest fuel first, as set forth in its Annual Capacity Report, makes it unlikely that any significant fraction of total spent fuel generated will be stored for longer than the 30 years beyond the expiration of any operating reactor license. This expectation, established in the Commission's original proceeding, continues to be reasonable, even in the event that a repository is not available until some time during the first quarter of the twenty-first century. Even in the case of premature shutdowns where spent fuel is most likely to remain at a site for 30 years or longer beyond OL expiration (see Finding 2 above), the Commission has confidence that spent fuel will be safely managed until safe disposal is available.

Until the reactor site has been fully decommissioned and spent fuel has been transferred from the utility to DOE as required by NRC regulations, the licensee remains responsible to NRC. Furthermore, under 10 CFR 50.54bb, originally issued in final form by the Commission with its 1984 Waste Confidence Decision, a reactor licensee must provide to NRC, five years before

expiration of an operating license, notice of plans for spent fuel disposition. Accordingly, the Commission concludes that nothing has changed since the enactment of the Nuclear Waste Policy Act of 1982 and the Waste Confidence Decision in August 1984 to diminish the Commission's "...reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available...."

Pursuant to the NWPA, the Commission issued in final form 10 CFR Part 53, "Criteria and Procedures for Determining Adequacy of Available Spent Nuclear Fuel Storage Capacity," addressing the determination of need, if any, for DOE interim storage. Thus far, no applications have been received under Part 53. Application must be made by June 30, 1989 (Section 53.11(b)). It seems unlikely that any applications will be made to NRC for interim storage by DOE. Even if NRC were to make an exception for a late application, a determination must be made before January 1, 1990 to comply with the NWPA.

### 3.B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 3.

Although a DOE facility will not be available to enable the Department to begin accepting spent fuel in 1998, as provided in the contracts under the NWPA, the Commission's confidence in safe storage is unaffected by any potential contractual dispute between DOE and spent fuel generators and owners as to responsibility for spent fuel storage. In the event that DOE does not take title to spent fuel by this date, a licensee under either 10 CFR Part 50 or Part 72 cannot abandon spent fuel in its possession. Further, the Commission notes that only two reactors are currently scheduled for shutdown before 2003, DOE's anticipated repository startup date. (See Nuclear Regulatory Commission 1989 Information Digest, NUREG-1350, Vol. 1, p.33). To resolve any continuing uncertainties, however, it would be helpful if DOE and utilities and other spent fuel generators and owners could reach an early and amicable settlement to the question of how and when DOE will accept responsibility for spent fuel. This would facilitate cooperative action to provide for a smoothly operating system for the ultimate disposition of spent fuel.

The Commission recognizes that the NWPA limitation of 70,000 MTHM capacity for the first repository is inadequate for the total amount of spent fuel projected to be generated by all currently operating licensed reactors. The NWPAA effectively places a moratorium on a second repository program until 2007-2010. Either the first repository must be authorized and able to provide expanded capacity sufficient to accommodate the spent fuel generated, or there must be more than one repository. Since Congress specifically provided in the NWPAA for a first repository, and required DOE to return for legislative authorization for a second repository, the Commission believes that Congress will continue to provide institutional support for adequate repository capacity.

The Commission's confidence regarding the availability of repository capacity is not affected by the possibility that some existing reactor licenses might be renewed to permit continued generation of spent fuel at these sites. Because only two reactor licenses are scheduled to expire before 2003, the impact of license renewals (a matter not considered in the Commission's 1984 Decision) will have no significant effect within the first quarter of the twenty-first century on scheduling requirements for a second repository. Renewals may slightly alleviate the need for a second repository in the short term because spent fuel storage capacity will be expanded for extended storage at these reactor sites. Over the longer term, however, renewals might increase spent fuel generation through the latter half of the twenty-first century. Nonetheless, there is nothing in this situation that diminishes the Commission's assurance of the availability of safe storage.

In summary, the Commission finds no basis for changing the Third Finding in its Waste Confidence Decision. The Commission continues to find "reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level waste and spent fuel."

Original Finding 4: The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

Proposed Finding 4: The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years.

#### 4.A. Issues Considered in Commission's 1984 Decision on Finding 4.

In the Commission's discussion of Finding 4 in its Waste Confidence Decision (49 FR 34658, August 31, 1984) Section 2.4 "Fourth Commission Finding," the Commission said that:

Although the Commission has reasonable assurance that at least one mined geologic repository will be available by the years 2007-09, the Commission also realizes that for various reasons, including insufficient capacity to immediately dispose of all existing spent fuel, spent fuel may be stored in existing or new storage facilities for some periods beyond 2007-09. The Commission believes that this extended storage will not be necessary for any period longer than 30 years beyond the term of an operating license. For this reason, the Commission has addressed on a generic basis in this decision the safety and environmental impacts of extended spent fuel storage at reactor spent fuel basins or at either onsite or offsite spent fuel storage installations. The Commission finds that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of reactor operating licenses. To ensure that spent fuel which remains in storage will be managed properly until transferred to DOE for disposal, the Commission is proposing an amendment to its regulations (10 CFR Part 50). The amendment will require the licensee to notify the Commission, five years prior to expiration of its reactor operating license, how the spent fuel will be managed until disposal.

The Commission's finding is based on the record of this proceeding which indicates that significant releases of radioactivity from spent fuel under licensed storage conditions are highly unlikely. It is also supported by the Commission's experience in conducting more than 80 individual safety evaluations of storage facilities.

The safety of prolonged spent fuel storage can be considered in terms of four major issues: (a) The long-term integrity of spent fuel under water pool storage conditions, (b) structure and component safety for extended facility operation, (c) the safety of dry storage, and (d) potential risks of accidents and acts of sabotage at spent fuel storage facilities."

