NRC Waste Confidence Positions

- 1984 (Original)
- 1990
- 1999
- 2008 (proposed revision)

NRC Waste Confidence Position: 1984 (Original)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

COMMISSIONERS:

Nunzio J. Palladino, Chairman
Thomas M. Roberts
James K. Asselstine
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Lando W. Zech, Jr.

In the Matter of **Docket Nos. PR-50**
PR-51
(44 Fed. Reg. 61,372)

RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE
(Waste Confidence Rulemaking) **August 22, 1984**

The Commission sets out its findings in this waste confidence rulemaking proceeding called for by the Court of Appeals for the District of Columbia Circuit in *Minnesota v. NRC,* 602 F.2d 412 (1979). In general, the Commission finds that it can, with reasonable assurance, reach favorable conclusions with respect to the safe storage and disposal of high-level radioactive waste and spent fuel. Specifically the Commission finds 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 2007-09, 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 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; and (5) safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

DECISION

1.0 INTRODUCTION

1.1 Initiation of the Waste Confidence Rulemaking Proceeding

In response to the remand of the U.S. Court of Appeals for the District of Columbia Circuit (*Minnesota v. NRC,* 602 F.2d 412 (1979)), and as a continuation of previous proceedings conducted in this area by NRC (44 Fed. Reg. 61,372), the Commission initiated a generic rulemaking proceeding on October 25, 1979. In its Notice of Proposed Rulemaking, the Commission stated that the

> purpose of this proceeding is solely to assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or offsite storage will be available, and to determine whether radioactive wastes can be safely stored on site past the expiration of existing facility licenses until offsite disposal or storage is available.

The Commission also stated that in the event it determined that onsite storage of spent fuel would be necessary or appropriate after the expiration of facility licenses, it would propose a rule addressing the environmental and safety implications of such storage. The Commission recognized that the scope of this generic proceeding would be broader than the Court's instruction, which required the Commission to address the questions of whether offsite storage for spent fuel would be available by the expiration of reactor operating licenses and if not, whether spent fuel could continue to be safely stored on site (44 Fed. Reg. 61,373).

However, the Commission believed that the primary public concern was whether nuclear waste could be disposed of safely rather than with an offsite solution to the storage problem *per se.* Moreover, as stated in the *Federal Register* Notice on October 25, 1979, the Commission committed itself to reassess its basis for reasonable assurance that methods

of safe permanent disposal of high-level waste would be available when they are needed. In conducting that reassessment, the Commission noted that it would "draw upon the record compiled in the Commission's recently concluded rulemaking on the environmental impacts of the nuclear fuel cycle (44 Fed. Reg. 45,362-74 [August 2, 1979])" (44 Fed. Reg. 61,373).

The Department of Energy (DOE), as the lead agency on nuclear waste management, filed its statement of position (PS) on April 15, 1980. Statements of position were filed by thirty participants by June 9, 1980, and were followed by cross-statements (CS) from twenty-one of the participants by August 11, 1980.

1.2 Establishment of the Working Group

On May 28, 1980, the Commission directed the staff to form a Working Group to advise the Commission on the adequacy of the record to be compiled in this proceeding, to review the participants' submissions and identify issues in controversy and any areas in which additional information would be needed. The Working Group submitted a report to the Commission on January 29, 1981. The report summarized the record, identified key issues and controversies, and commented on the adequacy of the record for considering the key issues. The participants were invited to submit comments on the adequacy of the Working Group's summary of the record and its identification and description of the issues. Such comments were made by twenty participants by March 5, 1981.

1.3 Commission's Order for Oral Presentations

The Commission found additional limited proceedings to be useful to allow the participants to state their basic positions directly to the Commissioners and to enable the Commissioners to discuss specific issues with them. In addition, the Commission invited comment on the following policy developments: (1) the Administration's announcement[1] of a policy favoring commercial reprocessing of spent fuel and instructing the Secretary of Energy to proceed swiftly toward deployment of a means of storing and disposing of commercial high-level radioactive waste, and (2) the submission of information to the Presiding Officer in

[1] Presidential Nuclear Policy Statement, October 9, 1981.

this proceeding by DOE on March 27, 1981, concerning the DOE decision to "discontinue [its] efforts to provide federal government-owned or -controlled away-from-reactor (AFR) [spent fuel] storage facilities." The participants were asked to comment on the significance to the proceeding of issues, particularly institutional concerns, resulting from these policy developments and to comment on the merits of DOE's new projection of spent fuel storage requirements and on the technical and practical feasibility of DOE's suggested alternative storage methods.

To implement the additional limited proceedings, the Commission consolidated the participants into the following identifiable groups: (a) Federal government, (b) State and local participants, (c) industry, and (d) public interest groups (Second Prehearing Memorandum and Order, November 6, 1981 (unpublished)). Prehearing statements (PHS) were provided by the consolidated groups, as well as by individual participants. The oral arguments were presented to the Commissioners on January 11, 1982.

The extensive record, comprised of all written and oral submissions, provides the primary basis for the Commission's decision regarding the safe storage and disposal of spent fuel and nuclear waste. However, while the Commission was preparing this Waste Confidence decision, the Nuclear Waste Policy Act of 1982 (NWPA) was enacted. The Commission found that this Act had a significant bearing on the Commission's decision, and the Commission has considered the NWPA in reaching its conclusions. The Commission believes that the NWPA had its most significant impact in narrowing the uncertainties surrounding institutional issues. Moreover, although the NWPA is intrinsically incapable of resolving technical issues, it will establish the necessary programs, milestones, and funding mechanisms to enable their resolution in the years ahead.

The Commission's preliminary decision in the Waste Confidence proceeding was served on the consolidated participants on May 17, 1983. However, the parties to this proceeding had not yet had an opportunity to comment on what implications, if any, the NWPA had on the Commission's decision. Further, the Commission's discussion of the safety of dry storage of spent nuclear fuel, in its preliminary decision, relied substantially on material not yet in the record. Therefore, the preliminary decision was issued as a draft decision. The Commission requested the consolidated groupings of participants to comment on either or both of these issues. In addition, the Commission found that onsite storage after license expiration might be necessary or appropriate, and therefore, in accordance with its notice initiating this proceeding, it proposed

a rule to establish how the environmental effects of extended onsite storage would be considered in licensing proceedings (48 Fed. Reg. 22,730 (1983)), as amendments to 10 C.F.R. Parts 50 and 51.

Subsequently, in response to public comments on the proposed amendments to 10 C.F.R. Part 51, the Commission reopened the comment period to address the environmental aspects of the fourth finding of the Commission's Waste Confidence decision, on which the proposed amendment to Part 51 is based (48 Fed. Reg. 50,746 (1983)). Public comments were requested on: (1) the environmental aspects of the fourth finding — that the Commission has reasonable assurance that, if necessary, spent fuel can be stored without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations; (2) the determination that there are no significant nonradiological consequences which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses either at reactors or at independent spent fuel storage installations; and (3) the implications of comments on items (1) and (2) above for the proposed amendment to 10 C.F.R. Part 51.

After reviewing these additional comments, the Commission found no reason to modify its fourth finding or the supporting determination. The analysis of comments, together with the Commission's response is summarized in the Addendum to the Commission's decision.

The Commission notes that two relevant developments have occurred subsequent to the closing of the record in the Waste Confidence proceeding. They are the publication of DOE's draft Mission Plan for the Civilian Radioactive Waste Management Program (April 1984) and the Commission's concurrence in DOE's General Guidelines for Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984). These developments are a matter of public record, and in the case of the Commission's concurrence was the conclusion of a separate public proceeding. The Commission has considered the effects of these developments on its previously announced decision in this proceeding and determined that these developments do not substantially modify the Commission's previous conclusions.

The decision is summarized as five Commission findings in § 2.0. The detailed rationale for these findings, including references to the record developed in this proceeding, is contained in the Appendix to this document. The Commission considers these five findings to be a response to the mandate of the U.S. Court of Appeals for the District of Columbia Circuit and, in addition, a generic determination that there is

reasonable assurance that radioactive waste can and will be safely stored and disposed of in a timely manner.

In keeping with its commitment to issue a rule providing procedures for considering environmental effects of extended onsite storage of spent fuel in licensing proceedings, final amendments to 10 C.F.R. Parts 50 and 51 are being issued simultaneously with this decision.

2.0 COMMISSION FINDINGS[2]

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.

2. The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-09, 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 such reactor and generated up to that time.

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 radioactive waste and spent fuel.

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.

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

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[2] All findings by the Commission in this proceeding are limited to the storage and disposal of high-level radioactive waste and spent fuel generated by nuclear power reactors required to be licensed under §§ 103 or 104b of the Atomic Energy Act of 1954 (42 U.S.C. §§ 2133 and 2134(b)), and to facilities intended for such storage or disposal. The Commission's findings in this proceeding do not address the storage and disposal of high-level radioactive waste or spent fuel resulting from atomic energy defense activities, research and development activities of the Department of Energy, or both. This is consistent with the Nuclear Waste Policy Act of 1982, § 8(c).

3.0 FUTURE ACTIONS BY THE COMMISSION

The Commission's Waste Confidence decision is unavoidably in the nature of a prediction. While the Commission believes for the reasons set out in the decision that it can, with reasonable assurance, reach favorable conclusions of confidence, the Commission recognizes that the possibility of significant unexpected events remains open. Consequently, the Commission will 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.

4.0 FOR FURTHER INFORMATION

Contact Dennis Rathbun or Clyde Jupiter, Office of Policy Evaluation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (202) 634-3295, or Sheldon Trubatch, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555; telephone (202) 634-3224.

Commissioner Zech did not participate in this action.

For the Commission

Samuel J. Chilk
Secretary of the Commission

Dated at Washington, D.C.,
this 22nd day of August 1984.

Addendum to the Commission's Waste Confidence Decision

INTRODUCTION

On May 17, 1983, the Commission issued its proposed decision in the Waste Confidence proceeding, and asked the consolidated groups of participants to comment on two aspects of the decision: the implications of the Nuclear Waste Policy Act (NWPA) for the decision and the Commission's discussion of the safety of dry storage of spent nuclear fuel,

which relied substantially on material not in the record. The analysis of these comments is subdivided into several issue categories and presented, with NRC's responses, in Part I below. The membership of the consolidated groups responding to the Commission's request as well as the abbreviations used to identify the groups are provided in § 3 of Part I.

Subsequently, in response to public comments on the Commission's proposed amendment to 10 C.F.R. Part 51 (48 Fed. Reg. 22,730 (1983)), the Commission reopened (48 Fed. Reg. 50,746 (1983)) the comment period to address the environmental aspects of the fourth finding of the Commission's proposed Waste Confidence decision on which the proposed amendment to Part 51 is based. Public comments were requested on: (1) the environmental aspects of the fourth finding — that the Commission has reasonable assurance that, if necessary, spent fuel can be stored without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations; (2) the determination that there are no significant nonradiological consequences which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses either at reactors or at independent spent fuel storage installations; and (3) the implications of comments on items (1) and (2) above for the proposed amendment to 10 C.F.R. Part 51. The analysis of public comments and NRC's responses are presented in Part II of this addendum. The list of respondents to this reopened comment period and the abbreviations used to identify them are given in § 4 of Part II.

The Commission notes that two relevant developments have occurred subsequent to the closing of the record in the Waste Confidence proceeding. They are the publication of DOE's draft Mission Plan for the Civilian Radioactive Waste Management Program (April 1984) and the Commission's concurrence in DOE's General Guidelines for Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984). These developments are a matter of public record, and in the case of the Commission's concurrence was the conclusion of a separate public proceeding. The Commission has considered the effects of these developments on its previously announced decision in this proceeding and determined that these developments do not substantially modify the Commission's previous conclusions.

PART I: ANALYSIS OF THE CONSOLIDATED GROUPS' COMMENTS ON THE COMMISSION'S WASTE CONFIDENCE DECISION AND NRC RESPONSES

1. Effect of the Nuclear Waste Policy Act on the Commission's Decision

A. General

(1) Summary of Comments

The Consolidated Industry Group agreed with the Commission's view that the NWPA contains provisions pertinent to all of the major elements relevant to mined geologic disposal of high-level radioactive wastes (Industry at 3). The Industry Group called attention to the comprehensive nature of the NWPA which authorizes DOE to undertake steps leading to the construction, operation and maintenance of a deep geologic test and evaluation facility; requires DOE to prepare a waste management mission plan; establishes a prescribed schedule for repository siting, construction and operation; defines the decisionmaking roles of affected States and Indian tribes in repository site selection and evaluation; provides for the continuity of Federal management of the nuclear waste program and continued funding; and facilitates the establishment of an overall integrated spent fuel and waste management system. The Industry Group suggested that these features of the Act should increase the Commission's confidence that waste can and will be disposed of safely. The Group pointed out that the Act also contains special procedures to facilitate the licensing of spent fuel storage capacity expansion and transshipments; directs DOE research, development and cooperation with utilities in developing dry storage and rod compaction; and provides for federally supplied interim storage capacity to supplement that of industry (Industry at 4-8).

The Industry Group believed that the NWPA's enactment — in and of itself — provides a sound basis for confidence that institutional difficulties can and will continue to be resolved. At the same time, Industry stated that the NWPA's enactment was not essential for the Commission to reach an affirmative decision in this proceeding (Industry at 9).

In contrast, the Consolidated Public Interest Group (CPIG) believed that the NWPA provides an insufficient basis for the Commission's decision in this proceeding with respect to the availability or timing of a nuclear waste repository. The CPIG contended that the NWPA contains many areas of ambiguity, and gave as examples:

(i) Section 114(a) of the NWPA requires DOE to make a recommendation to the President for the first repository site, accompanied by the preliminary comments by the Commission concerning the suitability of three alternative candidate sites for licensing under 10 C.F.R. Part 60. DOE interprets this section to require such preliminary comments *before* site characterization begins. . . . The Commission staff interprets that section . . . to require a judgment of suitability under 10 C.F.R. Part 60 *after* site characterization has occurred.

(ii) DOE originally interpreted § 112(f) to permit continuation of ongoing site characterization at Hanford before completion of the DOE siting guidelines. DOE now concedes that such site characterization work must await completion of an environmental assessment prepared in accordance with final DOE siting guidelines.

(CPIG at 2-3).

(2) NRC Response

The Commission has considered the effect of enactment of the Nuclear Waste Policy Act of 1982 and concludes that the Act provides support for timely resolution of technical uncertainties and reduces uncertainties in the institutional arrangements for the participation of affected States and Indian tribes in the siting and development of repositories and in the long-term management, direction and funding of the repository program. The bases for the Commission's conclusion are set forth in the decision and will not be repeated here. The passage of the Act provides evidence of a strong national commitment to the solution of the radioactive waste management problem.

The Commission recognizes the possibility of differing interpretations regarding the implementation of the NWPA. With respect to CPIG's discussion of § 114(a), the Commission is unaware of any differences between DOE and NRC in the interpretation of this section of the Act. We note that DOE's recommendation of a repository site to the President would necessarily be made after DOE's preliminary determination that three sites are suitable for development. DOE and NRC now agree that the preliminary determination of site suitability for the alternative sites should be made following site characterization (Commission's Final Decision on the U.S. Department of Energy's General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984)).

Concerning § 112(f), DOE has continued site characterization at Hanford during formulation of the siting guidelines; in accordance with the views of the States and environmental groups, DOE has deferred drilling of the exploratory shaft pending the completion of the guidelines, sub-

mission of the site characterization plan to NRC and preparation of an environmental assessment of site characterization activities.

B. Technical Aspects

(1) Summary of Comments

The Consolidated Industry Group believed that the Act contained provisions pertinent to all of the major elements relevant to disposal (Industry at 3). The Consolidated Public Interest Group, on the other hand, contended that the NWPA did not resolve technical uncertainties concerning repository development and safety (CPIG at 5). The Consolidated State Group did not believe that the NWPA supported a finding of confidence because it failed to resolve technical questions and merely set target dates for deciding on the site of the first waste repository. The State Group noted that if technical problems are not resolved by the dates proposed by Congress, the milestone dates will have to be postponed. The State Group contended too that, although the Act authorizes DOE to conduct research on unresolved technical issues, the research could uncover additional problems (States at 2). However, DOE pointed out that the NWPA provides for a focused, integrated and extensive research and development program for the deep geologic disposal of high-level waste and spent fuel. DOE believed that § 215 of the Act enhances confidence in the timely availability of disposal facilities by authorizing a research facility to develop and demonstrate a program for waste disposal. DOE also stated that the schedule for a Test and Evaluation Facility would require the *in situ* testing described in § 217 of the Act to begin not later than May 6, 1990, thus allowing for research and development results to be incorporated in the repository which is scheduled to open in 1998 (DOE at 11, 12).

(2) NRC Response

As the record of this proceeding shows, there are no known technical problems that would make safe waste disposal impossible. Clearly, further engineering development and site-specific evaluations will be required before a repository can be constructed. The Commission did not propose to rely on the NWPA as the basis for resolving technical uncertainties. Rather, the Commission found that the NWPA provides a framework for facilitating the solution of the remaining technical issues. Title II of the Act authorizes DOE to undertake steps leading to the construction, operation and maintenance of a deep geologic test and

evaluation facility and to conduct the necessary research and development as well as to establish a demonstration program. The schedule set forth in the Act is consistent with the objective of assuring repository operation within the time period discussed in the Waste Confidence decision. The "Mission Plan" which is required by the Act will provide an effective management tool for assuring that the many technical activities are properly coordinated and that results of research and development projects are available when needed.

C. Institutional Aspects

(1) Summary of Comments

The Consolidated State Group believed that the NWPA failed t resolve institutional questions. The States argued that their cooperatio cannot be assumed in the event that the general public in the vicinity o a proposed site is opposed to the location. Further, the States contende that, if a site is vetoed by a host State or Indian tribe, there is no assur ance that Congress will vote to override the veto. Moreover, if the vet is overridden, a legal challenge is likely and the outcome is uncertai (States at 3).

The Consolidated Public Interest Group also believed that the NWP has not significantly reduced institutional uncertainties regarding partic pation and objections of affected States and Indian tribes. As example of institutional difficulties, CPIG pointed out that State officials an Indian tribes still have concerns regarding the adequacy of time to mon tor and comment upon agency proposals, the lack of agency response t their concerns, and inadequate funding to support their full particip tion. Further, CPIG noted that the Act (§ 115) provides States ar Indian tribes with strong new authority to veto the siting of a reposito within their borders (CPIG at 5).

DOE, on the other hand, believed that §§ 116 and 117 of the NWP would reduce Federal-State institutional uncertainties (DOE at 9).

(2) NRC Response

It would be unrealistic to expect that the NWPA will resolve all i stitutional issues. However, it does provide specific statutory procedur and arrangements for accomplishing such resolution. The right of affe ed States and Indian tribes to disapprove a site designation under t NWPA might create uncertainty in gaining the needed approvals. Neve theless, the NWPA's establishment of a detailed process for State a

tribal participation in the development of repositories and for the resolution of disputes should minimize the potential for substantial disruption of plans and schedules. The Commission does not expect that the NWPA can eliminate all disagreement about development of waste repositories. However, in providing for information exchange, financial and technical assistance to affected groups, and meaningful participation of affected States and tribes in the decisionmaking process, the Act should minimize the potential for direct confrontations and disputes.

D. Funding Aspects

(1) Summary of Comments

The Consolidated Industry Group expressed its general belief that the NWPA assures adequate funding for interim storage and disposal of radioactive waste (Industry at 6, 7). Similarly, DOE believed that the funding mechanism provided by the NWPA should largely remove uncertainties in assuring adequate resources to complete the program (DOE at 10, 11). On the other hand, the Consolidated States Group contended that, since the law can be changed at any time, the NWPA assures neither an adequate level of funding nor a prolonged congressional commitment (States at 4).

(2) NRC Response

The Commission believes that the general approach prescribed by the NWPA is to operate DOE's radioactive waste program on a full-cost-recovery basis. It seems clear that Congress intended to establish a long-term program for waste management and disposal, with built-in reviews and adjustments of funding as necessary to meet changing requirements. In this regard, the Act provides that DOE must annually review the amount of the established fees to determine whether collection of the fees will provide sufficient revenues to offset the expected costs. In the event DOE determines that the revenues being collected are less than the amount needed to recover costs, DOE must propose to Congress an adjustment to the fees to ensure full cost recovery. The Act also provides that, if at any time, the monies available in the waste fund are insufficient to support DOE's nuclear waste program, DOE will have the authority to borrow from the Treasury. The Commission believes that the long-term funding provisions of the Act will ensure adequate financial support for DOE's nuclear waste program for FY 1984 and beyond.

The Commission believes that uncertainties regarding the adequacy of financial management of the nuclear waste program have also been reduced by the NWPA requirement that an Office of Civilian Radioactive Waste Management be established within the Department of Energy. This Office is to be headed by a Director, appointed by the President with Senate confirmation, who will report directly to the Secretary of Energy. Further, the Act stipulates that an annual comprehensive report of the activities and expenditures of the Office will be submitted to Congress and that an annual audit of the Office will be conducted by the Comptroller General, who will report the results to Congress.

Some concern has been expressed that the Congress may amend the funding provisions of the NWPA and thereby undermine the financial stability of the Federal radioactive waste management program. Commenters have not provided any basis for this belief. The Commission considers this possibility to be most unlikely. It is reasonable to assume that the long-range public health and safety and political concerns which motivated the Congress over the past several years to pass the NWPA will continue to motivate the Congress in considering amendments to the NWPA.

E. Schedule

(1) Summary of Comments

DOE contended that the NWPA provides additional assurance that a repository will be available by 1998. As the basis for this belief, DOE stated that §§ 111 through 125 of the NWPA provide specific schedules and reporting requirements for the timely siting, development, construction, and operation by 1998 of a repository for high-level waste and spent fuel (DOE at 6). DOE believed that these schedules and reporting requirements will ensure that deadlines are met. The Commission notes that DOE recognizes that there has been a delay of about 1 year in its schedule for meeting early milestones such as publication of its siting guidelines; nevertheless, DOE continues to maintain that its date for completion of repository development will be met (DOE draft Mission Plan for the Civilian Radioactive Waste Management Program, April 1984).

The Consolidated Public Interest Group, however, did not believe that the provision of specific dates in the NWPA gives assurance that they will be met. CPIG cited, for example, the delay in preparing DOE's site-selection guidelines, which were due by June 1983, and were expected to be delayed further (CPIG at 4).

Further, the CPIG contended that a date for the availability of a repository is not certain since both the President and the NRC have explicit authority to reject any or all site proposals that are submitted to them (CPIG at 4). Also, CPIG believed that the legislation contemplates the possibility of delay beyond statutory deadlines and NWPA's legislative history indicates that the timing of repository availability remains uncertain (CPIG at 5).

(2) NRC Response

One of the primary purposes of the NWPA is "to establish a schedule for the siting, construction, and operation of repositories that will provide reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and such spent nuclear fuel as may be disposed of in a repository." (§ 111(b)(1)). The Commission believes this purpose will be achieved.

As the Commission noted in the proposed decision, the Congress would not be able to legislate the schedules for the accomplishment of fundamental technical breakthroughs if it believed that such breakthroughs were necessary. They are not necessary. Rather, it is the Commission's judgment that the remaining uncertainties can be resolved by the planned step-by-step evaluation and development based on ongoing site studies and research programs. The Commission believes the Act provides means for resolution of those institutional and technical issues most likely to delay repository development, both because it provides an assured source of funding and other significant institutional arrangements, and because it provides detailed procedures for maintaining progress, coordinating activities and rectifying weaknesses.

The Commission believes that the milestones established by the Act are generally consistent with the schedules presented by DOE in the Waste Confidence proceeding and that those milestones are generally reasonable. Achievement of the scheduled first date of repository operation is further supported by other provisions of the Act which specify means for resolution of issues most likely to delay repository completion. One of the earlier milestones — publication of DOE's general guidelines for the recommendation of sites for a repository — was about a year behind schedule and the Commission was concerned that this delay could result in corresponding delays in DOE's nomination of at least five sites for characterization work. However, DOE has indicated in its draft Mission Plan (April 1984) that the subsequent milestones have been scheduled to provide completion of the first repository by 1998.

The Commission believes that the timely attainment of a repository does not require DOE's program schedule to adhere strictly to the milestones set out in the NWPA over the approximately 15-year duration of the repository development program. Delays in some milestones as well as advances in others can be expected.

The Commission has no evidence that delays of a year or so in meeting any of the milestones set forth in the NWPA would delay the repository availability date by more than a few years beyond the 1998 date specified in the NWPA. The Commission found reasonable assurance that a repository would be available by 2007-09, a decade later than that specified in the NWPA, and a date which allows for considerable slippage in the DOE schedule. The Act also requires that any Federal agency that determines that it cannot comply with the repository development schedule in the Act must notify both the Secretary of Energy and Congress, provide reasons for its inability to meet the deadlines, and submit recommendations for mitigating the delay. The Commission notes that the Act also clarifies how the requirements of the National Environmental Policy Act are to be met. These provisions of the Act, as well as the provisions for research, development and demonstration efforts regarding waste disposal, increase the prospects for having the first repository in operation not later than the first few years of the next century.

The repository development schedule may have to accommodate such contingencies as vetoes of proposed repository sites, prolonged public hearings, protracted litigation, possible project reorientation, or delay in promulgation of siting guidelines. The schedule now incorporated into the Act allows substantial time for these possibilities.

2. Discussion of the Safety of Dry Storage

A. Summary of Comments

DOE believed that the availability of dry storage techniques provides further reasonable assurance of the ability to safely store nuclear wastes at least 30 years beyond the expiration of reactor operating licenses. DOE stated that the citations quoted in the Commission's rationale are reliable and representative of the literature in the area, and that the Commission's technical judgment on dry storage conforms with DOE's experience and is accurate and correct (DOE at 16). The Consolidated Industry Group also stated that the pertinent points in the Commission's discussion appear to be adequately supported with appropriate references (Industry at 10, 11).

In further support of the safety of dry storage, DOE cited the following:

- Extensive worldwide experience shows that dry fuel handling and storage is safe and efficient. Irradiated fuel has been handled, shipped, and safely stored under dry conditions since the mid-1940s. All types of irradiated fuel have been handled dry at hot cells, where a variety of phenomena have been observed in detail. The passive nature of most dry storage concepts contributes to the safety of interim storage by not requiring active cooling systems involving moving parts (DOE at 16).
- Regarding specific experience, DOE stated that reactor fuel has been successfully stored in dry vaults licensed under Part 50 at the Hallam sodium-cooled graphite research reactor in Nebraska and the Fort St. Vrain HTGR prototype facility in Colorado. In addition, dry storage of zircaloy-clad fuel has been successfully conducted in drywells and in air-cooled vaults at DOE's Nevada Test Site. There is favorable foreign experience with dry storage at Wylfa, Wales in Great Britain, at Whitesell in Canada, in the Federal Republic of Germany, in France where vault dry storage of vitrified waste is routine, and in Japan, where a dry storage vault has been recently constructed (DOE at 17).
- To date, all dry storage tests have indicated satisfactory storage of zircaloy-clad fuel without cladding failure over the temperature range of 100°C to 570°C, in inert atmospheres. Existing data which support the conclusion that spent fuel can be stored safely in an inert atmosphere for at least 30 years is being augmented by additional ongoing research (DOE at 17, 18).

None of the consolidated groups of participants offered comments which were critical of the Commission's discussion of the safety of dry storage.

B. NRC Response

The Commission is confident that dry storage installations can provide continued safe storage of spent fuel at reactor sites for at least 30 years after expiration of the reactor operating licenses.

3. List of Respondents

CONSOLIDATED PARTICIPANTS AS RESPONDENTS TO THE COMMISSION'S WASTE CONFIDENCE DECISION

1.	Department of Energy	(DOE)
2.	Consolidated States Representative[1]	(States)
3.	Consolidated Public Interest Representative[2]	(CPIR)
4.	Consolidated Industry Representative[3]	(Industry)

PART II: COMMISSION CONSIDERATION OF ADDITIONAL COMMENTS ON ITS FOURTH FINDING

1. Introduction

On November 3, 1983, the Commission reopened the comment period in this proceeding to receive comments on: (1) the environmental aspects of its fourth finding — that it has reasonable assurance that, if necessary, spent fuel can be stored without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations; (2) the determination that there are no significant nonradiological consequences which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses either at reactors or at independent spent fuel storage installations; and (3) implications of comments on items (1) and

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[1] The Consolidated States Group consists of the Attorney General of the State of New York, Minnesota (by its Attorney General and the Minnesota Pollution Control Agency), Ohio, South Carolina and Wisconsin. The remaining participants previously consolidated in the States Group have not joined in these comments.

[2] The Consolidated Public Interest Group is represented here by the Natural Resources Defense Council, Inc., the New England Coalition on Nuclear Pollution, the Sierra Club, the Environmental Coalition on Nuclear Power, Wisconsin's Environmental Decade, Mississippians Against Disposal, Safe Haven, Ltd., John O'Neill, Jr., and Marvin Lewis.

[3] The Consolidated Industry Group is represented by: American Institute of Chemical Engineers; American Nuclear Society; Association of Engineering Geologists; Atomic Industrial Forum; Bechtel National; Consumers Power; General Electric; Neighbors for the Environment; Scientists and Engineers for Secure Energy; Tennessee Valley Authority; the Utilities group (Niagara Mohawk Power Corporation, Omaha Public Power District, Power Authority of the State of New York, and Public Service Company of Indiana, Inc.); and the Utility Nuclear Waste Management Group-Edison Electric Institute. In order to emphasize the independent nature of its participation, the American Nuclear Society has chosen to proceed separately. ANS continues to protest its assignment to the Consolidated Industry Group and has offered separate comments on the Commission's Waste Confidence decision. Since only the consolidated groups of participants were invited to comment on the proposed decision, the ANS's separate comments are not discussed here. Further, TVA, as a Federal agency, wishes to stress the independent nature of its participation.

(2) above for the proposed amendment to 10 C.F.R. Part 51 (48 Fed. Reg. 50,746).

The Commission has considered those comments and, for the reasons discussed below, finds no reason to substantively modify its fourth finding or other related aspects of its decision in this proceeding. The Commission has, however, made revisions in its fourth finding to clarify its original intent.

Thirteen comments were received. Seven commenters identified various reasons which they believed argued against the finding.[4] Six commenters supported the finding.[5] In addition to the issues on which the Commission specifically requested comments, some commenters raised additional issues regarding the Commission's compliance with the National Environmental Policy Act (NEPA).

2. Environmental Aspects of Extended Storage of Spent Fuel

A. Radiological Consequences of Spent Fuel Storage

The Commission's proposed fourth finding stated:

> The Commission finds reasonable assurance that, if necessary, spent fuel can be stored safely without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations.

The public was invited to submit additional comments on the environmental aspects of this finding. Those comments, and the Commission's responses to them, are set out below.

The State of Minnesota ("Minnesota"), through its Attorney General, and the Sierra Club believe that an event at the spent fuel pool for Prairie Island Nuclear Generating Station ("Prairie Island") indicates that irradiated spent fuel assemblies are degrading rapidly with time. In December 1981, during a fuel transfer operation at Prairie Island, the top nozzle assembly separated from the remainder of a spent fuel assembly due to stress corrosion cracking of the spent fuel assembly while it was in the spent fuel pool. Minnesota and the Sierra Club acknowledge that this separation was an isolated event; over 5000 similar spent fuel

[4] Department of Law of the State of New York, Marvin Lewis, Sierra Club, Safe Haven, Ltd., Attorney General of the State of Minnesota, Department of Justice of the State of Wisconsin and Natural Resources Defense Council, Inc.

[5] Scientists and Engineers for Secure Energy, Inc., American Institute of Chemical Engineers, American Nuclear Society, Utility Nuclear Waste Management Group-Edison Electric Institute, and U.S. Department of Energy.

assemblies have been moved successfully at other plants. These commenters also acknowledge that television examination showed no corrosion cracking of similarly designed fuel assemblies at other nuclear power plants: Zion, Trojan, Kewanee and Point Beach. They also acknowledge that even though the water contaminant contributing to stress corrosion cracking has never been identified, the possibility that it may have been sulfates has led the Commission to suggest that Prairie Island monitor the sulfate levels of its spent fuel pool.

However, the Sierra Club contended[6] that the NRC staff essentially ignored the opinion of Mr. Earl J. Brown, an NRC engineer, that sulfate contamination is a generic problem at pressurized water reactors (PWRs). The Sierra Club also believes that television inspection of spent fuel assemblies in spent fuel pools cannot reveal the initial signs of stress corrosion cracking. For these reasons, the Sierra Club and Minnesota believe that there is no assurance that spent fuel can be stored safely in spent fuel pools for 30 years after reactor shutdown or for 60 years after irradiation.

The NRC investigated the Prairie Island event and found it to be an isolated event without generic impact. The staff also concluded that if a fuel assembly were to drop due to top nozzle failures, such an event would not lead to a criticality hazard in a spent fuel pool and that such an accident would result in radiation levels at the site boundary well within the limits in 10 C.F.R. Part 100. The NRC Staff Assessment Report ("SAR") and associated memoranda, although already publicly available in the Commission's Public Document Room, have been added to the docket of this proceeding. That SAR concluded that the event was caused by intergranular stress corrosion cracking due to an unidentified corrodant temporarily present in the spent fuel pool.

As for the Sierra Club's specific comments, the staff recognized that sulfate contamination was suspected to have contributed to the corrosion and recommended that licensees administratively control sulfate levels concentrations in spent fuel pools. Such monitoring had been recommended by Mr. Brown as the only action that should be taken in response to the incident. Although Mr. Brown stated that in his opinion the event was a "potential" generic issue for PWRs, subsequent staff investigation revealed that the event was an isolated incident. The sta

[6] Sierra Club also stated that the staff did not consider an Oak Ridge report (ORNL-3684, Novemb 1964) which identified water vapor as contributing to corrosion of the type of steel used in spent fu assemblies. That report is not germane to light water reactor fuel because it addressed the sensitizati of stainless steel in a high-temperature, gas-cooled reactor environment, which is very different fro the environment of a light water reactor. Refer to the discussion in § 2.4A of the Appendix to the Co mission's decision.

also considered the properties of the steel used in the spent fuel assemblies and acknowledged that they could have contributed to the event. However, the absence of any similar events for 5000 other spent fuel assemblies indicated that the type of steel was not critical. Accordingly, the Commission finds no basis for reconsidering the Safety Assessment Report's finding that the Prairie Island event was an isolated incident and recommendation that sulfate control was an adequate response, or for altering its conclusion concerning the potential environmental impacts of stored spent fuel.

Wisconsin, Safe Haven, Ltd., and NRDC contended that the environmental effects of extended spent fuel storage are site-specific and should be considered on a case-by-case basis.[7] Safe Haven believes that the individuality of each plant and its environmental surroundings necessitate separate evaluations of extended storage of spent fuel, but identified no site-specific factors which would result in significant environmental impacts. NRDC listed some site-specific factors: geology, hydrology, seismicity, ecological factors and individual proposals for spent fuel management and storage. However, NRDC did not suggest how these factors could lead to significant site-specific environmental impacts that would preclude the Commission from making a generic finding. Similarly, Wisconsin listed as relevant factors proximity to population centers, highways, geologic faults, dams, floodplains or shorelines affected by erosion, but offered no suggestion of how these factors could affect the Commission's generic determination. For example, there has been no discussion of why the Commission's seismic design requirements, though site-specific, are not generically adequate to assure that spent fuel can be stored for up to 30 more years in a spent fuel pool designed to withstand the largest expected earthquake at each reactor site. Mr. Marvin Lewis contended that the fourth finding had no basis because the Commission had little or no experience with storing spent fuel for 30 years or with storing fuel that could be up to 70 years old. Mr. Lewis also asserted that the pyrophoricity of the zircaloy tubes containing spent fuel for 30 years presents an unknown fire danger. This comment is based on a private communication to Mr. Lewis regarding the condition of the spent fuel at Three Mile Island, Unit 2. By the terms of that letter, any fire danger associated with pyrophoricity of zircaloy arises from the accident conditions at TMI-2. NRC has previously studied the

[7] Safe Haven also suggested that a full environmental and safety review should accompany any utility's proposed plans submitted pursuant to 10 C.F.R. Part 50 (§ 50.54(aa)) for extended storage of spent fuel. The Commission will treat its review of any such utility proposal in accordance with the established procedures for considering any application for a license amendment.

effects of loss of water from pools on the temperature of stored spen fuel (NUREG/CR-0649, "Spent Fuel Heatup Following Loss of Wate During Storage," March 1979). While this study noted that oxidatio could become self-sustaining for temperatures in the neighborhood c 850-950°C (NUREG/CR-0649, at 13), the study shows that such oxida tion can only occur for extreme temperature conditions and for spen fuel that has been stored for a relatively brief storage period. In order fc rapid oxidation to occur, the age of the spent fuel (30,000 MWD/M burnup) would have to be in the range of less than 10 days to less than years, depending on the density at which it is stored (*see* NUREG/CR 0649, Figure 17, at 55). Moreover, one must assume a continuin oxygen supply adequate to sustain the oxidation. Any damaged spen fuel such as that from TMI-2, would be canned to avoid particulate los and would have already aged several years. Neither the heat load leadin to temperatures capable of initiating rapid oxidation nor the presence c an adequate supply of oxygen to sustain a pyrophoric reaction woul seem to be present in any storage configuration or under conditions tha would receive NRC approval. While it is correct that spent fuel has nc been stored for over 30 years, the record shows that utilities have suc cessfully stored spent fuel for over 20 years, and that there are n known physical processes which would indicate that it is impractical t extrapolate that experience to make predictions about the behavior c spent fuel for 70 years of storage.

The Utility Nuclear Waste Management Group — Edison Electric In stitute and the U.S. Department of Energy referred to several documen in the record which show that the relatively low energy content of spen fuel and the relatively benign static environment of spent fuel storag render insignificant the radiologic impacts arising from the extende storage of spent fuel. As discussed in more detail below, these doc ments also show that there are no significant nonradiologic environmen tal impacts arising from such extended storage. Under these circun stances, the Commission finds that it has sufficient experience wit spent fuel storage to predict spent fuel behavior during 70 years of sto age and to find that such storage will not result in significant enviro mental effects.

B. Nonradiological Consequences of Spent Fuel Storage

The Commission's fourth finding rested in part on the Commission determination that there are no significant nonradiological consequenc due to the extended storage of spent fuel which could adversely affe the environment. The public was invited to comment also on this findir

and to provide a detailed discussion of any such environmental impacts. Mr. Marvin Lewis asserted that the continuous storage of spent fuel under water for 30 years or more requires unprecedented institutional guarantees. He also noted that there had been no consideration of financial, economic and security implications of storage for 30 or more years. Mr. Lewis did not expand upon these assertions to explain how they would result in significant nonradiological environmental consequences. In any event, the more than 20 years of experience with storing spent fuel demonstrates that storage of spent fuel for 30 years or more does not require unprecedented institutional guarantees or raise unique questions regarding finances, economics or the security of extended spent fuel storage. Further, the Commission will require all reactor licensees, 5 years before expiration of their operating license, to provide a plan for managing the spent fuel prior to disposal. Moreover, the record documents referred to by UNWMG-EEI, DOE and AIF show that there are no significant nonradiological environmental impacts associated with the extended storage of spent fuels. The amount of heat given off by spent fuel decreases with time as the fuel ages and decays radioactively. No additional land needs to be devoted to storage facilities because reactor sites have adequate space for additional spent fuel pools or dry storage installations. The additional energy and water needed to maintain spent fuel storage is also environmentally insignificant. No commenter has challenged these assessments of environmental impacts and the Commission has no reason to question their validity. Under these circumstances, the Commission has no reason to reassess its prior determination that extended storage of spent fuel will present no significant nonradiological consequences which could adversely affect the environment.

3. Commission Compliance with NEPA

Several participants challenged the Commission's compliance with NEPA. The States of New York ("New York") and Wisconsin contend that since its inception, this proceeding has focused on the availability and safety of spent fuel storage, and has been conducted outside the scope of NEPA. New York supports this contention with the following quote from the First Prehearing Conference Order (February 1, 1980) (unpublished):

> This rulemaking proceeding does not involve a major federal action having a significant impact on the environment, and consequently an environmental impact statement is not required by NEPA . . . .

New York asserts that this statement caused the participants not to consider NEPA in their filings. Accordingly, New York believes that the Commission cannot now transform the Waste Confidence Proceeding into a NEPA proceeding. In New York's view, joined by the Natural Resources Defense Council, Inc. ("NRDC"), NEPA required the Commission to prepare an environmental impact statement ("EIS") or environmental assessment to consider the environmental impacts of spent fuel storage at reactor sites beyond the expiration dates of reactor licenses. The Utility Nuclear Waste Management Group-Edison Electric Institute ("UNWMG-EEI") believes that it has been clear from the outset of this proceeding that the Commission intended to develop environmental regulations appropriate to the issues considered here. UNWMG-EEI cites several factors in support of its position: (1) this proceeding was the direct outgrowth of a NEPA case, *Minnesota v. NRC*, 602 F.2d 412 (D.C. Cir. 1979); (2) the Notice of Proposed Rulemaking explicitly stated a Commission intent to deal with environmental aspects of spent fuel storage; (3) the proceeding was docketed under Part 51, the Commission's regulations implementing NEPA; (4) the Commission stated that it would draw on the record of the rulemaking on environmental impact of the nuclear fuel cycle (Table S-3) and included in the NRC Data Bank for this proceeding sources of information on the environmental impacts of spent fuel storage; and (5) several participants included in their statements information pertaining to the environmental impacts of spent fuel storage.

The Commission believes that from the very beginning of this proceeding, participants were on notice that environmental aspects of spent fuel storage were under consideration. The notice initiating this proceeding stated, in pertinent part:

> If the Commission finds reasonable assurance that safe, offsite disposal for radioactive wastes from licensed facilities will be available prior to expiration of the facilities' licenses, it will promulgate a final rule providing that the *environmental and safety implications of continued onsite storage after the termination of licenses* need not be considered in individual licensing proceedings. In the event the Commission determines that onsite storage after license expiration may be necessary or appropriate, it will issue a proposed rule providing *how that question will be addressed.*
>
> * * *
>
> Based on the material received in this proceeding and on any other relevant information properly available to it, the Commission will publish a proposed or final rule in the *Federal Register.* Any such final rule will be effective thirty days after publication.