For reasons of administrative convenience, the Commission chose to consider the period of spent fuel storage as bounded in general by the expected advent of an operational geologic repository. This enabled the Commission to arrive at a provisional figure of 70 years or more for storage (i.e., a 40-year reactor operating license span plus 30 years or more).

In making the Fourth Finding, however, the Commission did not determine that for technical or regulatory reasons, storage would have to be limited to 70 years. This is apparent from the Commission's use of the words "... for at least 30 years beyond the expiration of that reactor's operating license ... [emphasis added]."

The 70-year-plus estimate is supported by oral testimony from the nuclear industry to the Commission in the Waste Confidence Proceeding. (See Transcript of Commission Meeting, "In the Matter of: Meeting on Waste Confidence Proceeding," January 11, 1982, Washington, DC, pp. 148-160). This testimony specifically addressed safety issues related to water pool storage of spent fuel and supported the position that spent fuel could be stored for an indefinite period, citing the industry's written submittal to the Commission in the proceeding. (See "The Capability for the Safe Interim Storage of Spent Fuel" (Document 4 of 4), Utility Nuclear Waste Management Group and Edison Electric Institute, July 1980). Some of this material alluded to in the oral testimony was subsequently referenced by the Commission in its discussion of water pool storage issues and its Fourth Finding of reasonable assurance that spent fuel and high level waste "will be managed in a safe manner." (See 49 FR 34658 at pp. 34681-2, August 31, 1984).

Similarly, in using the words "at least" in its proposed revised Finding Four, the Commission is not suggesting that 100 years represents any technical limitation for safe and environmentally benign storage. Degradation rates of spent fuel in storage are slow enough that it is hard to distinguish by degradation alone between spent fuel in storage for less than a decade and spent fuel stored for several decades. If a reactor with a 40-year initial license were to have that licensed renewed for another 30 years, the Commission believes that the spent fuel generated at that reactor can be safely stored for at least several decades past the end of the 70-year operating period. Adding to these 70 years the expected 30-year post-OL period during which the Commission believes under Finding 2 that sufficient repository capacity will be made available for any reactor's spent fuel, the total storage time would be about 100 years.

The Commission's proposed revised Finding here is meant to apply both to wet storage in reactor pools and dry storage in engineered facilities outside the

reactor containment building. Both dry and wet storage will be discussed in detail below.

Since the original Waste Confidence Decision, which found that material degradation processes in dry storage were well understood and that dry storage systems were simple, passive, and easily maintained, NRC and ISFSI operators have gained experience with dry storage which confirms the Commission's 1984 conclusions. NRC staff safety reviews of topical reports on storage system designs, the licensing and inspection of storage at two reactor sites, and NRC promulgation of the Part 72 amendment for MRS have significantly increased the agency's understanding of and confidence in dry storage.

Under NWSA Section 218(a), DOE has carried out spent fuel storage research and development as well as demonstration of dry cask storage at its Idaho National Engineering Laboratory. Demonstration has been carried out for metal casks under review or previously reviewed by NRC staff. DOE has also provided support to utilities in dry storage licensing actions (see Godlewski, N.Z., "Spent Fuel Storage -- An Update," Nuclear News, Vol. 30, No. 3, March 1987, pp.47-52).

Dry storage of spent fuel has become an available option for utilities, with at-reactor dry storage licensed and underway at two sites: the H. B. Robinson Steam Electric Plant, Unit 2, in South Carolina, and the Surry Nuclear Station in Virginia. NRC has received an application for dry storage at Duke Power Company's Oconee Power Station site as well. This application is still under review, but the environmental review is completed and an environmental assessment and finding of no significant impact have been issued (see 53 FR 44133, November 1, 1988). Based on utility statements of intent, and projections of need for additional storage capacity at reactor sites, the NRC staff expects numerous applications from utilities over the next decade (see Final Version Dry Cask Storage Study (DOE/RW-0220), February 1989).

Since the original Waste Confidence finding, the Commission has reexamined long-term spent fuel storage in issuing an amendment to 10 CFR Part 72 to address the storage of spent fuel and high-level radioactive waste in an MRS as envisioned by Congress in Section 141 of the NWSA. (See 53 FR 31651, August 19, 1988). Under this rule, storage in an MRS is to be licensed for a period of 40 years, with the possibility for renewal. The Commission determined not to prepare an environmental impact statement for the proposed amendments to 10 CFR Part 72, however. (See 53 FR 31651 at p. 31657, August 19, 1988). An environmental assessment and finding of no significant impact were issued because the Commission found that the consequences of long-term storage are not significant. The "Environmental Assessment for 10 CFR Part 72 "Licensing Requirements for the Independent Storage of Spent Fuel and High-Level Radioactive Waste" (NUREG-1092) assessed dry storage of spent fuel for a period of 70 years after receipt of spent fuel from a reactor:

The basis chosen for evaluating license requirements for the long-term storage of spent nuclear fuel and high-level radioactive waste in an MRS

is an installation having a 70-year design lifetime and a 70,000 MTU storage capability. This assessment focuses on the potential environmental consequences for a long-term storage period, a period for which the Commission needs to assure itself of the continued safe storage of spent fuel and high-level radioactive waste and the performance of materials of construction. This means the reliability of systems important to safety needs to be established to ensure that long-term storage of spent fuel and HLW does not adversely impact the environment.

For example, the staff needs to establish that systems, such as concrete shielding, have been evaluated to determine how their physical properties withstand the consequences of irradiation and heat flux for about a 70-year period. The Commission addressed structure and component safety for extended operation for storage of spent fuel in reactor water pools in the matter of waste confidence rulemaking proceeding. The Commission's preliminary conclusion is that experience with spent fuel storage provides an adequate basis for confidence in the continued safe storage of spent fuel for at least 30 years after expiration of a plant's license. The Commission is therefore confident of the safe storage of spent fuel for at least 70 years in water pools at facilities designed for a 40-year lifetime. The Commission also stated that its authority to require continued safe management of spent fuel generated by licensed plants protects the public and assures them the risks remain acceptable. In consideration of the safety of dry storage of spent fuel, the Commission's preliminary conclusions were that their confidence in the extended dry storage of spent fuel is based on a reasonable understanding of the material degradation processes, together with the recognition that dry storage systems are simpler and more readily maintained. In response to Nuclear Waste Policy Act of 1982 authorizations, the Commission noted; '...the Commission believes the information above [on dry spent fuel storage research and demonstration] is sufficient to reach a conclusion on the safety and environmental effects of extended dry storage. All areas of safety and environmental concern (e.g., maintenance of systems and components, prevention of material degradation, protection against accidents and sabotage) have been addressed and shown to present no more potential for adverse impact on the environmental and the public health and safety than storage of spent fuel in water pools.' At this time, the Commission is confident it can evaluate the long-term integrity of material for constructing an installation and provide the needed assurance for safe storage of spent fuel and HLW to establish the licensibility of an MRS over extended periods of time. The MRS fuel storage concepts discussed here for revision of 10 CFR Part 72 covers only dry storage concepts. [References omitted].

The Commission believes that its 1984 Fourth Finding should be changed to reflect the environmental assessment in the 10 CFR Part 72 MRS rulemaking and other evidence that spent fuel can be stored, safely and without significant environmental impact, for extended periods. While the Commission does not believe storage in excess of a century to be likely, with or without a

monitored retrievable storage facility, there is the potential for storage of spent fuel for times longer than 30 years beyond the expiration of an initial, extended, or renewed reactor operating license, if a reactor operating under such a license were prematurely shut down. The Commission does not, however, see any significant safety or environmental problems associated with storage for at least 30 years after the licensed life for operation of any reactor, even if this effectively means storage for at least 100 years in the case of a reactor with a 70-year licensed life for operation.

Under the environmental assessment for the MRS rule, the Commission has found confidence in the safety and environmental insignificance of dry storage of spent fuel for 70 years following a period of 70 years of storage in spent fuel storage pools. Thus, this environmental assessment supports the proposition that spent fuel may be stored safely and without significant environmental impact for a period of up to 140 years if storage in spent fuel pools occurs first and the period of dry storage does not exceed 70 years.

The Commission has also found that experience with water pool storage of spent fuel continues to confirm that pool storage is a benign environment for spent fuel that does not lead to significant degradation of spent fuel integrity. Since 1984, utilities have continued to provide safe additional reactor pool storage capacity through reracking, with over 110 such actions now completed. The safety of storage in pools is widely recognized among cognizant professionals. Specifically, the Commission notes one expert's view that:

During the last 40 years there has been very positive experience with the handling and storing of irradiated fuel in water; thus wet storage is now considered a proved technology. There is a substantial technical basis for allowing spent fuel to remain in wet storage for several decades. For the past two decades, irradiated Zircaloy-clad fuel has been handled and stored in water. There continues to be no evidence that Zircaloy-clad fuel degrades significantly during wet storage -- this includes: fuel with burnups as high as 41,000 MWd/MTU; continuous storage of low-burnup fuel for as long as 25 years; and irradiation of fuel in reactors for periods up to 22 years. Cladding defects have had little impact during wet storage, even if the fuel is uncanned. [References omitted. See Bailey, W.J. and Johnston, Jr. A.B., et al., "Surveillance of LWR Spent Fuel in Wet Storage," (NP-3765), Electric Power Research Institute, October 1984, pp. 2-10.]

This last conclusion has been reaffirmed by the same authors, who recently wrote: "There continues to be no evidence that LWR spent fuel with Zircaloy or stainless steel cladding degrades significantly during wet storage [EPRI 1986; IAEA 1982]." (See Results of Studies on the Behavior of Spent Fuel in Storage," Journal of the Institute of Nuclear Materials Management, Vol. XVI, No. 3, April 1988, p. 27.IV A).

In addition to the confidence that the spent fuel assemblies themselves will not degrade significantly in wet storage, there is confidence that the water pools in which the assemblies are stored will remain safe for extended periods:

As noted in the recent IAEA world survey, the 40 years of positive experience with wet storage illustrates that it is a fully-developed technology with no associated major technological problems. Spent fuel storage pools are operated without substantial risk to the public or the plant personnel. There is substantial technical basis for allowing spent fuel to remain in wet storage for several decades. Minor, but repairable, problems have occurred with spent fuel storage pool components such as liners, racks, and piping. [See Bailey, W.J., and Johnson, Jr., A.B., et al., "Surveillance of LWR Spent Fuel in Wet Storage," (EPRI NP-3765), prepared by Battelle Pacific Northwest Laboratories, Final Report, October 1984, p. 6-1.]

The studies cited above support the view that rates of uniform corrosion of spent fuel cladding in storage pools are low over time. Localized corrosion on cladding surfaces has also been gradual and can be expected to remain so. Cladding that has undergone damage while in the reactor core has not resulted in significant releases of radioactivity when stored in pools. Furthermore, the operational experience accumulated since the 1984 Waste Confidence Decision and NRC experience in licensing and inspection reinforce the conclusions in that Decision that wet storage involves a relatively benign environment. There are no driving mechanisms, such as temperature and pressure, to degrade storage structures or components or the fuel itself, or to spread contamination. Degradation mechanisms are gradual and well understood; they allow ample time for remedial action, including repair or replacement of any failing systems. This extensive experience adequately supports predictions of long-term integrity of storage basins.