44 Fed. Reg. 61,372, 61,373-74 (1979). (Emphasis supplied.)

It is clear from this notice that if the Commission found that onsite storage after termination of reactor operating licenses would be necessary or appropriate, then it would propose a rule for dealing with the question of environmental and safety implications of continued onsite storage. New York's reference to the statement in the First Prehearing Conference Order is inapposite. That statement addressed the issue of whether a decision in this proceeding would be a proposal for major federal action having significant impact on the environment so as to require an EIS. The Presiding Officer found that the decision itself would not require an EIS. His decision in no way implied a change in the scope of the proceeding as announced in the notice initiating it.

There is also nothing about the Commission's fourth finding which requires an EIS. Neither New York nor NRDC has explained how this finding is a major Federal action having a significant impact on the human environment. The finding provides a basis for a rule that provides that environmental impacts from extended storage of spent fuel are so insignificant as not to be required to be included in an impact statement. The validity of such a rule depends on the procedures used to promulgate it and the record supporting it. An EIS is not required because such a rule itself has no environmental impacts, significant or otherwise.[8] To require an EIS here would be essentially to require an EIS to show that no EIS is required. Clearly such a result would be incorrect. Accordingly, the Commission finds that NEPA does not require an EIS to support the fourth finding.

4. List of Respondents

RESPONDENTS TO THE COMMISSION'S NOVEMBER 3, 1983, ORDER (48 FED. REG. 50,746) TO REOPEN THE PERIOD FOR LIMITED COMMENT ON THE ENVIRONMENTAL ASPECTS OF THE COMMISSION'S FOURTH FINDING IN THE WASTE CONFIDENCE PROCEEDING

1. Attorney General of the State of New York (N.Y.)
2. Marvin Lewis (Lewis)
3. Sierra Club Radioactive Waste Campaign (Sierra)
4. Scientists and Engineers for Secure Energy, Inc. (SE2)

[8] *See*, for example, *Natural Resources Defense Council, Inc. v. NRC*, 547 F.2d 633, 653 n.57 (D.C. Cir. 1976), *rev'd on other grounds, sub nom. Vermont Yankee Nuclear Power Corp. v. NRC*, 435 U.S. 519 (1978).

5. Safe Haven, Ltd. (S.H.)
6. American Institute of Chemical Engineers (AICE)
7. Atomic Industrial Forum, Inc. (AIF)
8. Utility Nuclear Waste Management Group-Edison Electric Institute (UNWMG-EEI)
9. Natural Resources Defense Council, Inc. (NRDC)
10. Attorney General of the State of Wisconsin (Wis.)
11. U.S. Department of Energy (DOE)
12. American Nuclear Society (ANS)
13. Attorney General of the State of Minnesota (Minn.)

APPENDIX

RATIONALE FOR COMMISSION FINDINGS IN THE MATTER OF THE WASTE CONFIDENCE PROCEEDING

Table of Contents

1.0 INTRODUCTION

The rationale for the five Commission findings resulting from the Waste Confidence proceeding is summarized below. This rationale is based principally on the record of the proceeding which includes participants' position statements, cross-statements, prehearing and oral statements (in the discussion below, the participants are identified by the citations defined in the Reference Notation at the end of this document). The Commission also relied on the provisions of the Nuclear Waste Policy Act of 1982 (NWPA), and other substantive material not originally included in the record relating to the discussion of the safety of dry storage of spent nuclear fuel in the Commission's Fourth Finding; the NWPA and the dry storage material have now been incorporated into the record along with the relevant comments of participants in this proceeding.

The Commission notes that two relevant developments have occurred subsequent to the closing of the record in the Waste Confidence proceeding. They are the publication of DOE's draft Mission Plan for the Civilian Radioactive Waste Management Program (April 1984) and the Commission's concurrence in DOE's General Guidelines for Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984). These developments are a matter of public record, and in the case of the Commission's concurrence was the conclusion of a separate public proceeding. The Commission has considered the effects of these developments on its previously announced decision in this proceeding and determined that these developments do not substantially modify the Commission's previous conclusions.

2.0 RATIONALE FOR COMMISSION FINDINGS

2.1 First Commission Finding

The Commission finds reasonable assurance that safe disposal of radioactive waste and spent fuel in a mined geologic repository is technically feasible.

The Commission finds that safe disposal of high-level radioactive waste and spent fuel is technically possible and that it is achievable using existing technology. Although a repository has not yet been constructed and its safety and environmental acceptability demonstrated, no fundamental breakthrough in science or technology is needed to implement a successful waste disposal program. Those participants who questioned the availability of a repository did not contend that fundamental scientific breakthroughs were required, but questioned whether technical problems could be resolved in a timely manner. The record supports the conclusion that the safe disposal of high-level radioactive waste and spent nuclear fuel from licensed facilities can be accomplished.

The Department of Energy's (DOE) position is that disposal in mined geologic repositories can meet the goal of providing safe and effective isolation of radionuclides from the environment (DOE PHS at 2, 4; Tr. at 11). A number of participants stated that waste containment and isolation from the biosphere are scientifically feasible (USGS PS at 4; NRDC PS at 9; UNWMG-EEI PS, Doc. 1 at 22, Doc. II at II-6; Consolidated Industry Group Tr. at 16; Consolidated States Group Tr. at 98). This view is consistent with the conclusions of the *Report to the American Physical Society by the Study Group on Nuclear Fuel Cycles and Waste Management* (50 Rev. Mod. Phys. (No. 1, Pt. II), S6 (January 1980)) and the "Report to the President of the Interagency Review Group on Nuclear Waste Management" 38 (Final Report, March 1979).

The conclusion that safe radioactive waste disposal is technically feasible is based on consideration of the basic features of repository design and the problems to be solved in developing the final design. A mined geologic repository for disposal of high-level radioactive waste, as developed during the past three decades, will be based on application of the multi-barrier approach for isolation of radionuclides. The high-level radioactive waste or spent fuel is to be contained in a sealed package and any leakage from the package is to be retarded from migrating to the biosphere by engineered barriers. These engineered barriers include backfilling and sealing of the drifts and shafts of the mined repository. We believe that the isolation capability and long-term stability of the geologic setting provide a final barrier to migration to the biosphere.

The selection of a suitable geologic setting is one of the key technical problems which DOE must solve. Other problems include development of waste packages that can contain the waste until the fission product hazard is greatly reduced and engineered barriers that can effectively retard migration of radionuclides out of the repository. The Commission recognizes that these three problems are not the only ones which DOE's program must solve, but they are critical components of the multi-barrier approach for nuclear waste isolation. Much of the discussion in this proceeding has focused on these problems. We have reviewed each of these issues and have concluded that they do not present an insoluble problem which will prevent safe disposal of radioactive waste and spent fuel.

A. The Identification of Acceptable Sites

There is general agreement among the participants that the period during which the wastes must be isolated from the biosphere is at least several millenia and that such prolonged isolation can be achieved in a deep mined repository provided the geologic setting is suitable. The geologic setting is the "final" isolating barrier. If the waste package and engineered barriers fail to perform as expected, the geologic barrier must prevent harmful quantities of radioactive materials from entering the human environment.

The Commission believes that technically acceptable sites exist and can be identified. In many locations in the continental United States there are geologic media potentially suitable for a waste repository. These media occur in large, relatively homogeneous and unfaulted formations and have properties (e.g., mechanical strength, thermal stability, impermeability to water) which qualify them as potential host rocks

for radioactive wastes. The potential host rocks include those being investigated by DOE — that is, domed salt, bedded salt, tuff, basalt, granite, and shale (DOE PS at II-70 to II-80). Thousands of square miles of the United States are underlain with formations containing extensive masses of such potential host rocks. Moreover, more than one-half of the United States is underlain with rock that has been stable against significant deformation and disruption for over 10 million years. The potential sites being investigated by DOE are in regions of relative tectonic stability (USGS PS at 19, 23, 24, 25, 26, 28; Tr. at 236).

Host rock suitability and formation stability are not the only relevant technical factors to be considered in repository site selection. Geohydrologic conditions — particularly the absence of significant groundwater flow from the repository to the biosphere — must be favorable for effective isolation of the wastes (USGS PS at 11). DOE's investigations reveal that the hydrologic characteristics of a major portion of the sites underlain with stable formations of potential host rock appear to be suitable for repository location (Tr. at 236; DOE PS at II-77).

These general conclusions about the extent of potential repository sites are based on the results of DOE's site exploration program (DOE PS, Appendix B) and the extensive body of earth-sciences information available at the United States Geological Survey — the Federal agency principally concerned with earth-sciences issues and, under a DOE-USGS Memorandum of Understanding, a primary source of geologic, hydrologic and mineral resource data for the National Waste Terminal Storage program (USGS PS at 2 and Appendix A; DOE PS at III-44).

DOE's site exploration efforts are focused on four host rocks (domed salt, bedded salt, basalt, and tuff) in six regions (Gulf Interior, Paradox Basin, Permian Basin, Salina Basin, DOE Hanford Site, DOE Nevada Test Site). (DOE PS, Appendix B). Although investigations of granite sites in the U.S. have been limited, DOE is developing data on the potential of granite as a host rock in collaboration with foreign investigators. A Swedish-American cooperative program (DOE's Lawrence Berkeley Laboratory is the U.S. principal in the program) has involved a series of *in situ* tests in a granite formation conducted at the Stripa mine in Sweden. The investigations included determinations of thermally induced stresses and deformations in the granite rock mass. Another cooperative study at Studsvik in Sweden involved experiments in nuclide migration in fractured subsurface crystalline rocks (DOE PS at II-258).

Some participants objected to the fact that most of DOE's site exploration involved federally owned or controlled areas, arguing that this would result in ignoring sites that were technically better (NRDC PS at 17; Tr. at 206). This objection, apparently based on the assumption that

Federal lands investigated were limited in area and geologic diversity, is not supported by the record. The Federal lands being investigated by DOE are extensive and geologically diverse; moreover, they are more readily accessible to DOE and some of them, such as the Nevada Test Site, have been previously subjected to extensive geologic assessment. These latter factors are significant advantages (DOE PS, Appendix B; UNWMG-EEI CS at IV.B-4). Although, as the United States Geological Survey pointed out, there may be advantages from a purely earth-science viewpoint in examining all parts of the country for their potential as repositories, time and resource limitations require that site exploration efforts be concentrated in limited regions fairly early so that detailed site-specific characterization efforts can be undertaken in a timely way (USGS PS at 17).

A specific site has not yet been identified as technically acceptable, and investigations of potential sites have shown some to be unsuitable. This does not necessarily mean that DOE's site-selection program will be unsuccessful in identifying technically acceptable sites. The elimination of some sites is to be expected in a pursuit of the site-selection program and is not, as some participants implied, an indication that suitable sites cannot ultimately be found.

Although the record of this proceeding does not show that DOE has progressed far enough in site characterization to confirm the existence of an acceptable site, the record does indicate that DOE's site characterization and selection program is technically sound. The data obtained in each stage of the screening process are analyzed and compared against criteria that must be satisfied for adequate performance of the total isolation system. 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 (DOE PS at III-8 to III-24; CS at II-140). As discussed above, DOE's site-screening efforts have concentrated on a diverse set of potentially suitable geologic media and are directed to an examination of large areas of the country on both federally owned and nonfederal lands (USGS PS at 17).

The technology for site identification is particularly well advanced (UNWMG-EEI PS at III.A-1). The record describes numerous site characterization techniques, both remote sensing and *in situ,* which are being used to evaluate sites (DOE PS at II-84 to II-103). The location and demonstration of acceptability of repository sites are problems which can be solved by the investigative and analytical methods now available (AEG PS at 1). Site-selection criteria are being refined (DOE PS at II-80 to II-83; 48 Fed. Reg. 5671 (1983)) and the technology exists for

site characterization (DOE PS at II-84 to II-103). Areas have been found where most natural geologic and hydrologic processes operate at rates favorable to long-term containment in a mined repository (DOE PS at II-128; Consolidated Industry Group PHS at 9).

The Commission recognizes that there are gaps in the current state of knowledge about potential repository sites and geologic media, and about geochemical processes which affect radionuclide migration (e.g., CEC PS at 17, 54; NRDC PS at 18, 50, 64; NY at 38, 80; USGS CS at 5, 6). The gaps include a lack of a detailed understanding of such relevant processes as sorption of radionuclide-bearing molecules by the geologic media, leaching of the wastes by groundwater, and radionuclide migration through subsurface formations. Some participants contend that these gaps and uncertainties in knowledge make it difficult to predict on the basis of any effort less than a detailed onsite investigation whether a candidate repository site will be technically suitable (e.g., NRDC PS at 18, 50, 53; ECNP PS at 3, 4; NECNP PS at 20, 21, 22).

The Commission recognizes that detailed site characterization is necessary to confirm that a proposed site is indeed suitable. The Commission does not believe, however, that all uncertainties must be resolved as a precondition to repository development. The performance of a repository may be bounded by using conservative values for controlling parameters, such as waste form solubility, groundwater travel time and retardation of radionuclides. Furthermore, bounding analyses can be useful to take residual gaps in knowledge and uncertainties into account. If it can be established that a repository can perform its isolation function using established, conservative values for the controlling parameters, then it is not necessary to resolve uncertainties in the range of values these parameters may exhibit (DOE CS at II-83, II-84, II-130, III-9, III-12).

The statements of those participants who are pessimistic about timely accomplishment of disposal tend to assign equal importance to all areas of uncertainty. Hence, they contain few attempts to assess the consequences of gaps in knowledge or to project the benefits of expected results from ongoing research and development efforts. It is the Commission's belief that the waste isolation system elements are adequately understood so that major unforeseen surprises in results of research and development are highly unlikely. This view is supported by USGS (USGS CS at 1-2).

A further concern of some participants is that, even if DOE were to identify a potentially acceptable repository site, the *in-situ* testing required to determine acceptability would breach the integrity of the candidate site (NY PS at 59, 63-65). If, for example, boreholes essential to

characterize a potential site result in penetration of aquifers which are not amenable to effective sealing, this might make the site unacceptable (DOE PS at II-161 to II-164). However, no persuasive evidence was presented in the record to support the position that *in-situ* tests for site characterization work are likely to compromise the integrity of candidate sites. The Commission believes that *in-situ* tests can be successfully accomplished without adversely affecting site integrity for the following reasons. Many nondestructive, remote-sensing methods are available for determining site characteristics. Further, boreholes can be located in shafts or pillars of the future repository to minimize the possibility of leakage through them.

As discussed later, borehole sealing methods are expected to be adequate. The number of boreholes necessary to adequately characterize a site can be minimized by careful planning and by use of remote-sensing methods in conjunction with the drilling program (DOE PS at II-84 to II-103, II-181). Finally, the Commission believes that if a site is found to be sufficiently sensitive to the testing program that its integrity would be destroyed, then that site would necessarily be found unacceptable.

In summary, the Commission believes that technically acceptable sites for disposal of radioactive waste and spent fuel exist and can be found. There are a number of suitable host rock types to select from; many areas are underlain with massive, stable formations containing these host rocks; the areas being investigated by DOE contain such rock formations; and the uncertainties in knowledge of the earth and material sciences relevant to the identification of an acceptable repository site are not fundamental uncertainties that would prevent the identification of technically acceptable sites. Further, *in-situ* testing required to characterize a candidate site would not necessarily compromise its integrity.

B. *The Development of Effective Waste Packages*

1. Waste Package Considerations

An important technical aspect of safe waste disposal is to assure that the waste form and the balance of the waste package, including the primary container and ancillary enclosures, are capable of containing the radioactivity for a time sufficient for the hazard from fission-product activity to be significantly reduced (e.g., DOE PS at II-8). Decay heat, groundwater and nuclear radiation could cause the waste package components to interact with each other or with the host rock materials in such a way as to degrade the ability of the package to contain the radionuclides. These items are discussed below.

To assure long-term containment, DOE's conceptual design of a waste package is based on a defense-in-depth approach and involves a number of components including spent fuel, stabilizer (or filler), waste canister, overpack, and an emplacement hole sleeve. The stabilizer is intended to improve heat transfer from the spent fuel, to provide mechanical resistance to possible canister collapse caused by lithostatic pressure, and to act as a corrosion-resistant barrier between the spent fuel and the canister. Selection of canister overpack and emplacement hole sleeve materials will be based on tests of their chemical and physical integrity at various temperatures and levels of radiation and under various conditions of groundwater chemistry, as well as tests of their compatibility with each other and with the host rock materials under repository conditions. The canister, overpack, and sleeve should constitute relatively impermeable elements of the waste package. A variety of candidate materials is being considered for these elements. The various waste package components are to be combined in a conservative design that will compensate for the overall technical uncertainties in containment capability. The requirement for retrievability during some specified period after emplacement places conditions (e.g., ruggedness) on waste package design which are added factors to be considered in its development (DOE PS at II-129 to II-152, II-282).

It is apparent from the foregoing that the development of an effective waste package depends on obtaining engineering data on those materials that appear to be promising candidates for package components. DOE is studying over twenty-eight candidate materials for canisters and overpack (DOE PS at II-143). The DOE evaluation program indicates that many of these materials are promising. For example, iron alloys have demonstrated long-term durability (DOE PS at II-144, Ref. 383), and titanium alloys and nickel alloys show high resistance to corrosion (DOE PS at II-144, Refs. 315, 338, 342). Ceramics are resistant to chemical degradation and have many other desirable properties (DOE PS at II-145, Refs. 337, 347, 348 and 349). Preliminary analysis indicates that mild steel canisters with an appropriate backfill material would be a feasible waste package for either a salt or hard rock repository. For more demanding requirements, such as brine applications, the alloys of titanium, zirconium or nickel appear to represent alternate choices (DOE PS at II-150, Refs. 337, 382). The DOE program also includes experimental studies of the release of radioisotopes from spent fuel exposed to simulated repository conditions (e.g., salt brine and fresh water with varying dissolved oxygen content). The studies are being conducted under temperature and pressure conditions that bound and exceed repository conditions (DOE PS at II-139 to II-141).

Not all participants were optimistic about waste package development. One participant asserted that in spite of DOE's efforts to develop a package that would remain inert and stable under repository conditions, none had yet been found and the DOE program would not succeed in finding one (NRDC PS at 46). Other participants pointed to the limits of present knowledge, particularly about the leaching of radioisotopes from spent fuel in a groundwater environment, and concluded that it is not possible to select a waste form which will prevent radioisotopes from migrating to the biosphere (e.g., CEC PS at 51). They also pointed out that chemical and physical properties of spent fuel varied widely and depended on burnup, location within the reactor core, age, and physical integrity; design of a system of barriers to accommodate this heterogeneity within the context of a given geohydrologic environment would be a major undertaking (NY PS at 83).

The Commission recognizes the difficulties which must be overcome in developing a suitable waste package. A large body of experimental data must be accumulated and applied to a variety of candidate arrangements of waste package components. Suitably conservative assumptions must be postulated to define the repository conditions. Data from experiments of relatively short duration have to be used to predict behavior for much longer periods. It is common practice in materials research to perform short-duration experiments under physical or chemical conditions much more severe than those expected for the longer duration and, from known fundamental properties of the materials under investigation, to extrapolate the experimental data to predict long-term behavior. Conservatism can usually be assured by making the experimental conditions sufficiently severe.

The complex composition of the mixture of radionuclides in fission products and their basic chemical properties are known and have been the subject of investigation for more than three decades. The large body of published data on fission product chemistry and experience with fission product mixtures should provide considerable support for predicting the behavior of spent fuel and high-level radioactive waste in waste package designs.[1] The Commission, therefore, concludes that the chemical and physical properties of spent nuclear fuel and high-level radioactive waste can be sufficiently understood to permit the design of a suitable waste package.

[1] Published compilations of such data, although not specifically included in the record of this proceeding, are well known to the nuclear science and engineering community. Examples are the three volumes of the National Nuclear Energy Series, C.D. Coryell and N. Sugarman, "Radiological Studies: The Fission Products," McGraw-Hill (1951); "Fuel Reprocessing," in *Reactor Handbook*, S.M. Stoller and R.B. Richards, Eds. (Interscience Publishers, Inc., New York, 1961), Vol. II, 2d ed.

The Commission also concludes that the DOE program is capable of developing a suitable waste package which can be disposed of in a mined geologic repository. This conclusion is based upon the large number of candidate materials being considered by DOE, the detailed evaluation of these materials to be conducted as part of the DOE program and the results of DOE's preliminary analysis of candidate materials, as described above (*see* § 2.1-B.1). The Commission's conclusion that the development of a suitable waste package is technically feasible is also consistent with other material in the record. For example, a study sponsored by the National Academy of Sciences (NAS) concluded that no insurmountable technical obstacles were foreseen to preclude safe disposal of nuclear wastes in geologic formations (UNWMG-EEI PS, Doc. 2, at II-6). The United States Geological Survey stated that a long-lived canister is within the capability of materials science technology to be achieved in the same time frame as repository site identification, qualification and development (USGS PS at 11). The National Research Council, after reviewing the Swedish waste disposal work (DOE PS at II-335, Ref. 380), concluded that the Swedish waste package could contain the radionuclides in spent fuel rods for hundreds of thousands of years (DOE CS at II-98).

2. *Effect of Reprocessing on Waste Form and Waste Package*

The waste form itself (spent fuel or other high-level waste) serves as the first barrier to radionuclide release and thus supplements the containment capability of the other components of the waste package as well as the repository's natural isolation capability. Throughout this proceeding it has been assumed that the waste form would be spent fuel discharged from light water reactors, with mechanical disassembly for volume reduction and packaging in a canister as the only potential modifications. The relevant properties of the spent fuel (irradiated uranium dioxide pellets and zircaloy cladding) are known. DOE's program has been directed toward providing data to determine the behavior of spent fuel as a waste package component under repository conditions. In its Position Statement DOE stated that the "representative case" to be considered in this proceeding is the disposal and storage of spent fuel from commercial reactors and that this does not foreclose "other approaches, such as the reprocessing of spent fuel and solidification of resultant nuclear wastes" (DOE PS at I-2).

On August 27, 1981, the Natural Resources Defense Council filed a Motion for Judgment requesting a prompt ruling that, on the basis of the present record, there is not reasonable assurance that offsite storage

or disposal will be available by the year 2007-09. NRDC stated that, because the present Administration[2] had changed Federal policy towards commercial reprocessing of spent fuel (reprocessing was deferred "indefinitely" in April 1977 by the previous Administration), the disposal of spent fuel would be contrary to the present Administration's policy, and thus spent fuel was no longer a valid "reference waste form" for this proceeding. As a consequence, according to NRDC, DOE schedules and timetables, which were based on spent fuel storage and disposal, were irrelevant. The NRDC view was challenged by DOE as well as by seven participants representing utilities and the nuclear industry. The Commission took note of the NRDC filings and the responsive filings by other participants, considering them part of the record, and in its November 6, 1981 Second Prehearing Memorandum and Order asked the participants to address the significance of commercial reprocessing to the Commission's decision in the waste confidence proceeding. In response, the participants addressed this change in government policy in their prehearing statements filed in December 1981.

In response to those who argued that the change of reprocessing policy invalidated DOE's position, DOE stated that the program for development of the technology is not dependent on the waste form. Moreover, DOE pointed out that the purpose of this proceeding — "to determine whether there is at least one safe method of disposal or storage for high-level radioactive waste" is not changed by this Administration's support of reprocessing of spent fuel (DOE PHS at 2-3). Some participants who agreed with DOE commented that spent fuel disposal involves greater difficulty than disposal of solidified reprocessing waste because of its higher radioactivity and less easily handled form; in addition, they asserted that the removal of the uranium and most actinides by reprocessing would ease the requirements for safe long-term storage and simplify the waste disposal problem (UNWMG-EEI PHS at 16; SE2 PHS at 4). Others contended that spent fuel is a more difficult waste form because heat dissipation and packaging problems involved in disposal appear to be more severe than in disposal of solidified reprocessing waste (AIF PHS at 6; ANS PHS at 5).

The Commission recognizes that the proceeding has been primarily concerned with storage and disposal of spent fuel. However, the Commission does not believe that the possibility of future reprocessing, and the potential need to dispose of high-level radioactive waste resulting from reprocessing, significantly alters the technical feasibility or the

[2] The NRDC statement was based on DOE testimony before a congressional committee. The President's Nuclear Policy Statement of October 8, 1981, confirmed the DOE testimony.

schedule for developing a mined geologic repository and the design of its multiple barriers.

With regard to technical feasibility, the effect of spent fuel reprocessing on the commercial radioactive waste disposal problem is not a new consideration. The disposal of waste from reprocessing spent fuel has been studied for a longer time than the disposal of spent fuel. Until 1977, the commercial waste management program was directed primarily toward disposal of waste from spent fuel reprocessing, and those efforts have continued. A variety of waste forms has been studied (DOE PS at II-153 to II-160). Thus, considerable information is already available on the technical feasibility of developing a suitable waste form for reprocessed high-level radioactive waste. In fact, there is evidence that the disposal of reprocessed high-level waste may pose fewer technical challenges than the disposal of spent fuel (Tr. at 29). Moreover, commercial reprocessing of spent fuel cannot be undertaken in this country in the absence of a full NRC licensing review. That review will consider, among other things, the waste form to be produced by the reprocessing method and its implications for waste disposal. Unless the Commission determines that commercial reprocessing and management of its products assure adequate protection to the public health and safety and the common defense and security, spent fuel will continue to be the predominant commercial waste form available for disposal in a repository.

With regard to the impact on DOE's repository schedule, the Commission recognizes that DOE's waste package development program will eventually be affected to some extent by the nature of the waste form under development. However, the direction taken in research and evaluation of materials being conducted in the DOE program is expected to produce results which would be relevant to the waste package design, regardless of which waste form is used (DOE PS at II-141 to II-152, CS at II-96 to II-100). Moreover, the choice of waste form will not significantly affect other elements of the DOE repository program. The storage and disposal of reprocessed waste would involve substantially the same problems as those being addressed for spent fuel, and a change in waste form would not alter the site-selection program or the program for development of suitable engineered barriers (DOE PHS at 3). Thus, DOE's program is proceeding on a basis that would permit the disposal of either high-level waste or spent fuel. This approach is consistent with the recommendations of the Interagency Review Group in its March 1979 report to the President (IRG Final Report at 73) and with the direction in the Nuclear Waste Policy Act of 1982 (§ 111(a)(2)). Finally, as noted above, any decision to permit the commercial reprocessing of spent fuel

will include consideration of the reprocessed waste form and its implications for waste disposal. For these reasons, the Commission concludes that the possibility of commercial reprocessing does not substantially alter the technical feasibility of, or the schedule for, developing a suitable waste package.

The Commission concludes that the basic knowledge of spent fuel and high-level waste and its behavior in a repository environment, together with DOE's ongoing development and testing program, are sufficient to provide assurance that a waste package can be developed that will provide adequate containment until the potential hazard from the fission product activity is sufficiently reduced.

C. *The Development of Effective Engineered Barriers for Isolating Wastes from the Biosphere*

1. Backfill Materials

In DOE's conceptual design, one engineered barrier consists of backfill materials for filling voids between canister, overpack, sleeve and host rock. The materials are chosen to retard radionuclide migration. The task is to design and test barrier materials which will be effective for very long periods of time. Candidate materials include bentonite, zeolites, iron, calcium or magnesium oxide, tachyhydrite, anhydrite, apatite, peat, gypsum, alumina, carbon, calcium chloride, crushed host rock, and others (DOE PS at II-147). Host rock or other materials would also be used to backfill drifts and shafts within the repository.

The California Department of Conservation (CDC) contends that repository shaft and borehole backfill material performance may be degraded as a result of increased temperature and other factors (CDC PS at 19-22). However, the expected temperature rise in the shaft backfill material will be only about 10°F, and will cause no significant degradation of the shaft backfill material (DOE PS at II-347, Ref. 527, NUREG/CR-0495). Other participants believe that there is inadequate information to permit development of long-lived engineered barriers that will effectively contain high-level radioactive wastes (NRDC PS at 18, 32; Ill PS at 3-4; NECNP PS at 18). CDC further contends that at this time, no information appears to have been developed that specifies the best type of backfill material to be used in particular geologic media (CDC PS at 19-22). However, the choice of backfill must take into account the rock media at the selected site as well as the waste package material. Thus, the backfill cannot be selected until a repository site has

been selected. The NWTS program has as its objective, providing information on a practical range of options for backfill materials. Although a considerable amount of work remains to be done, an active research and development program on backfill materials is under way (DOE PS at II-147). Further, that program is providing information to evaluate the backfill material options, as well as to establish a basis for selection of a suitable material for the geologic media being considered. The Commission believes that this approach provides an adequate basis for concluding that effective backfill materials will be identified in a timely fashion.

In the National Waste Terminal Storage program, a wide range of candidate backfill materials has been and is continuing to be evaluated (DOE PS at II-129 to II-152). The DOE studies include measurements of the appropriate properties of backfill material including nuclide sorption capacities, capability to prevent or delay groundwater flow, thermal conductivity, mechanical strength, swelling, plastic flow and methods of backfill emplacement. Data on available candidate materials show significant radionuclide sorption capabilities, and sorptive properties can be maintained at elevated temperature and in the presence of radiation (DOE CS at II-98, II-99). Analyses indicate that several of the materials could provide adequate performance characteristics (DOE PS, Part II, Refs. 339, 340, 346, 372, 374, 376). As an example of the development of effective engineered barriers, the results of Swedish studies on radionuclide release in a repository were cited. The studies showed that a bentonite clay backfill, in conjunction with a thick copper canister (with spent fuel inside) could prevent the release of radionuclides to the host rock in the presence of granitic groundwater for thousands to hundreds of thousands of years. In the Swedish experiments, the clay barrier provided sorptive properties which were predicted to delay the breakthrough of various radionuclides for thousands of years and also served to chemically condition the groundwater, reducing its corrosive effect on the canister (DOE PS at II-145, II-148). The use of certain clays to retard the transport of radionuclides released by the waste package is applicable to repository designs here in this country. While DOE has not proposed using thick copper canisters as employed in the Swedish studies, this example of a durable combination of waste package and backfill material, which was demonstrated to be effective in isolating radionuclides for very long times, indicates that the basic approach is reasonable. The use of clays, combined with other appropriate materials, could provide an effective means for radionuclide retardation and corrosion control.

In sum, the Commission believes that DOE's ongoing developmental studies reported in this proceeding (DOE PS at II-129 to II-152) are

technically sound and provide a basis for reasonable assurance that engineered barriers can be developed to isolate or retard radioactive material released by the waste package.

2. Borehole and Shaft Sealants

A major factor in repository performance is the effective sealing of boreholes and shafts during repository closure operations. All penetrations provide potential pathways for radionuclides to reach the biosphere or for groundwater to enter the repository. The penetrations must be sealed for an extended period of time. Further, the geology and hydrology at a particular site, as well as the expected temperature and pressure conditions during repository lifetime, must be understood in order to make a proper choice of the borehole and shaft sealing materials and to develop effective borehole and shaft seals.

Some participants concluded that current information concerning the technology for the sealing of the boreholes and shafts is inadequate. They also questioned the capability of the DOE program to develop sufficient information to allow effective seal design (CDC PS at 19-22; NRDC PS at 5). The views of several participants who expressed concern about sealing were reflected in the comments of CDC. The Commission's response to each of the points raised by CDC on borehole and shaft sealing issues is discussed below.

CDC indicated that since long-term effects of heat and radiation on seal materials were not a factor in past oil and gas borehole sealing experience, such experience is not applicable to repository sealing.[3] However, at distances of more than several feet from waste canisters emplaced in a repository, radiation exposures are small and the temperature rise at seals in the shafts and boreholes is insignificant for sealing purposes (DOE CS at II-108).

CDC also believes that the tests of cement seals with epoxy resins in bedded salt deposits discussed by DOE are insufficient to provide assurance of seal stability over a period of 10,000 years, especially when the effects of higher temperature and radiation are not included. As noted above, temperature and radiation effects on seals are expected to be negligible.

[3] The Commission notes that the extensive oil and gas borehole sealing experience has not been concerned with very-long-term sealing. Therefore, DOE's sealing research and development must provide a basis to extend that experience for the development of long-term seals for a repository.

While these tests may not provide conclusive proof of performance for 10,000 years, they are expected to provide useful information for seal development.

CDC states that the results of field tests described by DOE as continuing over the next few years will not be completed in time to contribute to seal design criteria which are to be completed[4] in 1982. However, the final seal design for the selected site is scheduled for 2 years after a site is selected (DOE PS at II-184). Testing up to that date is expected to be useful in designing an effective seal.

CDC questioned whether tests of waste package system component interactions with the surrounding media in bedded salt described by DOE will be completed in time for location of a repository. However, the Commission finds no basis for this assertion in the record. The DOE program appears to be adequately addressing this issue. Studies are in progress to characterize further the interactions between candidate backfill-getter materials and waste container alloys. These studies include investigations of dry rock salt/metal interactions and high-intensity radiation/salt/brine/metal interactions. (DOE PS at II-149, II-150).

CDC asserts that DOE has not discussed designing backfill material and penetration seals to allow for safe reentry if retrieval should become necessary. However, the provision to retrieve high-level waste and spent fuel for a number of years after the repository is filled has been addressed by DOE (DOE PS at II-280 to II-283). Although it has not yet been established whether backfilling and sealing will be conducted before repository closure, these operations may be reserved until a final decision for closure is made. In any event, CDC provides no basis for concluding that providing for retrievability will necessarily create any major difficulties for the design of backfill material and penetration seals.

According to one participant,

> [t]here is no established way to seal a repository so as to prevent radionuclide release to the biosphere for the necessary period of time. DOE has termed the sealing problem a "key unknown" but there is no consensus that the technology which is currently anticipated will provide adequate seals for even a few decades.

(Consolidated States Group PHS at 8). Other participants maintained that seals must perform as well as the host rock in preventing radionuclide migration (NRDC PS at 55). The DOE position is that the seal should provide a barrier with sufficient integrity to ensure acceptable

[4] DOE has published "Schematic Designs for Penetration Seals for a Reference Repository in Bedded Salt," ONWI-405, November 1982.

consequences, and sealing adequacy should be determined only on a site-specific basis (DOE CS at II-106). DOE asserted that its program will successfully resolve remaining uncertainties in repository sealing technology (DOE CS at II-106 to II-109).

DOE has been studying cement-based borehole plugging and has examined use of grout materials for application to the Waste Isolation Pilot Plant (WIPP) and other potential repository sites. Earth-melting technology for plugging in salt and use of compacted natural earth materials are also being investigated (DOE PS at II-183, CS at 106-09). There is a considerable body of experience in sealing subsurface formations in the oil, gas, and other mineral-extraction industries. However, related industrial experience and requirements for sealing a repository differ in one important respect: repository sealing must be effective for a very long time while most other sealing applications are for relatively short time periods (DOE PS at II-182). Future DOE effort will be needed to verify borehole seal performance and durability for each candidate medium. An important aspect of DOE's work is to determine the rate of degradation of seal performance as a function of time. DOE plans to determine seal performance specifications for a particular site on the basis of calculated predictions of radionuclide release and transport to the accessible environment (DOE PS at II-182). These predictions are expected to indicate that a site whose characteristics for waste isolation are clearly superior may not require sealing performance specifications as stringent as those for a less-favorable site.

Based upon the extensive experience with shaft and borehole sealing in other industries and DOE's detailed program for evaluating the long-term performance of seals, the Commission believes that there is a reasonable basis to expect that long-term effective borehole and shaft seals can be developed.

D. Summary of Views on the Technical Feasibility of Safe Waste Disposal

The Commission notes that participants in the Waste Confidence Rulemaking proceeding have generally agreed there are no known fundamental technical problems which would make safe waste disposal impossible. Where they differ is the extent to which the technical problems of disposal technology and siting have already been solved and the capability of DOE to solve them, and particularly to solve them by 2007-09 or by the expiration date of reactor operating licenses (e.g., NY PS at 3; NECNP PS at 171; Minn PS, Enclosure at 13-20).

The Commission believes that the record provides a basis for reasonable assurance that the key technical problems can be solved. Technically acceptable sites exist and can be found among the various types of geologic media and locations under investigation by DOE. Currently developed geophysical methods for site evaluation appear capable of adequately characterizing the site, and the residual uncertainties in earth sciences data do not seem to be an insurmountable impediment. Further, the Commission believes that the multi-barrier approach to waste package design is sound and that package development is being adequately addressed by DOE. DOE's development work on backfill materials and sealants provides a reasonable basis to expect that backfill materials and long-term seals can be developed. Reprocessing of spent fuel would only become a licensed commercial activity if disposal of reprocessing waste in a mined repository would be established as technically feasible. While the Commission recognizes that more engineering development and site-specific work on disposal technology will have to be conducted before a waste repository can be constructed and operated, the Commission concludes that it is technically feasible to safely dispose of high-level radioactive waste and spent fuel in a mined geologic repository.

2.2 Second Commission Finding

The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

While the record of the proceeding supports a finding that disposal is technically achievable, the Federal government has, in the past, made inadequate progress in developing sound waste management policies and programs. The Commission notes that DOE has stated in its April 1984 draft Mission Plan that the first repository will begin operations in 1998, and that the second will start up in 2004. However, it is recognized that both technical and institutional issues contribute to uncertainties concerning DOE's ability to complete one or more mined geologic repositories for high-level radioactive waste by those dates. The technical issues concern DOE's ability to find technically acceptable sites in a timely fashion and the timely development of waste forms, packages, and engineered barriers. The institutional issues concern primarily Federal-State relations and the management and funding of the Federal program.

The Commission has considered the effect of enactment of the Nuclear Waste Policy Act of 1982 and concludes that the Act helps to reduce these scheduling and institutional concerns. The Act provides support for timely resolution of technical uncertainties by: (1) establishing specific milestones for all the key tasks; (2) coordinating the activities of all the involved Federal agencies; (3) providing for time schedules and a mission plan for the accomplishment of the tasks; and (4) providing a mechanism for monitoring progress, for identifying failures to meet the schedules and the milestones, and for adjusting the future elements of the program in the event that such failures occur. In order to further enhance the resolution of technical uncertainties regarding rock thermal-geomechanics the Act provides for the establishment of a Test and Evaluation facility to carry out *in-situ* studies of rock at repository depth. The Act also reduces uncertainties in the institutional arrangements for the participation of affected States in the siting and development of repositories and in the long-term management, direction and funding of the repository program. The Commission's assessment of both the technical and institutional factors is discussed below.

A. Technical Uncertainties

The ability to construct and operate a mined geologic repository that will provide for the safe disposal of high-level radioactive waste and spent fuel by the years 2007-09 has been challenged by several participants. In addition to the institutional issues which must be resolved, interrelated technical problems have to be solved in a coordinated and timely fashion. The Department of Energy is confident the technical problems can be solved as scheduled in the National Waste Terminal Storage Program plans (DOE PS at III-86, CS at III-13; DOE draft Mission Plan, April 1984). Other participants conclude that because of unresolved technical problems, DOE's schedule cannot be met (e.g., Consolidated Public Interest Group PHS at 2-7; Consolidated State Group PHS at 1-13). For convenience, we consider the technical controversy in two categories: (a) finding technically acceptable sites in a timely fashion, and (b) the timely development of waste packages and engineered barriers.

1. Finding Technically Acceptable Sites in a Timely Fashion

To assure the adequacy of a candidate site requires extensive onsite investigations including drilling or excavating, as well as analyses and technical evaluations. Although DOE has not yet begun subsurface site

characterization to enable identification of an acceptable site, the record does indicate that DOE's site screening and selection 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.

DOE is investigating four geologic media at a number of sites: domed salt (Gulf Interior Region); bedded salt (Paradox Basin, Permian Basin, Salina Basin); basalt (DOE's Hanford Site), and volcanic tuff (DOE's Nevada Test Site). Investigations in a fifth media (granite) are planned, but sites have not yet been determined (DOE PS, Appendix B). Exploratory shaft excavation at three sites in different geologic media was to begin for basalt in April 1983, for volcanic tuff in October 1983, and for salt in December 1983 (Tr. at 241-42). However, the Nuclear Waste Policy Act of 1982 (NWPA) imposed new conditions which made it necessary to revise this schedule. The NWPA specified that DOE had to prepare environmental assessments for each of five nominated sites, from which three sites would be recommended to the President for characterization. DOE's preparation of environmental assessments and recommendation of three sites were to be accomplished in keeping with the provisions of the repository siting guidelines required by the NWPA. The Commission's concurrence in DOE's siting guidelines on July 3, 1984, enables DOE to proceed to nominate and recommend repository sites for characterization. DOE has recently published a revised schedule for site-selection milestones in its April 1984 draft Mission Plan. As described in its Mission Plan, the current status of DOE's site-selection schedule calls for the issuance of environmental assessments for five nominated sites and the recommendation of three of those sites for characterization by December 1984. DOE's schedule for work in the various geologic media is summarized below.

Salt: Resolution of the identified key screening issues in FY 84 is expected to permit nomination of a candidate salt dome site in December 1984. DOE is still choosing from among several salt domes in the Gulf Coast interior region (Tr. at 243-44; DOE draft Mission Plan, April 1984). For bedded salt, primary effort has been focused on the Palo Duro Basin in Texas, the Paradox Basin in Utah, and the Permian Basin, particularly the Delaware Basin in the Los Medanos area, the site considered for the proposed WIPP. The Bureau of Land Management issued the report "Environmental Assessment of DOE Proposed Location and Baseline Studies in the Paradox Basin, Utah-Final" UT-060-51-2-11, in July 1982. Each of the seven potentially acceptable salt sites has been evaluated for environmental conditions, and a site characterization plan is expected to be issued for salt in September 1985. DOE will start

land access and permitting activities for salt after negotiating agreements with affected States and Indian tribes (DOE draft Mission Plan, April 1984).

Basalt: The basalt formations at the Hanford Reservation in the center of the Pasco Basin (Columbia Plateau, central Washington) are prime candidates for repository sites. DOE expects to issue a site characterization plan for basalt in January 1985 and start drilling for the exploratory shaft in March 1985 (DOE draft Mission Plan, April 1984).