The Commission also notes the endorsement of this basic confidence by cognizant professional organizations:

The American Nuclear Society issued a policy statement [ANS 1986] in 1986 regarding storage of spent nuclear fuel. The statement indicates that continued wet storage of spent fuel at nuclear power plant sites until the federal government accepts it under existing contracts with the utilities is safe, economical and environmentally acceptable. [See Gilbert, E.R., Bailey, W.J., and Johnson, A.B., "Results of Studies on the Behavior of Spent Fuel in Storage," Journal of the Institute of Nuclear Materials Management Vol. XVI, No. 3, April 1988, p. 27.IV A).]

Thus, supported by the consistency of NRC experience with that of others, the Commission has concluded that spent fuel can be stored safely and without significant environmental impact, in either wet storage or in wet storage followed by dry storage, for at least 100 years. The Commission considers it unlikely, however, that any fuel will actually remain in wet storage for 100 years or even for 70 years. We anticipate that, consistent with the currently

developing trend, utilities will move fuel rods out of spent fuel pools and into dry storage to make room in pools for freshly discharged spent fuel.

While the Commission has concluded that reactor spent fuel pools can safely be used to store spent fuel for 100 years, there is no technically compelling reason to use them that long. If reactor licenses are renewed for as long as 30 years, making a total of 70 years of operation, it will be necessary to store the spent fuel discharged at the end of the reactor's operation in a spent fuel pool for several years to allow for radioactive decay and thermal cooling. After this period, the fuel could be placed in dry storage and the spent fuel pool decommissioned. Thus, for most reactors, the most likely maximum period of storage will be well within the extended 30-year post-operational period under the Commission's proposed revision to Finding 4. Moreover, considering that under certain conditions spent fuel can be stored safely and without significant environmental impacts for up to 140 years, the Commission believes there is ample basis for a finding of confidence in storage for at least 100 years.

In its 1984 Waste Confidence Decision the Commission also concluded that "there are no significant additional non-radiological impacts which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses for reactors" (see 49 FR 34658 at p. 34686, August 31, 1984). The Commission did not find anything to contradict this conclusion in its 1988 rulemaking amending 10 CFR Part 72 for long-term spent fuel and high-level waste storage at an MRS:

In August 1984, the NRC published an environmental assessment for this proposed revision of Part 72 NUREG-1092, 'Environmental Assessment for 10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Fuel and High-Level Radioactive Waste.' NUREG-1092 discusses the major issues of the rule and the potential impact on the environment. The findings of the environmental assessment are '(1) past experience with water pool storage of spent fuel establishes the technology for long-term storage of spent fuel without affecting the health and safety of the public, (2) the proposed rulemaking to include the criteria of 10 CFR Part 72 for storing spent nuclear fuel and high-level radioactive waste does not significantly affect the environment, (3) solid high-level waste is comparable to spent fuel in its heat generation and in its radioactive material content on a per metric ton basis, and (4) knowledge of material degradation mechanisms under dry storage conditions and the ability to institute repairs in a reasonable manner without endangering the health [and safety] of the public shows dry storage technology options do not significantly impact the environment.' The assessment concludes that, among other things, there are no significant environmental impacts as a result of promulgation of these revisions of 10 CFR Part 72.

Based on the above assessment, the Commission concludes that the rulemaking action will not have a significant incremental environmental

impact on the quality of the human environment. [53 FR 31651 at pp. 31657-31658, August 19, 1988].

Thus, the 1988 amendments to 10 CFR Part 72 provide the basis for the Commission to conclude that the environmental consequences of long-term spent fuel storage, including non-radiological impacts, are not significant.

Finally, no considerations have arisen to affect the Commission's confidence since 1984 that the possibility of a major accident or sabotage with offsite radiological impacts at a spent-fuel storage facility is extremely remote. The NRC has recently reexamined reactor pool storage safety in two studies, "Seismic Failure and Cask Drop Analyses of the Spent Fuel Pools at Two Representative Nuclear Power Plants" (NUREG/CR-5176) and "Beyond Design Basis Accidents in Spent Fuel Pools" (NUREG-1353). These studies reaffirmed that there are no safety considerations that justify changes in regulatory requirements with respect to pool storage. Both wet and dry storage activities have continued to be licensed by the Commission. In its recent rulemaking amending 10 CFR Part 72 for monitored retrievable storage, the Commission did choose to eliminate an exemption regarding tornado missile impact "to assure designs continue to address maintaining confinement of particulate material." (53 FR 31651 at p. 31655, August 19, 1988). However, NRC staff had previously considered tornado missile impacts in safety reviews of design topical reports and in licensing reviews under 10 CFR Part 72.

#### 4.B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 4.

In its original Finding 4, the Commission found reasonable assurance of safe storage without significant environmental impacts for at least 30 years beyond reactor operating license expiration. Delays and uncertainties in the schedule for repository availability since the 1984 Decision have convinced the Commission to allow some margin beyond the scheduled date for repository opening currently cited by DOE. As noted above in Finding 2, the Commission has reasonable assurance that at least one repository will be available within the first quarter of the twenty-first century. For all currently operating reactors, this would still be within the period of 30 years from expiration of operating licenses, which the Commission previously found to be the minimum period for which spent fuel storage could be considered safe and without significant environmental impact.

Under the NWPA as amended, DOE is authorized to dispose of up to 70,000 MTHM in the first repository before granting a construction authorization for a second repository. Under existing licenses, projected spent fuel generation could exceed 70,000 MTHM as early as the year 2010. Possible extensions or renewals of operating licenses also need to be considered in assessing the need for and scheduling the second repository. It now appears that unless Congress lifts the capacity limit on the first repository -- and unless this repository has the physical capacity to dispose of all spent fuel generated under both the original and extended or renewed licenses -- it will be necessary to have at

least one additional repository. Assuming here that the first repository is available by 2025 and has a capacity on the order of 70,000 MTHM, additional disposal capacity would probably not be needed prior to about the year 2040 in order to avoid storing spent fuel at a reactor for more than 30 years following expiration of reactor operating licenses.

Although action on a second repository before the year 2007 would require Congressional approval, the Commission believes that Congress will take the necessary action if it becomes clear that the first repository site will not have the capacity likely to be needed. If DOE were able to address the need for a second repository earlier, for example by initiating a survey for a second repository site by the year 2000, DOE might be able to reduce the potential requirement for extended spent fuel storage in the twenty-first century. The Commission does not, however, find such action necessary to conclude that spent fuel can be stored safely and without significant environmental impact for extended periods.

The potential for generation and onsite storage of a greater amount of spent fuel as a result of the renewal of existing operating licenses does not affect the Commission's findings on environmental impacts. In Finding 4 the Commission did not base its determination on a specific number of reactors and amount of spent fuel generated. Rather, the Commission took note of the safety of spent fuel storage and lack of environmental impacts overall, noting that individual actions involving such storage would be reviewed. In the event there were applications for renewal of existing reactor operating licenses, each of these actions would be subject to safety and environmental reviews with subsequent issuance of an environmental assessment or environmental impact statement, which would cover storage of spent fuel at each reactor site during the period of the renewed license.

The Commission also notes that the amount of spent fuel expected to be discharged by reactors has continued to decline significantly, a trend already noted in the Commission's discussion of its Finding 5 (49 FR 34658 at p. 34687, August 31, 1984). At the time of the Commission's decision, "the cumulative amount of spent fuel to be disposed of in the year 2000 [was] expected to be 58,000 metric tons of uranium" (see Spent Fuel Storage Requirements (Update of DOE/RL-82-17) DOE/RL-83-1, published January, 1983). Today that figure has declined to 40,384 metric tons (see Spent Fuel Storage Requirements (DOE/RL-88-34), published October 1988, p. A. 17). Thus, the amount of spent fuel considered likely to be discharged by the year 2000 in the Commission's 1984 decision will not be attained until well into the first decade of the twenty-first century, if then.

The Commission believes that its 1984 Finding 4 should be revised to acknowledge the possibility and assess the safety and environmental impacts of extended storage for periods longer than 70 years. The principal reasons for this proposed revision are that: (1) the long-term material and system degradation effects are well understood and known to be minor; (2) the ability

to maintain the system is assured; and (3) the Commission maintains regulatory authority over any spent fuel storage installation.

On the basis of experience with wet and dry spent fuel storage and related rulemaking and licensing actions, the Commission concludes that spent fuel can be safely stored without significant environmental impact for at least 100 years if necessary. Therefore, the Commission proposes to revise its original Fourth Finding thus: "The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years."

Original Finding 5: The Commission finds reasonable assurance that safe independent onsite spent fuel storage or offsite spent fuel storage will be made available if such storage capacity is needed.

Proposed Finding 5: Same as above.

#### 5.A. Issues Considered in Commission's 1984 Decision on Finding 5.

In the Commission's discussion of Finding 5 in its Waste Confidence Decision (49 FRN 34658, August 31, 1984) in Section 2.5 "Fifth Commission Finding," the Commission said that:

The technology for independent spent fuel storage installations, as discussed under the fourth Commission Finding, is available and demonstrated. The regulations and licensing procedures are in place. Such installations can be constructed and licensed within a five-year time interval. Before passage of the Nuclear Waste Policy Act of 1982 the Commission was concerned about who, if anyone, would take responsibility for providing such installations on a timely basis. While the industry was hoping for a government commitment, the Administration had discontinued efforts to provide those storage facilities. ... The Nuclear Waste Policy Act of 1982 establishes a national policy for providing storage facilities and thus helps to resolve this issue and assure that storage capacity will be available.

Prior to March 1981, the DOE was pursuing a program to provide temporary storage in off-site, or away-from-reactor (AFR), storage installations. The intent of the program was to provide flexibility in the national waste disposal program and an alternative for those utilities unable to expand their own storage capacities.

Consequently, the participants in this proceeding assumed that, prior to the availability of a repository, the Federal government would provide for storage of spent fuel in excess of that which could be stored at reactor sites. Thus, it is not surprising that the record of this proceeding prior to the DOE policy change did not indicate any direct commitment by the utilities to provide AFR storage. On March 27, 1981, DOE placed in the record a letter to the Commission stating its decision 'to discontinue its efforts to provide Federal government-owned or controlled away-from-reactor storage facilities.' The primary reasons for the change in policy were cited as new and lower projections of storage requirements and lack of Congressional authority to fully implement the original policy.

The record of this proceeding indicates a general commitment on the part of industry to do whatever is necessary to avoid shutting down reactors or derating them because of filled spent fuel storage pools. While industry's incentive for keeping a reactor in operation no longer applies after expiration of its operating license, utilities possessing spent fuel are required to be licensed and to maintain the fuel in safe storage until

removed from the site. Industry's response to the change in DOE's policy on federally-sponsored away-from-reactor (AFR) storage was basically a commitment to do what is required of it, with a plea for a clear unequivocal Federal policy. ... The Nuclear Waste Policy Act of 1982 has now provided that policy.

The Nuclear Waste Policy Act defines public and private responsibilities for spent fuel storage and provides for a limited amount of federally-supported interim storage capacity. The Act also includes provisions for monitored retrievable storage facilities and for a research development and demonstration program for dry storage. The Commission believes that these provisions provide added assurance that safe independent onsite or offsite spent fuel storage will be available if needed. [References omitted].