Volcanic Tuff: The Nevada Test Site offers several suitable candidates for waste repository siting. The primary focus is welded tuff on Yucca Mountain, where DOE has begun a program of drilling and geophysical evaluation. DOE expects to issue a site characterization plan for tuff in March 1985 and begin shaft work in September 1985 (DOE draft Mission Plan, April 1984).

Granite: Granite and other crystalline rock media are being considered for the second repository (DOE draft Mission Plan, April 1984). DOE has conducted only limited investigations of granite at the Nevada Test Site (DOE PS at B-66, B-72), but is developing data on the potential of granite as a repository medium in collaboration with Swedish investigators (DOE PS at II-258). This project has already produced a large amount of rock thermal-mechanics data at repository depth for use in repository designs in granite media in this county (DOE PS at II-258 to II-260).

As indicated in our discussion of technical feasibility, the identification of technically acceptable sites is a key problem and the date of successful solution of this problem is a critical milestone in the repository program. Those participants who believe DOE could not meet its site-selection schedule asserted that determination of the acceptability of proposed repository sites requires information that will not be available when needed. They maintained that DOE's knowledge is seriously incomplete with respect to all of the potential sites considered to date. Further, they asserted that because new information could disqualify any of the potential sites, as it did at the Palestine dome, there is, as yet, no basis for reasonable assurance that an acceptable repository site will be available in the time period under consideration (NRDC PS at 44; NECNP PS at 24). The Commission recognizes that if the DOE program were further along, e.g., in the middle of exploratory shaft work, there would be much more site-specific information available (including the results of *in-situ* tests) and a firmer basis for assessing whether DOE's revised schedule can be met. However, the Commission can make a reasonable prediction with the information now before it.

Underlying the pessimism of some participants is apparently a belief that DOE's past record in solving technical problems undermines the possibility of finding confidence in DOE's ability to solve the waste disposal problems in a timely way. The Commission acknowledges that in the past the waste programs of DOE and its predecessor organizations have experienced difficulty in making timely progress toward a solution of the nuclear waste problem. However, the Commission need not rely on this past record in making its confidence determination. The DOE program is now adequately addressing the issues yet to be resolved in identifying an acceptable site, and DOE's schedule is a reasonable one (*see* the discussion in § 2.2-B.4, below). The qualifications and professional experience of the many scientists and engineers on the overview committees and peer review groups who advise and consult on the DOE program should provide confidence in DOE's efforts (DOE CS, Appendix D). The support of the USGS in the earth sciences field (USGS PS, Appendix A) clearly contributes to confidence that the technical problems associated with identifying an acceptable repository site will be solved. As noted before, no fundamental technical breakthroughs are necessary. Rather, completing the program is a matter of step-by-step evaluation and development based on ongoing site studies and research programs.

The Commission believes that the enactment of the Nuclear Waste Policy Act of 1982 provides impetus to that program and helps ensure that it will be completed on a schedule consistent with the Commission's findings. The Nuclear Waste Policy Act establishes a detailed step-by-step plan for developing a waste repository. The Act directs DOE to prepare a comprehensive Mission Plan which will establish programmatic milestones for research, development, technology demonstration and systems integration. The Act also requires the various Federal agencies involved in the program to coordinate their activities. Involved agencies must report their progress, or lack thereof, to Congress, explain any slip in schedule and set a new schedule for activities. Thus, the Act provides a framework and schedule for developing a repository.

The schedule set forth in the Act calls for the identification of adequate sites in time to meet the final decision date on construction authorization by the NRC and well before the time at which such action would be necessary to assure repository operation within the time period discussed in this decision. The time between sinking of an exploratory shaft and the completion of site characterization contemplated by the Act (§§ 112, 114) is 26 months, with an extension to 38 months under certain conditions; the DOE schedule for these activities is generally compatible with this schedule (*see* § 2.2-B.4, below).

The Nuclear Waste Policy Act also puts in place procedures (§§ 115, 116, 117, 118, 119) which the Commission believes will help to resolve potential institutional problems that might affect the schedule for site selection. These are discussed in detail hereafter. The Commission believes that the provisions of the Act should also provide resources (§§ 302, 303) to adequately fund the site selection and characterization work.

Given all of these considerations, the Commission concludes that there is reasonable assurance that technical uncertainties — unsolved technical problems and information gaps — will be removed in time for DOE to meet its proposed schedule. DOE's program is adequate and its schedule is reasonable. The Act provides a greater degree of confidence than existed previously that site selection will proceed within the general time frame that DOE has described in its position statement.

2. Timely Development of Waste Packages and Engineered Barriers

Some participants have expressed strong reservations concerning DOE's ability to develop waste forms, packages, and engineered barriers in a timely fashion. The DOE technical effort to solve problems was characterized as only just being defined in many significant areas, including the prevention of corrosion of waste canisters (NRDC PS at 18). Other participants contended that: the design and evaluation studies of penetration seals and backfill material might not be completed soon enough to meet the goal of achieving an operational repository by 1997 to 2006; the long-term effects of heat and radiation on the integrity of the seal materials are not known; tests of cement seals with epoxy resin in bedded salt deposits are insufficient to assure stability of such seals over a period of 10,000 years; and field tests of liquid permeability during a period of 3 months cannot provide confidence concerning the stability of seals during a period of 10,000 years. Participants also contended that no information had yet been provided which specified the type of backfill material most suitable for specific geological media and capable of withstanding thermal stress (CDC PS at 19-22).

Although technical problems associated with the development of waste packages and engineered barriers could delay DOE's schedule, DOE believes that the uncertainties surrounding the waste package would be resolved or bounded as a result of implementation of its program (DOE PS at II-160, CS at II-96). The DOE Waste Package Program Plan (ONWI-96) which was issued in August 1980, updated in June 1981 (NWTS-96) and updated further in DOE's April 1984 draft Mission Plan, sets forth details of DOE's program. Waste package performance

criteria will be developed in the near future. Final action on the criteria will be contingent upon the final issuance of NRC's technical criteria (10 C.F.R. Part 60, Subpart E), the publication of the relevant regulatory guides on waste packages, and the ONWI-33 series of criteria documents, i.e., the reports DOE/NWTS-33(1), (2), (3), "NWTS Program Criteria for Mined Geologic Disposal of Nuclear Wastes."

Earlier, DOE had planned to complete the waste package preliminary designs for salt in September 1982, for basalt in June 1985, for tuff in June 1984, for granite in September 1984, and for argillaceous rock in December 1984, and to establish a baseline for waste form specifications by June 1983 (ONWI-96). According to DOE's April 1984 draft Mission Plan, the current reference canister material for basalt is carbon steel. Alternative materials include an iron-chromium-molybdenum alloy, copper and a copper-nickel alloy. On the basis of preliminary corrosion test results, carbon steel has also been selected as the reference canister material for salt. The titanium alloy Tricode 12 has been designated as an alternative material. Type 304L stainless steel has been identified as the reference container material for tuff; other austenitic stainless steels, Inconel and copper are alternatives. Waste-package conceptual designs have been developed for basalt, salt and tuff. (The conceptual design for tuff is based on saturated conditions; a conceptual design for the unsaturated zone will be available in late FY 84 (DOE draft Mission Plan, April 1984)).

Tests with spent fuel and borosilicate glass have been initiated under site-specific conditions for basalt, salt and tuff. Preliminary waste acceptance requirements have been developed for basalt and salt. In addition, for salt media, interim waste-acceptance requirements for borosilicate glass and draft waste acceptance requirements for spent fuel were prepared in FY 83. Preliminary requirements for tuff will be prepared in FY 84. DOE intends to submit the baseline waste form specifications developed during the conceptual design studies for acceptance by NRC. The specifications will be subjected to configuration control for application throughout the waste processing and disposal program.

According to the DOE draft Mission Plan the complete waste package performance model will be verified and validated by September 1989. Further, the program plan calls for completion of the waste package final design that takes into account the selected site environmental conditions, after completion of *in-situ* testing in FY 89 and FY 90. Packing material is included in the reference waste package only for basalt. The reference packing material for basalt is a mixture of crushed basalt and sodium-bentonite clay. Ongoing physical property testing of reference packing material is expected to be completed in FY 87 and ongoing

radionuclide sorption, solubility and diffusion testing are to be completed by September 1989.

Some participants' statements are pessimistic assessments based on the fact that the DOE program has not yet reached the critical milestones — e.g., establishment of waste form specifications, completion of waste package preliminary designs, verification of a waste package performance model, and qualification of barrier materials. However, the Commission believes that these technical problems will be solved without delaying a repository schedule. DOE has put in place an extensive nuclear waste research program that addresses each of these technical problems. Research results already reported on waste form packaging and barrier materials indicate that these research efforts, although not yet completed, can reasonably be expected to provide solutions to those problems when those solutions are needed to meet the DOE schedule (DOE PS at II-129 to II-197, CS at II-93 to II-100).

The Commission's positive assessment is strengthened by provisions in the Nuclear Waste Policy Act of 1982. Title II of the Act authorizes DOE to undertake steps leading to the construction, operation and maintenance of a deep geologic test and evaluation facility and to establish a focused and integrated research, development and demonstration program. In the area of waste package design, the Act directs that DOE's Mission Plan identify a process for solidifying high-level radioactive waste or packaging spent fuel with an analysis of the data to support selection of the solidification process or packaging technique. The Act calls for a schedule for implementing such a plan and for an aggressive research and development program to provide a high-integrity disposal package at a reasonable price (§ 301(a)(8)). The Commission notes that DOE's published draft Mission Plan (April 1984) addresses these issues in detail. Congressional authorization of those programs, together with the assurance of necessary funding, provides the Commission additional confidence that the required research work will be done in a timely manner.

The Commission also notes that the programs to solve the major technical problems relating to the timely development of waste forms, waste packages, and engineered barriers can proceed in parallel. Because the waste repository must be designed as a system, the problems are interrelated; however, the relationships are such that solving one problem need not await the solution of another. DOE could proceed for a number of years on waste package development before making a decision on the form of the waste, without affecting the repository availability schedule.

B. Institutional Uncertainties

The principal institutional issues that affect the schedule for availabi ty of a mined geologic repository include: measures for dealing wi Federal-State disputes; an assured funding mechanism that will be suf cient over time to cover the period for developing a repository; an org nizational capability for managing the high-level waste program, wheth this be DOE or a successor organization; and a firm schedule and esta lishment of responsibilities which will lead to repository development a reasonable period of time. Each of these is discussed in turn.

1. Measures for Dealing with Federal-State-Local Concerns

The President and Congress have recognized the need to involv State and local governments in the decisionmaking process and hav taken steps, including enactment of the Nuclear Waste Policy Act c 1982, to establish an institutional framework to accomplish this enc DOE pointed out that Presidents Carter and Reagan have considere State involvement in site selection an important aspect of the high-leve radioactive waste disposal program. President Carter, in his message t Congress, directed "the Secretary of Energy to provide financial an technical assistance to States and other jurisdictions to facilitate the fu participation of State and local government in review and licensing pro ceedings." He committed the Federal government to work with State tribal and local governments in the siting of high-level waste reposito ries. Within a framework of "consultation and concurrence," a hos State would have a continuing role in Federal decisionmaking involvin the siting, design and construction of a high-level waste repository (DOE CS at II-11, II-13 to II-14). President Reagan's statement of Octo ber 8, 1981, similarly instructed DOE to work closely with industry anc State governments in developing methods of storing and disposing of commercial high-level waste.

Although industry groups believed that DOE had made substantial progress in cooperating with State and local authorities by encouraging their direct participation in planning and preliminary site-selection activities (UNWMG-EEI CS at V-27, V-28), States and environmental groups were skeptical that the mechanisms proposed by DOE for incorporating State and local views (e.g., consultation and concurrence) would work satisfactorily. Many States asserted a lack of confidence in DOE's claims that it would be able to gain agreement from States by persuasive measures (e.g., Ohio PS at 5; NY PS at 74; Wis PS, Kelly, at 5) and noted that information-sharing was inadequate to reduce or overcome a State's resistance to a repository (e.g., NY PS at 74; NRDC PS

at 69). The States also believed that DOE had underestimated potential State and local opposition to the siting of a repository (CEC PS at 27, Ohio PS at 12) and that consultation and concurrence must include a mechanism for resolving intergovernmental disputes (Vt PS at 3). Other participants argued that many States had already imposed bans on waste disposal (NECNP PS at 32) and that DOE had presented no means for resolving State nonconcurrence (NRDC PS at 69). Still others claimed that the State's role in the site-selection process must be specifically defined (Del PS at 6); but that DOE had provided no basis for optimism that this could be done (NECNP PS at 69). Some participants suggested that local opposition to waste repositories could be overcome by providing financial compensation to nearby communities (AIChE PS at 6) but that DOE had not adequately considered compensation to host communities for socioeconomic impacts (Ohio PS at 14).

The recently enacted Nuclear Waste Policy Act of 1982 defines the roles of the States and Indian tribes in repository site selection, and thereby reduces some of the uncertainties in settling disputes between the Federal government and affected States and Indian tribes. By providing for information exchange, for financial and technical assistance, and for processes of consultation, cooperation, negotiation and binding written agreement, the Act should help to minimize the potential for more formal objections and confrontations.

Specifically, the Act requires DOE to identify the States with one or more potentially acceptable sites for a repository and to notify the governing bodies of the affected States or Indian tribes of those sites (§ 116(a)). The Act establishes detailed procedures for consultation with the States and Indian tribes regarding repository site selection (§ 117). DOE, NRC and other agencies involved in the construction, operation, or regulation of any aspect of a repository in a State must provide to the State and to any affected Indian tribe, timely and complete information regarding plans made with respect to the site characterization, development, design, licensing, construction, operation, regulation, or decommissioning of such a repository (§ 117(a)(1)). If DOE fails to provide such information requested by the State or affected Indian tribe in a timely manner, it must cease operations at the site (§ 117(a)(2)). The Act also provides that DOE must consult and cooperate (§ 117(b)) with the affected States and Indian tribes and must enter into a binding written agreement (§ 117(c)) setting forth the procedures under which information transfer, consultation and cooperation is to be conducted.

Following consultation with affected States and Indian tribes, the Secretary of Energy is to recommend to the President three sites suitable

for characterization as candidates for selection as the first and second repositories (by July 1, 1985, and July 1, 1989, respectively) (§ 112(b)(B), (C)). The President must then submit to Congress his recommendation of sites qualified for construction authorization for a first and second repository (no later than March 31, 1987, and March 31, 1990, respectively) (§ 114(a)(2)(A)). Following submission by the President of a recommended site to Congress, the Governor or legislature of the State, or the Indian tribe in which such site is located, may disapprove the site designation and submit (within 60 days) a notice of disapproval to Congress (§ 116(b)(2)). The site is disapproved unless Congress passes a joint resolution within 90 days to override the State or Indian tribe disapproval (§ 115(c)). The Commission recognizes that the latter provision may create uncertainty in gaining the needed approvals of repository sites from the affected States or Indian tribes. Nevertheless, the Commission believes that, on balance, this congressional action to establish a detailed process for State and tribal involvement in the development of repositories will reduce overall uncertainties by encouraging Federal-State cooperation and by limiting the potential for formal State or Indian tribe objections that could lead to disruption of project plans and schedules. This conclusion is consistent with the views expressed by State participants in this proceeding that a mechanism for State participation, including the resolution of State objections and nonconcurrences, is necessary for State cooperation and for progress in repository development (Tr. at 117, 119, 120). Further, the Act fixes the point in time at which a State may raise formal objections. Once that time has passed, this should reduce uncertainties at later stages.

The Act stipulates that DOE will reimburse costs incurred by affected States and Indian tribes in participating in the activities identified above. The Act provides that the Secretary of Energy shall make financial grants (§§ 116, 118) to each State or affected Indian tribe notified by DOE that a potentially acceptable repository site exists within its jurisdiction. These grants are made to enable the State or affected Indian tribe to participate in the review and approval activities required by the Act (§§ 116, 117), or authorized by written agreement entered into with DOE. Further, DOE is to make financial grants (§§ 116, 118) to each State or affected Indian tribe where a candidate site for a repository is approved, to enable the State or Indian tribe to conduct the following activities: (a) review activities taken for purposes of determining impacts of such a repository, (b) develop a request for impact assistance, (c) engage in site monitoring, testing or evaluation, (d) provide information to its residents, and (e) request information. In addition, the Act specifies that financial assistance will be provided to mitigate any

economic, social, public health and safety, or environmental impacts of the development of a repository. The Act also provides that State and local government units shall receive payments equal to the amount they would receive from taxing such site characterization and repository development activities in the same manner that they tax other real property and industrial activities (§ 116). By providing a tangible benefit to those localities or Indian reservations where repository sites are being investigated, this provision should address one concern frequently expressed by State and tribal organizations, and may result in a more willing acceptance of a repository site.

In sum, the Commission believes that the provisions of the Nuclear Waste Policy Act of 1982 reduce uncertainties regarding the role of affected States and Indian tribes in repository site selection and evaluation, and minimize the potential for direct confrontation between the Federal government and the States or tribal organizations with respect to the disposal of commercial high-level waste and spent fuel. By reducing these uncertainties, the Act should help minimize the potential that differences between the Federal government and States or Indian tribes will substantially disrupt or delay the repository program. Further, as discussed previously in this section, the decisionmaking process set up by the Act provides a detailed, step-by-step approach which builds in regulatory involvement. This should also provide confidence to States and Indian tribes that the program will proceed on a technically sound and acceptable basis.

2. *Continuity of the Management of the Waste Program*

The Commission recognizes that the waste disposal program involves activities conducted over a period of decades. Thus, there is a need for long-term stability of management and organization. The Commission's Second Prehearing Memorandum and Order of November 6, 1981, sought comments on the implications of the possible dismantling of the DOE and assignment of its functions to other Federal agencies. In response, DOE stated:

> The ability of the Federal Government to implement the waste isolation program would not be affected by the President's September 24, 1981 proposal to dismantle DOE. As demonstrated by his Nuclear Policy Statement of October 8, 1981 . . . the President is committed to the swift deployment of means of storing and disposing of commercial high-level nuclear waste. Thus, some governmental unit will continue the program aggressively if DOE is dismantled.

(DOE PHS at 8). The DOE statement was amplified by the Deputy Secretary of Energy in the oral presentations on January 11, 1982:

> [A]s far as the reorganization is concerned, the plan is not, I think, to do away with the activities of the Department of Energy. The plan, as it has been announced so far, is to in fact merge the activities, in particular, these activities into the Department of Commerce. And we do not visualize at this time any significant changes in the way in which the programs relating to waste management would be altered, either technically or from a management point of view.

(Tr. at 13).

The nuclear industry participants agreed with DOE's view on this question (Consolidated Industry Group PHS at 18; AIF PHS at 7; SE2 PHS at 6; ANS PHS at 8; UG at 2). However, State participants and intervenor groups disputed the DOE view. They saw the potential dismantlement of DOE as leading to further delay in resolution of the radioactive waste disposal problem and asserted that DOE's possible abolition made representations regarding the future success of its waste program useless (Consolidated State Group PHS at 2, 9; Minn PHS at 6-8).

The Commission does not believe that the Administration's proposal to transfer the activities of the Department of Energy to the Department of Commerce introduces substantial new uncertainties regarding the continuity of Federal management of the nuclear waste program. As the Department of Energy stated, the Administration's proposal, if adopted, would simply transfer the nuclear waste program functions from one Federal agency to another. Moreover, congressional action is needed to adopt the Administration's proposal. Yet, in the 3 years since the Administration's proposal to dismantle DOE was made, there has been no discernible action by the Congress to proceed with adoption of the proposal. Because the Congress has not taken action toward adoption of the Administration's proposal, and because the proposal, even if adopted, would consist of only a transfer of the program from one agency to another, the Commission does not believe that the Administration's proposal constitutes a significant source of management uncertainty for the nuclear waste program.

The Commission believes that residual uncertainties regarding the continuity of Federal management of the nuclear waste program have also been reduced by the Nuclear Waste Policy Act of 1982. The Act provides for the establishment of an Office of Civilian Radioactive Waste Management within the Department of Energy. This Office is to be headed by a Director appointed by the President, with Senate confirmation, who will report directly to the Secretary of Energy (§ 304).

Further, the Act raises the activities of this Office to a high level of visibility and accountability by stipulating that an annual comprehensive report of the activities and expenditures of the Office will be submitted to Congress and that an annual audit of the Office will be conducted by the Comptroller General, who will report the results to Congress. The Act also requires two additional elements that provide added assurance of continuity: a "Mission Plan" and a schedule of activities for DOE. The Mission Plan is a detailed and comprehensive report which is intended to provide "an informational basis sufficient to permit informed decisions to be made in carrying out the repository program and the research, development, and demonstration programs required under this Act." The Secretary of Energy has already submitted a draft Mission Plan to the States, the affected Indian tribes, the Commission and appropriate government agencies for their comments; after revising the plan, DOE must submit it to the appropriate congressional committees (§ 301(a) and (b)). The schedule of DOE's activities in conducting this program was discussed in § 2.2-A.1, above. Taken together, the provisions of the Nuclear Waste Policy Act establish a detailed management framework for the conduct of the repository program that should help ensure both sound management and continuity — whether the responsibility for the repository program is retained in DOE or is transferred to another Federal agency.

3. Continued Funding of the Nuclear Waste Management Program

There is general agreement among all participants that the program to develop a mined geologic repository for nuclear wastes will require more than a decade of effort at a total cost of several billion dollars. A steady source of funding will be needed to assure the timely success of the program. DOE pointed out that it would request an adequate level of funding for the National Waste Terminal Storage (NWTS) Program as stated in the Department's Position Statement (DOE CS at II-30). In addition, DOE stated that Congress' commitment to the commercial waste disposal program was demonstrated by the continuous increase in the level of funding since 1976. The funding level was increased by more than a factor of 10 between 1976 and 1980 (DOE CS at II-30). Some participants disagreed with DOE's optimism concerning the future availability of funds and pointed out that competing priorities for Federal funds could deprive DOE of the necessary resources (CDC PS at 7; Lewis PS at 9; NRDC PS at 28; Tr. at 203).

Congress passed a continuing resolution for FY 83 funding of DOE's nuclear waste program at the level of $259.4 million. This is about $10

million more than DOE's earlier FY 83 request of $249 million. Additionally, the Nuclear Waste Policy Act authorizes the Secretary of Energy to enter into contracts and collect a fee of 1 mill per kilowatt-hour of electricity generated by nuclear reactors in return for the Federal government's acceptance of title, subsequent transportation, and disposal of high-level radioactive waste or spent fuel (§ 302(a)(2)). In order to be able to use a Federal repository, the Act required the generator or owner of such waste or spent fuel to enter into a contract by June 30, 1983, or the date on which generation is commenced or title is taken, whichever occurs later (§ 302(b)(2)). The Commission must require the negotiation of such contracts as a precondition to the issuance or renewal of a license (§ 302(b)(1)(B)). The Commission notes that all such contracts have been executed. DOE testified in the January 11, 1982, hearing that it expected the funds collected under such a program would allow support of the DOE waste program at an initial level of $185 million. Under the program subsequently adopted by the Congress, these funds are to be placed into a nuclear waste fund to support DOE's repository program. The general approach prescribed by the Act is to operate DOE's nuclear waste program on a full-cost-recovery basis. In this regard, the Act provides that DOE must annually review the amount of the fees established to evaluate whether collection of the fees will provide sufficient revenues to offset the costs expected. In the event DOE determines that the revenues being collected are less than the amount needed in order to recover the costs, DOE must propose to Congress an adjustment to the fee to ensure full cost recovery. The Act also provides (§ 302(e)(5)) that, if at any time, the monies available in the Waste Fund are insufficient to support DOE's nuclear waste program, DOE will have the authority to borrow from the Treasury. The Commission believes that the long-term funding provisions of the Act should provide adequate financial support for DOE's nuclear waste program.

4. DOE's Schedule for Repository Development

The DOE reference schedule described in its April 1984 draft Mission Plan establishes the earliest date of repository availability as 1998 and delineates the logic and the period of activities that are deemed achievable under current program assumptions. While DOE acknowledges that contingency time is required in the schedule to accommodate such factors as institutional uncertainties, public hearings, or possible project reorientation, it believes that an appropriate amount of time has, in fact, been allowed in the reference schedule. Under the reference schedule, DOE expects that disposal facilities will be operational in 1998 (DOE

draft Mission Plan, April 1984). DOE's updated repository development schedule specifies the critical milestones prior to commencing construction of the first repository as:

March	1985	(basalt)	Commencement of exploratory shaft work* at three sites (three different media: salt, basalt and tuff)**
September	1985	(tuff)	
—	—	(salt)	
August	1990		Submission of application for authorization to construct the first repository
August	1993		Construction authorization for the first repository

*Including borehole drilling.

**An October 1982 update of this information indicated that a pilot borehole was started in September 1982 for an exploratory shaft in tuff at the Nevada Test Site. In May 1982, DOE initiated work on surface preparation, construction of drilling pads and support buildings for the drilling operation at the BWIP basalt site. In January 1982, a borehole was begun at a point 300 feet from the BWIP planned exploratory shaft location to provide data for planning the shaft excavation. No exploratory shaft work has begun at the Paradox Basin bedded salt site. As noted in the siting discussion under the Second Commission Finding, the Nuclear Waste Policy Act of 1982 requires DOE to complete certain actions before site characterization. These include issuance of siting guidelines concurred in by NRC, preparation of environmental assessments, notification of State and affected Indian tribes where sites are located, and holding of public hearings in the vicinity of each site.

The Commission concurred in DOE's repository siting guidelines on July 3, 1984, enabling DOE to proceed to complete the other site-selection tasks. The Commission notes that DOE's draft Mission Plan (April 1984) anticipated the completion of the siting guidelines by mid-Summer 1984 and DOE revised its site-selection schedule accordingly. Final environmental assessments for five nominated sites (including salt, basalt and tuff media) are to be completed in December 1984, at which time three of the five sites will be recommended for characterization.

NRC's construction authorization (under 10 C.F.R. Part 60) would mark the end of the site-selection process.

Some participants believe that DOE cannot have a waste disposal facility available by 2007. These participants concluded that DOE's slow progress in the past suggests that DOE may be unable to solve the many problems that will arise in the future and that DOE's schedule for repository development is unduly optimistic (e.g., Minn PS at 6; Ill PS at 2; OCTLA PS at 8-9; CDC PS at 7).

One of the primary purposes of the recently enacted Nuclear Waste Policy Act of 1982 is "to establish a schedule for the siting, construction, and operation of repositories that will provide reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and such spent nuclear fuel as may be disposed of in a repository." (§ 111(b)(1)). The Commission recognizes that, if fundamental technical breakthroughs were necessary, it would not be possible for Congress to legislate their solution or specify schedules for their accomplishment. However, as discussed previously, such breakthroughs are not necessary. Rather, the remaining uncertainties are reflected in the need for step-by-step evaluation and development based on ongoing site studies and research programs. The Commission believes the Act provides means for resolution of those institutional and technical issues most likely to delay repository development, both because it provides an assured source of funding and other significant institutional arrangements, and because it provides detailed procedures for maintaining progress, coordinating activities and rectifying weaknesses. For these reasons, the Commission believes that the selection and characterization of suitable sites and the construction of repositories will be accomplished within the general time frame established by the Act, or within a few years thereafter.

The provisions of the Nuclear Waste Policy Act of 1982 that establish schedules for repository development are elaborate and allow for various contingencies. A number of steps are involved before NRC considers authorization of construction. DOE is to nominate five sites it believes suitable for site characterization for possible repository development (§ 112(b)). DOE is to recommend for site characterization three candidate sites to the President (§ 112(b)(1)(B)); the President is to recommend one of the characterized sites to the Congress (§ 114(a)(2)(A)); the affected State or Indian tribe is given an opportunity to submit a notice of disapproval to the Congress (§§ 115(b), (116)(b)(2), 118(a)); the Congress may overturn a State or Indian tribe's disapproval of the site by passing a resolution of approval (§ 115(c)); and, if Congress approves or no notice of disapproval is submitted by a State or Indian tribe, then DOE is to apply for construction authorization (§ 114(b)).

DOE's revised reference schedule (DOE draft Mission Plan, April 1984) states that the application for repository construction authorization will be submitted to the Commission in August 1990. Under the terms of the Act the Commission is expected to reach a decision within 3 years of the application date, or by August 1993 (§ 114) (under certain conditions, extension by 1 year would be permitted). If the NRC decision is favorable, the repository would be constructed and would begin operation, according to DOE's "reference schedule," in January 1998. Earlier dates can be achieved if the Presidential review time is reduced, if DOE promptly files the construction authorization application, if NRC provides a construction authorization in less than 3 years, or if DOE constructs the repository in a shorter period than provided in its estimated schedule. However, it is prudent to assume that such a contraction of the schedule will not be realized.

The Nuclear Waste Policy Act of 1982 establishes "not later than January 31, 1998" as the date when DOE is to begin disposal of high-level radioactive waste or spent fuel (§ 302(a)(5)(B)). This is consistent with the current dates of the DOE schedules discussed above and with the detailed step-by-step milestones established by the Act. The schedule established by the Act would assure the operation of the first repository well before the years 2007-09, i.e., the period of concern in the present proceeding.

Despite the delays in DOE's earlier milestones, the Commission believes that the program established by the Act is generally consistent with the schedule presented by DOE in this proceeding and that DOE's milestones are generally both realistic and achievable. Achievement of the scheduled first date of repository operation is further assured by other provisions of the Act which specify means for resolution of those institutional and technical issues most likely to delay repository completion. In addition to those provisions discussed previously, the Commission notes that the Act clarifies how the requirements of the National Environmental Policy Act are to be met (e.g., §§ 113(c), (d); 114(a), (f); 119(a); 121(c)). The Act also requires that any Federal agency determining that it cannot comply with the repository decision schedule in the Act must notify both the Secretary of Energy and Congress, explaining the reasons for its inability to meet the deadlines. The agency must also submit recommendations for mitigating the delay (§ 114(e)(2)). These provisions of the Act, as well as those that support the technical program — the provisions for research, development, and demonstration efforts regarding waste disposal (Title II of the Act), increase the prospects for having the first repository in operation not later than the first few years of the next century.

The Commission also finds reasonable assurance that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel generated up to that time. The Nuclear Waste Policy Act of 1982 establishes Federal responsibility and a clearly defined Federal policy for the disposal of such waste and spent fuel and creates a Nuclear Waste Fund to implement Federal policy. The Act establishes as a matter of national policy that this responsibility is a continuing one, and provides means for the Secretary of Energy to examine periodically the adequacy of resources to accomplish this end.

The Commission notes that as of September 30, 1982, the generating capacity of all commercial nuclear power plants in the U.S. with operating licenses or construction permits was 131 electrical gigawatts (GWe) and the capacity of those under construction permit review was about 5

GWe (NUREG-0871, Vol. 1, No. 4, at 2, 8). DOE, in its letter of March 27, 1981, to the Presiding Officer of this proceeding, provided an estimate of 180 GWe for the capacity of operating LWRs in the year 2000. This value is significantly lower than the value (276 GWe) presented in DOE's 1980 position statement (DOE PS at V-4) and lower than that (202 GWe) presented in the NRC's Generic Environmental Impact Statement on spent fuel handling and storage (NUREG-0575, Vol. 1, at 2-4). The validity of the latter predictions has been affected by the cancellations of a number of proposed units during the past 2 years. The DOE 1981 estimate of 180 GWe in the year 2000 appears to be a reasonable estimate of the likely installed capacity at that time. On this basis, during the 40 years of operation of each plant, using as a realistic assumption a 60% capacity factor, the electrical energy generation would be about 4300 GWe-years. Assuming 38 metric tons of heavy metal (MTHM) are discharged for each gigawatt-year (IRG Final Report at D-6; NUREG-0575, Vol. 1, at 2-4) the total discharged spent fuel from these plants would likely be about 160,000 metric tons. The capacity of each proposed repository will depend on such factors as the thermal loading limit in waste emplacement, space limitations within the host rock, nuclear power generation capacity in the region to be serviced by the repository, and economy of scale considerations (DOE PS at III-70 to III-79; IRG Final Report at D-21). In its cross-statement, DOE's estimate that three to six repositories might be needed was based on the assumption that nuclear power generation capacity grows to 250 GWe by the year 2000 and remains at that level until 2040 (DOE CS at II-53). The representative characteristics of each repository used by DOE were 2000 acres and a 40- to 100-kW/acre loading, corresponding to a repository capacity of about 70,000 to 170,000 metric tons of uranium, respectively (DOE PS at III-76). Reflecting the reduction in nuclear power projections, DOE estimated in the January 1982 hearing that the ultimate reactor capacity would be about 200 GWe (Tr. at 236). DOE then assumed a repository capacity of 100,000 metric tons and concluded that "between two and three" repositories would be needed (Tr. at 237). To accommodate the 160,000 metric tons we have assumed, two repositories, each with 100,000-metric-ton capacity, would appear to be sufficient.

Repository completion and operation at 3-year intervals would result in having adequate capacity about 3 years after initial operation of the first repository (DOE PS at III-86). As noted earlier, emplacement of spent fuel in the first repository should begin not later than the first few years of the next century. Thus, if the first repository begins to receive spent fuel in the year 2005, the second may begin operation as early as

2008, in which case all spent fuel would be emplaced by about 2026, assuming DOE's estimated receiving rates (DOE PS at III-71) and operation of each repository as completed. Because the rate of waste emplacement during the first 5 years of operation would be about 1800 metric tons per year (DOE PS at III-71), only 5400 metric tons would be emplaced in the first repository by the time the second began operation. This would satisfy the requirements of § 114(d) of the Nuclear Waste Policy Act, i.e., the prohibition of emplacement of more than 70,000 metric tons in the first licensed repository before the second repository is in operation. If the DOE estimated emplacement rates (which would increase to 6000 metric tons/year after the first 5 years) are realized, it will take about 15 years to emplace 70,000 metric tons in the first repository.

For the foregoing reasons, the Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

2.3 Third Commission Finding

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 radioactive waste and spent fuel.

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 C.F.R. Part 50 for storage at the reactor facility and 10 C.F.R. Part 72 for storage in independent spent fuel storage installations (ISFSI). 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 eighty individual evaluations of the safety of spent fuel storage shows that significant releases of radioactivity

from spent fuel under licensed storage conditions are extremely remot (*see* discussion in § 2.4, below).

Some nuclear power plant operating licenses expire before the yea 2007-09. For technical, economic or other reasons, other plants ma choose, or be forced, to terminate operation prior to 2007-09 eve though their operating licenses have not expired. For example, the exist ence of a safety problem for a particular plant could prevent further oper ation of the plant or could require plant modifications that make contin ued plant operation uneconomic. The licensee, upon expiration or termi nation of its license, may be granted (under 10 C.F.R. Part 50 or Par 72) a license to retain custody of the spent fuel for a specified tern (until repository capacity is available and the spent fuel can be trans ferred to DOE under § 123 of the Nuclear Waste Policy Act of 1982 subject to NRC regulations and license conditions needed to assure ade quate protection of the public. Alternatively, the owner of the spen fuel, as a last resort, may apply for an interim storage contract witl DOE, under § 135(b) of the Act, until not later than 3 years after a repository or monitored retrievable storage facility is available for spen fuel. For the reasons discussed above, the Commission is confident tha in every case the spent fuel generated by those plants will be managec safely during the period between license expiration or termination and the availability of a mined waste repository for disposal.

To assure the continuity of safe management of spent fuel, the Commission, in a separate action, is preparing an amendment to 10 C.F.R. Part 50 which would require licensees of operating nuclear power reactors to submit, no later than 5 years before expiration of the reactor operating license, written notification to the Commission, for its review and approval, of the actions which the licensee will take to manage and provide funding for the management of all irradiated fuel at the reactor site following expiration of the reactor operating license, until ultimate disposal of the spent fuel in a repository. The licensee's notification will be required to specify how the licensee will fund the financial costs of extended storage or other disposition of spent fuel. It is possible for the funding of the storage to be provided by an internal reserve fund or special assessment during that 5-year period to cover the costs of storage of the spent fuel after the expiration of the reactor operating license. The storage costs are not large relative to power generation costs. A representative figure is $1 million/year for storage of spent fuel in reactor basins beyond the operating license expiration (NUREG/CR-0130, "Technology, Safety and Costs of Decommissioning a Reference BWR Power Station," Addendum 2, July 1983; NUREG/CR-0672, "Technol-

ogy, Safety and Costs of Decommissioning a Reference PWR Power Station," Addendum 1, July 1983).

Additional assurance that the conditions necessary for safe storage will be maintained until disposal facilities are available is provided by the Commission's authority to require continued safe management of the spent fuel past the operating license expiration or termination (10 C.F.R. § 50.82). If a utility should have technical problems in continuing its commitment to maintain safe storage of its spent fuel, NRC as the cognizant regulatory agency would intervene and the utility would be required to assure safe storage. If a licensee fails financially, or otherwise must cease its operations, the cognizant State public utility commission would be likely to require an orderly transfer to another entity. The successor would take over the licensee's facilities and, provided the conditions for transfer of licenses prescribed in NRC regulations (10 C.F.R. § 50.80) were met by the succeeding entity, operation of the original licensee's facilities would be permitted to continue. Moreover, an orderly transfer to a successor organization would be mandatory to protect the substantial capital investment. Further, the Commission believes that the possibility of a need for Federal action to take over stored spent fuel from a defunct utility or from a utility that lacked technical competence to assure safe storage is remote, but the authority for such action exists (§§ 186c and 188 of the Atomic Energy Act of 1954, as amended, 42 U.S.C. §§ 2236, 2238).

Interim storage capacity may be required for plants whose operating licenses expire or are terminated before sufficient repository capacity is available. As discussed in the rationale for the fifth finding, the Nuclear Waste Policy Act of 1982 includes a number of provisions to assure the availability of interim storage capacity for spent fuel during the period before repository operation (§§ 131 through 137). Provisions are made for Federal government-supplied interim storage capacity (up to 1900 metric tons) for civilian power reactors whose owners cannot reasonably provide adequate storage capacity.

In all cases where the interim storage is at a licensee's site, safe management will be assured by compliance with NRC regulations and specific license conditions. Where DOE provides the interim storage capacity, except in the use of existing capacity at Government-owned facilities, DOE is to "comply with any applicable requirements for licensing or authorization" (§ 135(a)(4)). If existing federally owned storage facilities are used, NRC is required to determine "that such use will adequately protect the public health and safety" (§ 135(a)(1)). These provisions of the Act would assure that spent fuel will be managed in a safe manner until repository capacity is available. Facilities for reprocessing

high-level waste, should any be constructed or become operational before a repository is available, would be licensed under 10 C.F.R. Part 50, and solidification and interim storage of high-level waste would be provided for at such facilities. For the foregoing reasons, the Commission finds reasonable assurance that high-level waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available for its safe disposal.

2.4 Fourth Commission Finding

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.

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 storage 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 C.F.R. Part 50). The amendment will require the licensee to notify the Commission, 5 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 eighty 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. Each of these issues is discussed separately below, in light of the information provided by the participants in this proceeding, and NRC experience in regulating storage of spent fuel.

A. Long-Term Integrity of Spent Fuel Under Water Pool Storage Conditions

The Commission finds that the cladding which encases spent fuel is highly resistant to failure under pool storage conditions. As noted by DOE in its Position Statement, there are up to 18 years of continuous storage experience for zircaloy-clad fuel and 12 years continuous storage experience for stainless-clad fuel (DOE PS at IV-73). Corrosion studies of irradiated fuel at twenty reactor pools in the United States suggest that there is no detectable degradation of zircaloy cladding. Data from corrosion studies of spent fuel stored in Canadian pools also support this finding (A.B. Johnson, Jr., "Behavior of Spent Nuclear Fuel in Water Pool Storage" (UC-70), Battelle Pacific Northwest Laboratories, BNWL-2256 (September 1977), at 10-11, 17).

The long-term integrity of spent fuel in storage pools, which has been confirmed by observation and analysis, was cited by industry participants (e.g., Consolidated Industry Group PHS at 3-6; UNWMG-EEI PS, Doc. 4, at 8; UG at 2). No degradation has been observed in commercial power reactor fuel stored in onsite pools in the United States. Extrapolation of corrosion data suggests that only a few hundredths of a percent of clad thickness would be corroded after 100 years (A.B. Johnson, Jr., "Utility Spent Fuel Storage Experience," PNL-SA-6863, presented at the American Nuclear Society's Executive Conference on Spent Fuel Policy and its Implications, Buford, Georgia (April 2-5, 1978)). The American Nuclear Society cited a study (G. Vesterbend and T. Olsson, BNWL-TR-320, May 1978, English Translation of RB78-29), which concluded that degradation mechanisms such as general corrosion, local corrosion, stress corrosion, hydrogen embrittlement, and delayed hydrogen cracking are not expected to produce degradation to any significant extent for 50 years (ANS PS at 34).

Canadian experience, including occasional examination during 17 years of storage, has indicated no evidence of significant corrosion or other chemical degradation. Even where the uranium oxide pellets were exposed to pool water as a result of prior damage of the fuel assembly, the pellets have been inert to pool water, an observation also confirmed by laboratory studies ("Canadian Experience with Wet and Dry Storage

Concepts," presented at the American Nuclear Society's Executive Conference on Spent Fuel Policy and Its Implications, Buford, Georgia (April 2-5, 1978)). Another Canadian study concluded that "50 to 100 years under water should not significantly affect their [spent fuel bundles] integrity" (J.F. Walker, "The Long-Term Storage of Irradiated CANDU Fuel Under Water," AECL-6313, Whiteshell Nuclear Research Establishment (January 1979)). This appraisal was based on findings such as no deterioration by corrosion or mechanical damage during 16 years of storage in water, no release of fission products from the uranium dioxide matrix during 11 years of storage in water, and no fission-product-induced stress corrosion cracking anticipated during water storage at temperatures below 100°C (C.E.L. Hunt, J.C. Wood, and A.S. Bain, "Long-Term Storage of Fuel in Water," AECL-6577, Chalk River Nuclear Laboratories (June 1979)).