The policy set forth in the NWPA regarding interim storage remains in place. Therefore, the Commission's confidence remains unchanged. The only policy change affecting storage involves long-term storage in a monitored retrievable storage (MRS) facility. The Nuclear Waste Policy Amendments Act of 1987 (NWPAA) sets schedule restrictions on an MRS by tying it to the repository siting and licensing schedule. These restrictions effectively delay implementation of an MRS. Consequently, its usefulness in providing storage capacity relief to utilities is likely to be lost.

While the Commission's confidence in its 1984 Decision did not depend on the availability of an MRS facility, the possibility of such a facility, as provided for in the NWPA, was one way in which needed storage could be made available. The NWPAA makes an MRS facility less likely by linking it to repository development. The potential impact of the decreased likelihood of an MRS on the Commission's confidence is, however, more than compensated for by operational and planned spent fuel pool expansions and dry storage investments by utilities themselves -- developments that had not been made operational at the time of the original Waste Confidence Decision. Consequently, the statutory restrictions that may make an MRS ineffective for timely storage capacity relief are of no consequence for the Commission's finding of confidence that adequate storage capacity will be made available if needed.

Although the NWPAA limits the usefulness of an MRS by linking its availability to repository development, the Act does provide authorization for an MRS facility. The Commission has remained neutral since its 1984 Waste Confidence Decision with respect to the need for authorization of an MRS facility. The Commission does not consider it necessary for public health and safety. If any offsite storage capacity is required under NRC regulations, utilities may make application for a license to store spent fuel at a new site. Consequently, while the NWPAA provision does affect MRS development and therefore can be said to be limiting, the Commission believes this should not affect its confidence in the availability of safe storage capacity.

### 5.B. Relevant Issues That Have Arisen Since the Commission's Original Decision on Finding 5.

DOE will not be able to begin operation of a repository before 2003 under current plans, and operation might begin somewhat later. Given progress to date on an MRS, the link between MRS facility construction and repository construction authorization established by the NWPAA, and the absence of other concrete DOE plans to store the spent fuel, it seems unlikely that DOE will meet the 1998 deadline for taking title to spent fuel. (Under Section 302(a)(5)(B) of the NWPA, "the Secretary, beginning not later than January 31, 1998, will dispose of the high-level radioactive waste or spent nuclear fuel [subject to disposal contracts].") This potential problem does not, however, affect the Commission's confidence that storage capacity will be made available as needed.

The possibility of a dispute between DOE and utilities over the responsibility for providing spent fuel storage will not affect the public health and safety or the environment. Uncertainty as to contractual responsibilities raises questions concerning: (1) who will be responsible; (2) at what point in time responsibility for the spent fuel will be transferred; (3) how the fuel will be managed; (4) how the transfer of management responsibility from the utilities to DOE will take place; and (5) how the cost of DOE storage might differ, if at all, from utility storage. Utilities possessing spent fuel in storage under NRC licenses cannot abrogate their safety responsibilities, however. Until DOE can safely accept spent fuel, utilities or some other licensed entity will remain responsible for it. If DOE and the utilities can amicably resolve their respective responsibilities for spent fuel storage in the interest of efficient and effective administration of the overall waste management system, including the Nuclear Waste Fund, NRC would gain added confidence in the institutional arrangements for spent fuel management (See also Finding 3 on this issue).

Estimates of the amount of spent fuel generated have continued to decline. At the time of the Commission's Decision, the Commission cited in Finding 5 the cumulative figure of 58,000 metric tons uranium of spent fuel generated in the year 2000 (See 49 FR 34658 at p. 34697, 8/31/84.) More recently, DOE estimated 40,384 metric tons (See Spent Fuel Storage Requirements [DOE/RL-88-34], October 1988, p. A. 17). While estimates may show an increase at some date well into the twenty-first century if licenses of some reactors are renewed or extended, this possibility does not affect the Commission's confidence in the availability of safe storage capacity until a repository is operational. The industry has made a general commitment to provide storage capacity, which could include away-from-reactor (AFR) storage capacity. To date, however, utilities in their storage applications have sought to meet storage capacity needs at their respective reactor sites. Thus, a new industry application for AFR storage remains only a potential option, which currently seems unnecessary and unlikely.

Utilities have continued to add storage capacity by reracking spent fuel pools, and NRC expects continued reracking where it is physically possible and

represents the least costly alternative. Advances in dry storage technologies and utility plans both have a positive effect on NRC's confidence. At the time the Commission reached its original findings, dry storage of light water reactor (LWR) spent fuel was, as yet, unlicensed under 10 CFR Part 72, and DOE's dry storage demonstrations in support of dry cask storage were in progress at the Idaho National Engineering Laboratory (INEL).

Today DOE's demonstration efforts have been successful (See Godlewski, N. Z., "Spent Fuel Storage-An Update," Nuclear News, Vol. 30, No. 3, March 1987, pp. 47-52 at p. 47.) Dry storage has been licensed at two reactor sites, and a third application is under review. Dry cask storage is licensed at Virginia Electric Power Company's Surry Power Station site (See License, SNM 2501 under Docket No. 72-2), and dry concrete module and stainless steel canister storage is licensed at Carolina Power and Light Company's (CP&L's) H. B. Robinson, Unit 2, site (See License SNM 2502, under Docket No. 72-3.) An application is under review for a similar modular system at Duke Power Company's Oconee Nuclear Station site (See Letter to Director, Division of Fuel Cycle and Material Safety, NRC, from Hal B. Tucker, Duke Power Company, dated March 31, 1988, under Docket No. 72-4). A new application has been received in 1989 for CP&L's Brunswick site, and another is expected in 1989 for the Baltimore Gas and Electric Company's Calvert Cliffs site. Applications are also expected for CP&L's Robinson 2 site (at another onsite location to allow for greater storage capacity), Wisconsin Electric Power Company's Point Beach site, and Consumer Power's Palisades site. The Tennessee Valley Authority has indicated that it will apply for its Sequoyah plant site.

Thus, the successful demonstration by DOE of dry cask technology for various cask types at INEL, utilities' actions to forestall spent fuel storage capacity shortfalls, and the continuing sufficiency of the licensing record for the Commission to authorize increases in at-reactor storage capacity all strengthen the Commission's confidence in the availability of safe and environmentally sound spent fuel storage capacity.

Renewal of reactor operating licenses will involve consideration of how additional spent fuel generated during the extended term of the license will be stored onsite or offsite. There will be sufficient time for construction and licensing of any additional storage capacity needed.

In summary, the Commission finds no basis to change the Fifth Finding in its Waste Confidence Decision. Changes by the NWPAA, which lessen the likelihood of an MRS facility, and the potential for some slippage in repository availability to the first quarter of the twenty-first century (see our discussion of Finding 2) are more than offset by the continued success of utilities in providing safe at-reactor-site storage capacity in reactor pools and their progress in providing independent onsite storage. Therefore, the Commission continues to find "reasonable assurance that safe independent onsite spent fuel storage or offsite spent fuel storage will be made available if such storage is needed."

ENCLOSURE 2

**NUCLEAR REGULATORY COMMISSION**

**10 CFR Part 51**

**Consideration of Environmental Impacts of Temporary Storage  
of Spent Fuel After Cessation of Reactor Operation**

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Proposed Rule.

**SUMMARY:** The Nuclear Regulatory Commission is proposing a revision to its generic determinations on the timing of availability of a geologic repository for commercial high-level radioactive waste and spent fuel and the environmental impacts of storage of spent fuel at reactor sites after the expiration of reactor operating licenses. These proposed revisions reflect proposed findings of the Commission reached in a five-year update and supplement to its 1984 "Waste Confidence" rulemaking proceeding, which are published elsewhere in this issue of the Federal Register. The Commission now finds that spent fuel generated in any reactor can be stored safely and without significant environmental impacts in reactor facility storage pools or independent spent fuel storage installations located at reactor or away-from-reactor sites for at least 100 years. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first

century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactors and generated up to that time.

DATE: Comment period expires \_\_\_\_\_, 1989. Comments received after this date will be considered if it is practical to do so, but assurance of consideration cannot be given except to comments received on or before this date.

ADDRESSES: Mail written comments to: Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch. Deliver comments to One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852, between 7:30 am and 4:15 p.m. weekdays.

FOR FURTHER INFORMATION CONTACT: Karen Cyr, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone: (301) 492-1637.

**SUPPLEMENTARY INFORMATION:**

Background

In 1984 the Commission concluded a generic rulemaking proceeding to reassess its degree of confidence that radioactive wastes produced by nuclear

facilities will be safely disposed of, to determine when any such disposal would be available, and whether such wastes can be safely stored until they are safely disposed of. This proceeding was known as the "Waste Confidence" proceeding. The Commission found that there was reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by 2007-2009. However, some reactor operating licenses might expire without being renewed or some reactors might be permanently shut down prior to this period. Since independent spent fuel storage installations had not yet been extensively developed, there was a probability that some onsite spent fuel storage after license expiration might be necessary or appropriate. In addition, the possibility existed that spent fuel might be stored in existing or new storage facilities for some period beyond 2007-2009. The Commission also found that the licensed storage of spent fuel for at least 30 years beyond the reactor operating license expiration either at or away from the reactor site was feasible, safe, and would not result in a significant impact on the environment.

Consequently, the Commission adopted a rule, codified in 10 CFR § 51.23, providing that the environmental impacts of at-reactor storage after the termination of reactor operating licenses need not be considered in Commission proceedings related to issuance or amendment of a reactor operating license. The same safety and environmental considerations applied to fuel storage installations licensed under Part 72 as for storage in reactor basins. Accordingly, the rule also provided that the environmental impacts of spent fuel storage at independent spent fuel storage installations for the period

following expiration of the installation storage license or amendment need not be considered in proceedings related to issuance or amendment of a storage installation license.

#### Amendment to Part 51

At the time of issuance of its Waste Confidence decision and the adoption of 10 CFR § 51.23, the Commission also announced that while it believed that it could, with reasonable assurance, reach favorable conclusions of confidence, it also recognized that significant unexpected events might affect its decision. Consequently, the Commission stated that it would "review its conclusions on waste confidence should significant and pertinent unexpected events occur, or at least every 5 years until a repository for high-level radioactive waste and spent fuel is available." The Commission has now undertaken a five-year review of its earlier findings. A description of this review and a proposed supplement and update to the earlier findings is announced elsewhere in this issue. As a result of this review, the Commission is proposing to modify two of its earlier findings. As originally promulgated in 1984, the Commission found reasonable assurance that:

One or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-2009, and sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of

existing commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time; and

If necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

Under the proposed revisions published today, the Commission intends to modify these findings to the following:

The Commission finds reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time; and

The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend

that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years.

The proposed revision on the timing of repository availability is premised on the following factors: the potential for delays in DOE's program; the mandate of the Nuclear Waste Policy Act Amendments of 1987 to characterize only the Yucca Mountain site which means that if that site is found unsuitable, characterization will have to begin at another site or suite of sites with consequent delay in repository availability; the regulatory need to avoid premature commitment to the Yucca Mountain site; and the usefulness of making predictions about completion of a project as complex and unique as the repository in terms of years rather than decades. But even with this change the Commission has concluded that it has reasonable assurance that on such a schedule for repository availability, sufficient repository capacity will be available within 30 years beyond the licensed life for operation of reactors. Adequate regulatory authority is available to require any measures necessary to assure safe storage of the spent fuel until a repository is available. In addition, the Commission has concluded that even if storage of spent fuel were necessary for at least 30 years beyond the licensed life of reactors, which in the case of a reactor whose operating license is renewed for 30 years would mean for a period of at least 100 years, such storage is feasible, safe and would not result in a significant impact on the environment.