The ability of spent fuel to withstand extended water basin storage is also supported by metallurgical examination of Canadian zircaloy-clad fuel after 11 years of pool storage, metallurgical examination of zircaloy-clad PWR and BWR high-burnup fuel after 5 and 6 years in pool storage, and return of Canadian fuel bundles to a reactor after 10 years of pool storage. Periodic hot-cell examination of high-burnup PWR and BWR bundles over 6 years of pool storage at the WAK Fuel Reprocessing Plant in Germany has also confirmed that spent fuel maintains its integrity under pool storage conditions. Other countries having favorable experience with pool storage of zircaloy-clad spent fuel include: the United Kingdom, 13 years; Belgium, 12 years; Japan, 11 years; Norway, 11 years; West Germany, 9 years; and Sweden, 7 years (Johnson, "Utility Spent Fuel Storage Experience," *supra,* at 7). Programs of monitoring spent fuel storage are being conducted in Canada, the United Kingdom and the Federal Republic of Germany (DOE PS at IV-59 to IV-61; UNWMG-EEI PS, Doc. 4, at 23).

The only fuel failures which have occurred in spent fuel pools involved types of fuel and failure mechanisms not found at U.S. commercial reactor facilities, e.g., degradation of zircaloy-clad metallic uranium fuel from the Hanford N-Reactor as a result of cladding damage in the fuel discharge system. The system differs from the fuel discharge systems of commercial reactors. Moreover, metallic uranium fuel is not used in commercial power reactors. NRDC cited some conclusions drawn by Mr. Justice Parker regarding his lack of confidence in long-term storage of spent fuel, based on the Windscale Inquiry in Great Britain in 1978, which involved stainless-steel-clad, gas-cooled reactor fuel (NRDC PS at 92). This is not pertinent to pool storage of commercial spent fuel since the high-temperature conditions in a gas-cooled reactor

which can cause sensitization of the cladding are not experienced by fuel in boiling or pressurized water reactors (Johnson, "Utility Spent Fuel Storage Experience," *supra,* at 17-18).

Some participants did not agree that there is an adequate basis for confidence in safe extended-term spent fuel storage. Although agreeing with the extent of experience cited by DOE and other participants, the Natural Resources Defense Council, for example, stressed that more experience is needed before one can be confident of safe extended storage. NRDC considered the length of storage experience cited by DOE as insufficient to establish that spent fuel can be stored safely for periods well in excess of 40 years (NRDC PS at 88-92). A similar position was taken by the State of Minnesota (Minn PHS at 8-9). NRDC referred to the problem of the long-term storage of spent fuel reported in the Windscale Inquiry Report by the Hon. Mr. Justice Parker, Vol. 1, at 29-30. However, the conclusion quoted from the report, when taken in context, refers only to irradiated fuel from AGR (advanced gas-cooled) nuclear power plants. As noted earlier, the conditions to which the fuel cladding is exposed in gas-cooled reactors differ from those in U.S. commercial light water reactors. Moreover, the cladding of AGR fuel is identified as stainless steel in the Windscale Inquiry Report. Only two commercial LWR nuclear power plants operating in the U.S. today use stainless steel clad. Most U.S. nuclear fuel is zircaloy clad, and reactor operators have not seen evidence of degradation of LWR spent fuel, either zircaloy or stainless steel clad, in storage pools (A.B. Johnson, Jr., "Spent Fuel Storage Experience," *Nuclear Technology,* Vol. 43, at 171 (Mid-April 1979)). Further, as stated earlier, cladding degradation caused by stainless steel sensitization in an AGR high-temperature environment is not pertinent to the lower-temperature environment of LWRs. Therefore, the problem of long-term storage of spent fuel reported in the Windscale Inquiry is not relevant to U.S. spent fuel.

After expiration of a reactor operating license, the fuel storage pools at the reactor site would be licensed under 10 C.F.R. Part 72. The requirements of 10 C.F.R. Part 72 provide for operation under conditions involving a careful control of pool water chemistry to minimize corrosion. The required monitoring of the pool water would provide an early warning of any problems with defective cladding, so that corrective actions may be taken. Experience indicates that, under licensed storage conditions, significant releases of radioactivity are highly unlikely. The Commission is confident that the regulations now in place will assure adequate protection of the public health and safety and the environment during the period when the spent fuel is in storage (NUREG-0575, "Final Generic Environmental Impact Statement on Handling and Storage

of Spent Light Water Power Reactor Fuel," Vol. 1, August 1979, at ES-12, 4-10 to 4-17).

Although confidence that spent fuel will maintain its integrity during storage for an additional 30 years beyond the facility's license expiration date involves an extrapolation of experience by a factor of 2 or 3 in time, the extrapolation is made for conditions in which corrosion mechanisms are well understood. Technical studies cited above support the conclusion that corrosion would have a negligible effect during several decades of extended pool storage. The Commission finds that this extrapolation is reasonable and is consistent with standard engineering practice.

B. Structure and Component Safety for Extended Facility Operation for Storage of Spent Fuel in Water Pools

Questions were raised concerning the adequacy of structural materials and components of spent fuel storage basins to function effectively during periods that are double those assumed in the base design. This concern was expressed in connection with the possible necessity for longer storage times if permanent disposal is not available by the year 2006 (Del PS at 4). The experience at the General Electric Company Morris Operation in Illinois, where a mechanical failure caused contaminated water to leak into the environment, was cited as an example of an unforeseen failure that could jeopardize the safety of spent fuel storage (NECNP PS at 65). A generic problem regarding pipe cracks in borated water systems at PWR plants was also cited as evidence of uncertainty that long-term interim storage would be safely accomplished without modification and fuel shuffling (NECNP PS at 64). The Commission notes that the latter problem was discussed in detail in the Atomic Safety and Licensing Board Notification, "Pipe Cracks in Stagnant Borated Water Systems at PWRs," dated August 14, 1979, in the ASLB consideration of a proposed licensing amendment to permit modification of a spent fuel storage pool (*Commonwealth Edison Co.* (Zion Station, Units 1 and 2), LBP-80-7, 11 NRC 245 (1980)). The Notification referred to by NECNP indicated that cracks had occurred in safety-related type-304 stainless steel piping systems which contained stagnant borated water. Apparently, the cracking was attributable to stress corrosion caused by the residual welding stresses in heat-affected zones. The NRC staff review found that such cracking was not directly related to spent fuel pool modifications, and that necessary repairs could be readily made. The staff concluded that cracks in low-pressure spent fuel cooling systems do not have safety significance.

Extensive experience with storage pool operation has demonstrated the ability of pool components to withstand the operating environment (DOE CS at II-145 to II-148). In the relatively few cases of equipment failure, pool operators have been able to repair the equipment or replace defective components promptly (UNWMG-EEI PS, Doc. 4, at 25; UG at 2). The Commission finds no reason why spent fuel storage basins would not be capable of performing their cooling and storage functions for a number of years past the design-basis period of 40 years if they are properly maintained.

As one participant pointed out, "the pool structure as well as the racks are designed to withstand extreme physical conditions set forth in NRC licensing requirements. These include seismic, hydrologic, meteorological and structural requirements" (UNWMG-EEI PS, Doc. 4, at 25; UG at 2). The design requirements are set forth in 10 C.F.R. Parts 50 and 72. The design basis siting conditions for storage pools at reactor sites are those of the reactor itself. Siting conditions are reviewed by the NRC staff, the Advisory Committee on Reactor Safeguards and the Atomic Safety and Licensing Board at the construction permit stage and then reviewed again in connection with the issuance of the facility's operating license. In issuing a power reactor operating license, the Commission is, in effect, expressing its confidence that the design basis siting conditions will not be exceeded during the 40-year license period. If pool storage facilities were used to store spent fuel after expiration of reactor operating licenses, the utilities would be able, as part of their continuing maintenance of storage facilities, to replace defective components in a timely way, if needed, so as to avoid any safety problems. Some participants (e.g., NECNP PS at 63; Minn PHS at 8-9; and Del PS at 4) do not place the same weight which the Commission does on experience at spent fuel storage facilities and on studies cited by DOE and certain others which support the argument that the structural integrity of these basins can be readily maintained (DOE CS at II-145, III-13; UNWMG-EEI PS, Doc. 4, at 19). The disagreements appear to center largely on the extent to which present experience may be relied upon as a basis for predicting the safety of spent fuel storage over a period two or three times the design period.

The degradation mechanisms involved in spent fuel pool storage are well understood. The resulting changes in fuel cladding and pool systems and components are gradual and thus provide sufficient time for the identification and development of remedial action without subjecting plant personnel or the public to significant risk. The fuel storage racks are designed to maintain their integrity for many decades; if they fail in

any way, they may be replaced. There are a number of routine and radiologically safe methods for maintenance at spent fuel storage basins to ensure their continued effective performance. These include replacing racks or other components, or moving spent fuel to another storage facility. The Commission finds that the extensive operating experience with many storage pools adequately supports predictions of long-term integrity of storage basins.

The Commission concludes that the experience with spent fuel storage provides an adequate basis for confidence in the continued safe storage of spent fuel in water pools either at or away from a reactor site for at least 30 years after expiration of the plant's license.

C. Safety of Dry Storage of Spent Fuel

While the record of this proceeding has focussed on water pool storage, the Commission notes that dry storage of spent fuel has also been addressed to a limited extent (e.g., DOE PS at IV-12 to IV-22 and IV-63, CS at II-147, PHS at 9; UNWMG-PS, Doc. 4, at 16-17 and CS at III-6 to III-7; Tr. at 69-72). The NRC's regulation 10 C.F.R. Part 72 specifically covers dry storage of spent fuel (§ 72.2(c)), and experience with dry storage was a subject of public comment in the rulemaking (NUREG-0587, "Analysis of Comments on 10 C.F.R. Part 72," October 1980, at II-12 to II-13). NRC reports, NUREG-0575, "Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel" August 1979, and NUREG/CR-1223, "Dry Storage of Spent Nuclear Fuel, A Preliminary Survey of Existing Technology and Experience" April 1980, which have been referenced in this proceeding, examined potential environmental impacts and experience with interim dry storage of spent fuel. The GEIS (NUREG-0575, *supra*, Vol. 1, at 8-2) contained the conclusion that the use of alternative dry passive storage techniques for aged fuel, now being investigated by the Department of Energy, appears to be as feasible and environmentally acceptable as storage of spent fuel in water basins. Prior to the adoption of Part 72, dry storage of irradiated fuel had been licensed under Part 50 at the Hallam sodium graphite reactor. Dry storage is also presently licensed under Part 50 at the Ft. St. Vrain high-temperature gas reactor.

Although the number of years of experience with dry storage systems is less than that with water pool storage, the understanding of some of the material degradation processes experienced in water pool storage should be applicable to dry storage. As discussed below, dry storage involves a simpler technology than that represented by water basin storage

systems.[5] Water basin storage relies upon active systems such as pumps, renewable filters, and cooling systems to maintain safe storage. Favorable water chemistry must also be maintained to retard corrosion. On the other hand, dry storage reduces reliance upon active systems and does not need water which together with impurities may corrode spent fuel cladding. With convective circulation of an inert atmosphere in a sealed dry system, there is little opportunity for corrosion.[6] For these reasons, the Commission believes that safe dry storage should be achievable without undue difficulty. New dry storage experience with light water reactor (LWR) fuel is becoming available for examination, and the evaluations discussed below suggest that the favorable results of up to almost two decades of dry storage experience with non-LWR spent fuel can also be obtained for LWR spent fuel in adequately designed dry storage installations.

A recent review of dry storage experience by Johnson, *et al.*, in "Behavior of Spent Nuclear Fuel and Storage Components in Dry Interim Storage" (*supra* note 5), provides an update of dry storage activities, particularly with respect to zircaloy-clad spent fuel. In that report (at 18-24) the experimental data base for nonzircaloy-clad spent fuel, including stainless-steel-clad fuel and the data base for zircaloy-clad fuel are discussed. Tests conducted to verify the integrity of zircaloy cladding have not indicated any degradation in dry storage (*id.* at 27). In summary, the report states (at 44-45):

> Operating information is available from fueled dry well, silo, vault, and metal cask storage facilities. Maximum operational histories are:
>
> | | All Fuel | Zircaloy-Clad Fuel |
> |---|---|---|
> | Dry wells | up to 18 yr | up to 3 to 4 yr |
> | Vaults | up to 18 yr | up to 1 yr |
> | Silos | up to 7 yr | up to 7 yr |
> | Metal casks | – | < 1 yr |
>
> All times related to 1982.
>
> Operational history with interim storage in metal casks is minimal; however, there is extensive experience with metal shipping casks. In addition, metal storage casks have been designed and tested, and cask tests with irradiated fuel are currently under way in the Federal Republic of Germany and are planned in Switzerland and the United States. The integrity of zircaloy-clad fuel in a given demonstration test is relevant to predicting fuel behavior in other dry storage concepts under similar conditions.

[5] *See*, for example, K. Einfeld and J. Fleisch, "Fuel Storage in the Federal Republic of Germany" and R.J. Steffen and J.B. Wright, "Westinghouse Advanced Energy Systems Division," *Proceedings of the American Nuclear Society's Topical Meeting on Options for Spent Fuel Storage*, Savannah, Georgia, September 26-29, 1982; A.B. Johnson, Jr., E.R. Gilbert, and R.J. Guenther, "Behavior of Spent Nuclear Fuel and Storage System Components in Dry Interim Storage," PNL-4189, August 1982.

[6] "Fuel Storage in the Federal Republic of Germany," *supra* note 5, at 3.

Information on experience with dry cask storage in other countries is also becoming available. Einfeld and Fleisch's paper, "Fuel Storage in the Federal Republic of Germany," *supra* note 5, discussed the results of dry storage research on spent fuel in an inert atmosphere. They note on page 3 of their report:

> Several tests have been conducted to verify the integrity of LWR spent fuel cladding in dry storage. To date none of the integrity tests has indicated that the cladding is degrading during long-term storage. Even under conditions more severe than in the casks, the fuel shows no cladding failures. From the tests listed in Table II it can be concluded that dry storage under cask conditions even with starting temperatures to 400°C is not expected to cause cladding failures over the interim storage period.

Einfeld and Fleisch continue in their report (at 3-4) to comment on the successful demonstration of cask storage:

> A technical scale demonstration program with a fueled CASTOR cask is underway in the FRG since March 1982. The 16 assemblies which are subject to that program originate from the Wurgassen boiling water reactor. They resided in the core during 4 cycles of operation, burning up to about 27.8 GWD/t U.
>
> The general objectives of the demonstration with a fully instrumented cask and fuel bundles are the verification of cask design parameters, the operational experience in cask handling and the expansion of the data base on fuel performance. Fig. 2 shows a schematic drawing of the cask design and the axial thermocouple locations.
>
> The operational experiences and corresponding test data confirm the assumptions made about the cask concept and the cask loading and handling procedure. In addition, the technology data base for operating an interim storage plant could be expanded.
>
> – In-pool loading of a large storage cask and specific cask handling has been successfully demonstrated.
>
> – The passive heat transfer capabilities of the cask and fuel cladding integrity have been verified. The maximum local fuel rod temperatures for fuel with about one year decay time were within the expected range.
>
> – The total radiation shielding characteristics (< 10 mrem/h) are verified in practice (references deleted).

The authors conclude:

> The realization of the transport/storage cask concept, which is well under way in the Federal Republic of Germany, will provide sufficient interim spent fuel storage

capacity with the facilities planned or under construction. Dry interim storage is a proven technology and thus it constitutes an essential step in closing the backend of the nuclear fuel cycle.

R.J. Steffens and J.B. Wright's paper,[7] "Drywell Storage Potential," discussed drywell storage experience with pressurized water reactor spent fuel at the Nevada Test site. On page 6 of the paper, the authors note:

> Another drywell performance assessment method being employed during the demonstration storage period is that of periodically monitoring the storage canister atmosphere for fission products, specifically krypton-85 gas. Samples drawn to date have shown no detectable concentrations of this product after approximately 3 years of storage, indicating a maintenance of the fuel cladding integrity.

A third paper presented at the same Topical Meeting, by E.R. Gilbert and A.B. Johnson, Jr., "Assessment of the Light-Water Reactor Fuel Inventory for Dry Storage," focuses on dry spent fuel storage with respect to an acceptable temperature range for storage in air. They conclude on page 8 of their report:

> Dry storage demonstrations now in progress suggest that by 1986 a major fraction of the U.S. PWR spent fuel inventory that was placed in water storage before 1981 can be stored in dry storage facilities below 150 to 200°C.
>
> The LWR fuel inventory offers good prospects that the thermal characteristics of consolidated fuel will be acceptable for dry storage by proper selection of fuel.
>
> Dry storage of LWR fuel with defective cladding may be tolerable in inert cover gases or at temperatures below the threshold for significant oxidation in oxidizing cover gases. The range of acceptable storage temperatures is being investigated.

With respect to dry storage of spent fuel, the Commission notes the summary statement from "Behavior of Spent Nuclear Fuel and Storage Components in Dry Interim Storage" (PNL-4189), *supra* note 5, at xvii:

> Operational problems in vaults and dry wells have been minor after up to 18 yr. of operation (in 1982); and 7 yr of silo experience suggests that decades of satisfactory operation can be expected. Demonstration tests with irradiated fuel in metal storage casks are just beginning, but metal shipping casks with mild steel chambers have been used since the mid-1940s. Metal storage/shipping casks have successfully survived fire, drop, and crash tests.

[7] *Proceedings of the American Nuclear Society's Topical Meeting on Options for Spent Fuel Storage*, Savannah, Georgia (September 26-29, 1982).

Thus, with respect to the storage of spent fuel under dry conditions at storage installations located either at reactor sites or away from reactor sites, the Commission believes that current dry-storage technology is capable of providing safe storage for spent nuclear fuel. The modular character of dry storage installations enhances the ability to perform maintenance or to correct mechanical defects, if any should occur. The Commission is confident that its regulations will assure adequate protection of the public health and safety and the environment during the period when the spent fuel is in storage.

The Commission notes that § 211(2)(B) of the Nuclear Waste Policy Act authorizes the Secretary of Energy to carry out research on, and to develop facilities to demonstrate, dry storage of spent nuclear fuel. Although this provision indicates a judgment on the part of the Congress that additional research and demonstration is needed on the dry storage of spent fuel, the Commission believes the information discussed above 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 environment and the public health and safety than storage of spent fuel in water pools.

The technical studies cited above support the conclusion that corrosion would have a negligible effect during several decades of extended dry storage. The Commission's confidence in the safety of dry storage is based on an understanding of the material degradation processes, rather than merely on extrapolation of storage experience — together with the recognition that dry storage systems are simpler and more readily maintained. For these reasons, the Commission is confident that dry storage installations can provide continued safe storage of spent fuel at reactor sites for at least 30 years after expiration of the plant's license.

D. Potential Risks of Accidents and Acts of Sabotage at Spent Fuel Storage Facilities

The Commission finds that the risks of major accidents at spent fuel storage pools resulting in offsite consequences are remote because of the secure and stable character of the spent fuel in the storage pool environment, and the absence of reactive phenomena — "driving forces" — which may result in dispersal of radioactive material. Reactor storage pools and independent spent fuel storage installations have been designed to safely withstand accidents caused either by natural or man-

made phenomena. Even remote natural risks such as earthquakes and tornados and the risks of human error such as in handling or storing spent fuel are addressed in the design and operational activities of storage facilities and in NRC's licensing reviews thereof under its regulations. Under 10 C.F.R. Parts 50 and 72, spent fuel is stored in facilities structurally designed to withstand accidents and external hazards, such as those cited above, and to preclude radiation and radioactive material emissions from spent fuel that would significantly endanger the public health and safety. In order to preclude the possibility of criticality under normal or accident conditions, the spent fuel is stored in racks designed to maintain safe geometric configurations under seismic conditions. The spent fuel itself consists of solid ceramic pellets which are encapsulated in metal-clad rods held in gridded assemblies and stored underwater in reinforced concrete structures or in sealed dry storage installations such as concrete dry wells, vaults and silos or massive metal casks. The properties of the spent fuel (which in extended storage has decayed to the point where individual fuel assemblies have a heat generation rate of several hundred watts or less) and of the benign storage environment result in spent fuel storage being an activity with very little potential for adversely affecting the environment and the public health and safety. While any system employing high technology is subject to some equipment breakdowns or accidents, water pool storage facilities have operated with few serious problems (DOE PS at IV-56 to IV-57; UNWMG-EEI PS, Doc. 4, at 26). In these cases, the events at spent fuel pools have been manageable on a timely basis. Similarly, dry storage of spent fuel, as discussed in § C, above, appears to be at least as safe as water pool storage. A discussion of risks related to spent fuel storage is provided below.