The Commission's conclusions with respect to safety and environmental impacts of extended storage for at least 100 years are supported by NRC's Environmental Assessment for the 10 CFR Part 72 rulemaking "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (53 FR 31651, August 19, 1988) (EA). Ongoing licensing and operational experience as well as studies of extended pool storage continue to demonstrate that such storage is a benign environment for spent fuel which does not lead to significant degradation of spent fuel integrity. Significant advances in the processes of dry storage of spent fuel continue to demonstrate that dry storage systems are simple, passive and easily maintained. NRC staff safety reviews of topical reports on dry storage system designs and dry storage installations at two reactor sites, as well as the EA for Part 72, support the finding that storage of spent fuel in such installations for a period of 70 years does not significantly impact the environment. No significant additional non-radiological consequences which could adversely affect the environment for extended storage at reactors and independent spent fuel storage installations have been identified. In sum, the long-term material and system degradation effects are well understood and known to be minor, the ability to maintain a spent fuel storage system is assured, and the Commission maintains regulatory authority over any spent fuel storage installation.

The proposed amendment to Part 51 consists of a revision to paragraph (a) of 10 CFR § 51.23 to restate the revised generic Commission determination based on the supplemental Waste Confidence proceeding.

## ENVIRONMENTAL IMPACT

This proposed rule amends 10 CFR Part 51 of the Commission's regulations to modify the generic determination currently codified in Part 51 which was made by the Commission in the Waste Confidence rulemaking proceeding. That generic determination was that for at least 30 years beyond the expiration of a reactor's operating license no significant environmental impacts will result from the storage of spent fuel in reactor facility storage pool or independent spent fuel storage installations located at reactor or away-from-reactor sites. The proposed modification provides that, if necessary, spent fuel generated in a reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of any reactor. If a reactor's operating license were renewed, this would be a duration of at least 100 years. The environmental analysis on which the revised generic determination is based can be found in the proposed revision and supplement to the Waste Confidence findings published elsewhere in this issue. This proposed rulemaking action formally incorporating the revised generic determination in the Commission's regulations has no separate independent environmental impact. The proposed supplemental assessment and revisions to the Waste Confidence findings are available for inspection at the NRC Public Document Room, 2120 L Street, Lower Level NW., Washington D.C.

## PAPERWORK REDUCTION ACT STATEMENT

This proposed rule does not contain a new or amended information collection requirement subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.).

#### REGULATORY FLEXIBILITY CERTIFICATION

As required by the Regulatory Flexibility Act of 1980, 5 U.S.C. 605 (b), the Commission certifies that this rule, if adopted, will not have a significant economic impact on a substantial number of small entities. The proposed rule would describe a revised basis for continuing in effect the current provisions of 10 CFR § 51.23(b) which provides that no discussion of any environmental impact of spent fuel storage in reactor facility storage pools or independent spent fuel storage installations (ISFSI) for the period following the term of the reactor operating license or amendment or initial ISFSI license or amendment for which application is made is required in any environmental report, environmental impact statement, environmental assessment or other analysis prepared in connection with certain actions. This rule affects only the licensing and operation of nuclear power plants. Entities seeking or holding Commission licenses for such facilities do not fall within the scope of the definition of small businesses found in section 34 of the Small Business Act, 15 U.S.C. 632, in the Small Business Size Standards set out in regulations issued by the Small Business Administration at 13 CFR Part 121, or in the NRC's size standards published December 9, 1985 (50 FR 50241).

#### BACKFIT ANALYSIS

This proposed rule does not modify or add to systems, structures, components or design of a facility; the design approval or manufacturing license for a facility; or the procedures or organization required to design, construct or operate a facility. Accordingly, no backfit analysis pursuant to 10 CFR § 50.109(c) is required for this proposed rule.

LIST OF SUBJECTS IN 10 CFR PART 51

Administrative practice and procedure, Environmental impact statement, Nuclear materials, nuclear power plants and reactors, Reporting and recordkeeping requirements.

For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and 5 U.S.C. 553, the NRC is proposing to adopt the following amendment to 10 CFR Part 51.

PART 51--ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS

1. The authority citation for Part 51 continues to read as follows:

AUTHORITY: Sec. 161, 68 Stat. 948, as amended (42 U.S.C. 2201); secs. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

Subpart A also issued under National Environmental Policy Act of 1969, secs. 102, 104, 105, 83 Stat. 853-854, as amended (42 U.S.C. 4332, 4334, 4335); and Pub. L. 95-604, Title II, 92 Stat. 3033-3041. Sections 51.20, 51.30, 51.60, 51.61, 51.80, and 51.97 also issued under secs. 135, 141, Pub. L. 97-425, 96 Stat. 2232, 2241, and sec. 148, Pub. L. 100-203, 101 Stat. 1330-235 (42 U.S.C. 10155, 10161, 10168). Section 51.22 also issued under sec. 274, 73 Stat. 688, as amended by 92 Stat. 3036-3038 (42 U.S.C. 2021).

2. § 51.23, paragraph (a) is revised to read as follows:

§ 51.23 Temporary storage of spent fuel after cessation of reactor operation--generic determination of no significant environmental impact.

(a) The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. If a reactor's operating license were renewed for 30 years, this would extend that reactor's licensed life by 30 years, and extend the expected duration of safe and environmentally acceptable storage to at least 100 years. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to

dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time.

Dated at Rockville, Maryland, this        day of        1989.

For the Nuclear Regulatory Commission.

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Samuel J. Chilk  
Secretary of the Commission.