Comments from participants on the subject of accidents and their potential consequences at spent fuel storage facilities included a description of nonspecific references to numerous "accidents" in spent fuel storage facilities, a discussion of cases of leaks and inadvertent releases of contaminated storage pool water, and a suggestion that waste storage should be physically separated from reactor operation to reduce the risk of damage to the storage facility in the event of a reactor accident, and vice versa (NY PS at 102-07; OCTLA PS at 12). The State of New York, in its discussion of possible accidents at spent fuel storage pools, cited reports of an accident in the Soviet Union that is believed to have involved reprocessing plant wastes stored in tanks at a waste storage facility (NY PS at 107-08). The situation, as reconstructed from limited data, cannot be compared to the storage of ceramic fuel in metal cladding, placed in water storage pools. The issue raised, therefore, is not

relevant to this proceeding. The need for continued management of pool storage facilities over an extended time period was considered by some participants as creating a potential hazard because of the increased possibility of human errors or mismanagement (NRDC PS at 89-90). The State of New York characterized the Three Mile Island reactor accident as caused by multiple technical and human failures, and postulated that such failures are possible at storage facilities, and would result in serious offsite consequences (NY PS at 107).

These observations do not appear to take account of the numerous safety analyses that have been made of water pool storage and of alternative long-term storage methods which have demonstrated storage to be both safe and environmentally acceptable. Of course, the possibility of human error cannot be completely eliminated. However, Commission regulations (e.g., 10 C.F.R. Part 55; 10 C.F.R. Part 72, Subpart I) include explicit requirements for operator training, the use of written procedures for all safety-related operations and functions in the plant, and certification or licensing of operators, with the objective of minimizing the opportunity for human error. Unlike the accident at the Three Mile Island reactor, human error at a spent fuel storage installation does not have the capability to create a major radiological hazard to the public. The absence of high temperature and pressure conditions that would provide a driving force essentially eliminates the likelihood that an operator error would lead to a major release of radioactivity (DOE CS at II-156 to II-158). In addition, features incorporated in storage facilities are designed to mitigate the consequences of accidents caused by human error or otherwise (DOE PS at IV-34).

The possibility of terrorist attacks on nuclear facilities was advanced as an argument against the acceptability of extended interim storage of spent fuel (NRDC PS at 90). The intentional sabotage of a storage pool facility is possible, and NRC continues to implement actions to further improve security at such facilities. The consequences would be limited by the realities that, except for some gaseous fission products, the radioactive content of spent fuel is in the form of solid ceramic material encapsulated in high-integrity metal cladding and stored underwater in a reinforced concrete structure. Under these conditions, the radioactive content of spent fuel is relatively invulnerable to dispersal to the environment (NUREG-0575, Vol. 1, *supra*). Similarly, dry storage of spent fuel in dry wells, vaults, silos and metal casks is also relatively invulnerable to sabotage and natural disruptive forces, because of the weight and size of the sealed, protective enclosures which may include 100-ton steel casks, large concrete-lined near-surface caissons and surface concrete silos (NUREG/CR-1223, *supra*, at IV-C.2).

E. Summary

In summary, the Commission finds that spent fuel can be stored safely at independent spent fuel storage installations or at reactor sites for at least 30 years beyond the expiration of reactor operating licenses. This finding is based on extensive experience and on many factors that are not site-specific. These factors include the substantial capability of the fuel cladding to maintain its integrity under storage conditions, a capability verified in extensive technical studies and experience; the extreme thermal and chemical stability of the fuel form, enriched uranium oxide pellets; the long-term capability of spent fuel storage facilities to dissipate spent fuel heat and retain any radioactive material leakage; and the relatively straightforward techniques and procedures for repairing spent fuel storage structures, replacing defective components or equipment, or undertaking other remedial actions to assure containment of radioactivity (Johnson, "Behavior of Spent Nuclear Fuel in Water Pool Storage" (UC-70), *supra*). These factors contribute to the assurance that spent fuel can be stored for extended periods without significant impact on the public health and safety and the environment. Moreover, any storage of spent fuel at independent spent fuel storage installations or reactor sites beyond the operating license expiration will be subject to licensing and regulatory control to assure that operation of the storage facilities does not result in significant impacts to the public health and safety.

For the reasons discussed previously (§§ 2.4-A through 2.4-D, above), the Commission also concludes, from the record of this proceeding, that storage of spent fuel either at or away from a reactor site for 30 years beyond the operating license expiration would not result in a significant impact to the environment or an adverse effect on the public health and safety. The Commission's findings are also supported by NRC's experience in more than 80 individual safety evaluations of spent fuel storage facilities conducted in recent years. The record indicates that significant releases of radioactivity from spent fuel under licensed storage conditions are highly unlikely. This is primarily attributable to the resistance of the spent fuel to corrosive mechanisms and the absence of any conditions that would result in offsite dispersal of radioactive material. The Commission concludes that the possibility of a major accident or sabotage with offsite radiological impacts at a spent fuel storage facility is extremely remote because of the characteristics of spent fuel storage. These include the inherent properties of the spent fuel itself, the benign nature of the water pool or dry storage environment, and the absence of any conditions that would provide a driving force for dispersal of radioactive material. Moreover, there are no significant additional

nonradiological impacts which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses for reactors. The nonradiological environmental impacts associated with site preparation and construction of storage facilities are, and will continue to be, considered by the NRC at the time applications are received to construct these facilities, which are licensed under NRC's regulations in either 10 C.F.R. Part 50 for reactors or 10 C.F.R. Part 72 for independent spent fuel storage facilities. The procedure to be followed in implementing the Commission's generic determination is the subject of rulemaking which the Commission has conducted.

2.5 Fifth Commission Finding

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.

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 5-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 (Tr. at 157-58). 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 offsite, 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 (DOE PS at I-11; DOE CS at II-66). 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 (Tr. at 157-59). 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.

In Subtitle B of the Act, "Interim Storage Program," Congress found that owners and operators of civilian power reactors "have the primary responsibility for providing interim storage of spent nuclear fuel from such reactors" by maximizing the use of existing storage facilities on site and by timely additions of new onsite storage capacity. The Federal government is responsible for encouraging and expediting the effective use of existing storage facilities and the addition of new storage capacity as needed. In the event that the operators cannot reasonably provide adequate storage capacity to assure the continued operation of such reactors, the Federal government will assume responsibility for providing interim storage capacity for up to 1900 metric tons of spent fuel (§ 131(a)). Such interim storage capacity is to be provided by the use of available capacity at one or more Federal facilities, the acquisition of any modular or mobile storage equipment including spent fuel storage racks, and/or the construction of new storage capacity at any reactor site (§ 135(a)(1)).

The Nuclear Waste Policy Act authorizes the Secretary of Energy to enter into contracts with generators or owners of spent fuel to provide for storage capacity in the amount provided in the Act (§ 136(a)(1)). However, such contracts may be authorized only if the NRC determines that the reactor owner or operator cannot reasonably provide adequate

and timely storage capacity and is pursuing licensed alternatives to the use of Federal storage capacity (§ 135(b)).[8] Further, any spent fuel stored in the "interim storage program" is to be removed from the storage site or facility "as soon as practicable" but in no event later than 3 years following the availability of a repository or monitored retrievable storage facility (§ 135(e)). The Act establishes an "Interim Storage Fund" for use in activities related to the development of interim storage facilities, including the transportation of spent fuel and impact assistance to State and local governments (§ 136(d)).

In addition to providing for interim storage capacity, Congress found that "the long-term storage of high level radioactive waste or spent nuclear fuel in monitored retrievable storage facilities is an option for providing safe and reliable management of such waste or spent fuel." By June 1, 1985, the Secretary of Energy must complete a detailed study of the need for, and feasibility of, such a facility and submit to Congress a proposal for the construction of one or more such facilities. The Act also directs the Secretary of Energy to establish a demonstration program, in cooperation with the private sector, for the dry storage of spent nuclear fuel at reactor sites and provide consultative and technical assistance on a cost-sharing basis to assist utilities lacking interim storage capacity to obtain the construction, authorization and appropriate license from the NRC. Such assistance may include the establishment of a research and development program for the dry storage of no more than 300 metric tons of spent fuel at federally owned facilities (§ 218(a), (b), and (c)).

The Commission's confidence that independent onsite and/or offsite storage capacity for spent fuel will be available as needed is further supported by the strong likelihood that only a portion of the total spent fuel generated will require storage outside of reactor storage basins (DOE PS at V-3 to V-13). Estimates of the amount of spent fuel requiring storage away from reactors have declined significantly over the duration of this proceeding (DOE March 27, 1981, letter from O. Brown, II, DOE Office of General Counsel, to M. Miller, NRC, Presiding Officer in this proceeding).

DOE reported that cumulative spent fuel discharges, previously estimated as 100,000 metric tons of uranium (MTU), dropped to 72,000 MTU through the year 2000. Projected requirements for additional spent fuel storage capacity begin in 1986 (instead of 1981) and increase to 9500 MTU per year by 1997. Earlier projections indicated a need for

[8] Accordingly, the Commission has published proposed "Criteria and Procedures for Determining the Adequacy of Available Spent Nuclear Fuel Storage Capacity," 10 C.F.R. Part 53 (48 Fed. Reg. 19,382 (1983)).

16,000 MTU per year for additional storage capacity in 1997.[9] DOE pointed out that additional storage requirements could be satisfied in a number of ways, including: (a) use of private existing AFR storage facilities; (b) construction of new water basins at reactor facilities or away-from-reactor facilities by private industry or the utilities; (c) transshipment of spent fuel between reactors operated by different utilities; (d) disassembly of spent fuel and storage of spent fuel rods in canisters; and (e) dry storage at reactor sites.

Subsequently, DOE published new estimates for additional spent fuel storage capacity ("Spent Fuel Storage Requirements," DOE/RL-82-1, June 1982). These estimates show a maximum required away-from-reactor (AFR) storage capacity of 8610 metric tons uranium of spent fuel in the year 1997. This is a decline from DOE's previously published planning-base case. The information in Table 1, below, is excerpted from DOE/RL-83-1 and provides a range of projections of additional storage capacity needs. The first column is a projection of storage capacity needed over and above the currently existing and planned storage capacity. The second column provides projected values of additional storage capacity needed if maximum re-racking is conducted at existing or planned reactor basin storage pools. The storage capacity needs shown in the second column are somewhat smaller than in the first column. A further decrease in additional needed storage capacity is shown in the third column, which takes into account the possibility of transshipment of fuel from one reactor basin to another basin owned by the same utility. The projected values of needed storage capacity in the first and third columns provide a range of upper- and lower-bound values, respectively. The most likely outcome expected by DOE corresponds to the values in the second column. This was formerly known as the planning-base case and is now termed the reference case. All projections shown in the table assume the maintenance of a full-core reserve. The magnitude of need for additional spent fuel storage capacity projected by DOE has continued to decline, even though DOE has not assumed the use of newly developed technology, such as fuel rod consolidation.

The cumulative amount of spent fuel to be disposed of in the year 2000 is expected to be 58,000 metric tons of uranium (Spent Fuel Storage Requirements (Update of DOE/RL-82-1), DOE/RL-83-1, published January 1983). The additional required storage capacity of 13,000 metric tons of uranium projected in the second column for the year 2000 is less than 25% of the total quantity of spent fuel projected to be in storage. It

[9] DOE's planning-base studies assume maximum basin re-racking at reactors and the maintenance of full-core reserve in reactor basins.

Table 1: Additional Cumulative Spent Fuel Storage Requirements, Over and Above Current and Planned Storage at Reactor Storage Basins (Metric Tons of Uranium)*

Year	No change in current or planned storage capacity	Use maximum re-racking of current and planned storage capacity	Maximum re-racking plus transshipment
1982	0	0	0
1983	0	0	0
1984	13	13	0
1985	13	13	0
1986	110	110	3
1988	550	490	90
1990	1,500	1,360	310
1995	5,610	5,060	3,000
2000	14,760	13,090	10,370

*Spent Fuel Storage Requirements (Update of DOE/RL-82-1) DOE/RL-83-1, published January 1983.

is expected that additional storage will be provided at the reactor site, with some smaller portion to be moved off site.

In response to the Commission's Second Prehearing Memorandum and Order (November 6, 1981) the participants commented on the significance to the proceeding of issues resulting from the DOE policy change on spent fuel storage. The utilities generally limited their written responses to a restatement of the safety of interim storage and an affirmation of the technical and practical feasibility of the alternatives to Federal AFR storage facilities. An implied commitment by industry to implement AFR storage if necessary using one of the several feasible spent fuel storage alternatives is evident from the responses of the utilities, the nuclear industry, and associated groups (i.e., Tr. at 159).

Based upon the foregoing, the Commission has, then, reasonable assurance that safe independent onsite or offsite spent fuel storage will be available if needed. The technology is demonstrated and the licensing procedures are in place. The Nuclear Waste Policy Act establishes a national policy on interim storage of spent fuel and provides for contingency Federal storage capacity to augment that provided by industry. Further, the amount of fuel which may have to be stored in independent spent fuel storage facilities is less than was originally thought.

REFERENCE NOTATION

The following abbreviations have been used for the reference citations in the Appendix:

PS	Position Statement
CS	Cross-Statement
PHS	Prehearing Statement
Tr.	Transcript* of January 11, 1982 public meeting with the Commissioners

Participants have been identified by the following citations.

Citation	Participant
AIChE	American Institute of Chemical Engineers
ANS	American Nuclear Society
AEG	Association of Engineering Geologists
AIF	Atomic Industrial Forum, Inc.
Bech	Bechtel National, Inc.
CDC	California Department of Conservation
CEC	California Energy Commission
CPC	Consumers Power Company
Del	State of Delaware
DOE	U.S. Department of Energy
ECNP	Environmental Coalition on Nuclear Power
GE	General Electric Company
Ill	State of Illinois (PS includes Roy affidavit)
Lewis	Marvin I. Lewis
Lochstet	Dr. William A. Lochstet
Minn	State of Minnesota
MAD	Mississippians Against Disposal
NECNP	New England Coalition on Nuclear Pollution
NfE	Neighbors for the Environment (PS includes papers by Dornsife, Rae, and Strahl)
NRDC	Natural Resources Defense Council, Inc.
NY	State of New York

*The Commission considers this transcript to be part of the administrative record in this rulemaking. However, the transcript has not been reviewed for accuracy by the Commission or the participants, and therefore is only an informal record of the matters discussed.

Citation	Participant
OCTLA	Ocean County and Township of Lower Alloway Creek
Ohio	State of Ohio
SC	State of South Carolina
SE2	Scientists and Engineers for Secure Energy, Connecticut Chapter
SHL	Safe Haven, Ltd.
SMP	Sensible Maine Power, Inc.
TVA	Tennessee Valley Authority
UNWMG-EEI	Utility Nuclear Waste Management Group-Edison Electric Institute
USGS	United States Geological Survey
Vt	State of Vermont
Wis	State of Wisconsin (PS includes comments by Deese, Mudrey, Kelly, and Leverance)
UG	The Utilities Group (Niagara Mohawk Power Corp., Omaha Public Power District, Power Authority of the State of New York, and Public Service Company of Indiana. Inc.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING APPEAL BOARD

Administrative Judges:

Alan S. Rosenthal, Chairman
Gary J. Edles
Howard A. Wilber

In the Matter of **Docket No. 50-322-OL**

LONG ISLAND LIGHTING COMPANY
(Shoreham Nuclear Power Station, Unit 1)

August 3, 1984

The Appeal Board explains, for the benefit of the parties and the Commission, its agreement with the determination of the Chief Administrative Judge of the Atomic Safety and Licensing Board Panel not to refer to the Appeal Board his denial of intervenor's motion calling for his disqualification from participation in any matters concerning the Shoreham facility.

RULES OF PRACTICE: REFERRAL OF RULING (MOTION FOR DISQUALIFICATION)

The Commission's regulation at 10 C.F.R. § 2.704(c) provides for referral to the Commission or Appeal Board of only those disqualification motions addressed to the presiding officer or a designated member of a licensing board.

MEMORANDUM

On June 22, 1984, intervenors Suffolk County and the State of New York filed a motion calling upon B. Paul Cotter, Chief Administrative Judge of the Atomic Safety and Licensing Board Panel, to disqualify himself from participating in any matters concerning the Long Island Lighting Company's (LILCO) Shoreham Nuclear Power Station. This motion is one of three filed by the intervenors seeking disqualification of, respectively, the presiding Licensing Board in the low-power phase of the *Shoreham* operating license proceeding, NRC Chairman Palladino, and Judge Cotter. Administrative Judges Marshall E. Miller, Glenn O. Bright, and Elizabeth B. Johnson, who constitute the low-power Licensing Board, declined to step down. As required by 10 C.F.R. § 2.704(c) their decision was referred to us. We affirmed. *See* ALAB-777, 20 NRC 21 (1984). The motion to disqualify Chairman Palladino is pending before him.

Judge Cotter denied the motion for his disqualification in a memorandum and order issued on August 1, 1984. LBP-84-29A, 20 NRC 385. In a footnote in his decision, he observed that 10 C.F.R. § 2.704(c) provides for referral "to the Commission or the Atomic Safety and Licensing Appeal Board, as appropriate" of only those disqualification motions addressed to the "presiding officer or a designated member of an atomic safety and licensing board . . . ." Thus, he did not refer the motion to us.

We agree with Judge Cotter's disposition insofar as referral to this Board is concerned. To begin with, the express terms of the regulation apply only where "*the presiding officer* does not grant the motion or *the board member* does not disqualify himself . . ." (emphasis added). Judge Cotter is neither the "presiding officer" nor a "member" of a licensing board assigned to hear this case. Moreover, as best we can tell from the administrative history of this regulation, there was no intent to include within its scope anyone other than members of individual licensing boards.[1] Finally, it appears that Judge Cotter came into contact with the *Shoreham* litigation only in his administrative capacity as Chairman of the Atomic Safety and Licensing Board Panel. His functioning in that role here is better supervised by the Commission rather than an appeal board.

[1] When the Commission revised section 2.704 in 1975, it explained: "Section 2.704 currently contains provisions pertaining to the disqualification of a 'presiding officer' on his own motion or that of a party. Clarifying language has been added to reflect current understanding and practice that these provisions apply to all members of a licensing board. In addition, this Section is revised to reflect that a motion to disqualify a Board member shall be referred to the Commission, or the Atomic Safety and Licensing Appeal Board, as appropriate." 40 Fed. Reg. 51,995-96 (1975).

We have stated our intention not to review Judge Cotter's decision for the information of the parties and the Commission. In the circumstances, we express no view whatsoever with respect to the merits of the motion for disqualification.

FOR THE APPEAL BOARD

C. Jean Shoemaker
Secretary to the
Appeal Board

NRC Waste Confidence Position: 1990

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 final 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 final rule.

List of Subjects in 10 CFR Part 51

Administration 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. 552 and 553, the NRC is adopting 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. 1330-223 (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) and under Nuclear Waste Policy Act of 1982, sec. 121, 96 Stat. 2228 (42 U.S.C. 10141). Sections 51.43, 51.67, and 51.109 also issued under Nuclear Waste Policy Act of 1982, sec. 114(f), 96 Stat. 2216, as amended (42 U.S.C. 10134(f)).

2. Section 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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. 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 11th day of September, 1990.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

[FR Doc. 90-21889 Filed 9-17-90; 8:45 a.m.]

BILLING CODE 7590-01-D

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10 CFR Part 51

Waste Confidence Decision Review

AGENCY: Nuclear Regulatory Commission.

ACTION: Review and Final 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 assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or offsite storage will be available and to determine whether radioactive waste can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available." (49 FR 34658). The Commission noted in 1984 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 purpose of this notice is to present the findings of the Commission's first review of that Decision.

The Commission has reviewed its five findings and the rationale for them in light of developments since 1984. This revised Waste Confidence Decision supplements those 1984 findings and the environmental analysis supporting them. The Commission is revising the second and fourth findings in the Waste Confidence Decision 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 (which may include the term of a revised or renewed license) 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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

The Commission is reaffirming the remaining findings. Each finding, any 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 five years before 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 revised Findings 2 and 4, the Commission is providing elsewhere in this issue of the Federal Register 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.

Finally, the Commission is extending the cycle of its Waste Confidence reviews from every five years to every ten until a repository becomes available. In its 1984 Decision, the Commission said that because its conclusions were "...unavoidably in the nature of a prediction," it would review them "...should significant and pertinent unexpected events occur, or at least every five years until a repository...is available." As noted below, the Commission now believes that predictions of repository availability are best expressed in terms of decades rather than years. To specify a year for the expected availability of a repository decades hence would misleadingly imply a degree of precision now unattainable. Accordingly, the Commission is changing its original commitment in order to review its Waste Confidence Decision at least every ten years. This would not, however, disturb the Commission's original commitment to review its Decision whenever significant and pertinent unexpected events occur. The Commission anticipates that such events as a major shift in national policy, a major unexpected institutional development, and/or new technical information might cause the Commission to consider reevaluating its Waste Confidence Findings sooner than the scheduled ten-year review.

FOR FURTHER INFORMATION CONTACT: John Roberts, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (202) 492-0608.

SUPPLEMENTARY INFORMATION:

Analysis of Public Comments on the Proposed Waste Confidence Decision Review.

1.0 Introduction

Comments were received from a Federal agency, the public interest sector, the nuclear industry, and one State as listed below in order of their receipt:

Duke Power Company
Public Citizen
Edison Electric Institute
Malachy Murphy (State of Nevada)
Yankee Atomic Electric Company
Department of Energy
Philadelphia Electric Company
Commonwealth Edison
Virginia Electric and Power Company
Marvin I. Lewis, Registered Professional Engineer
Florida Power & Light Company

The majority of the commenters were supportive of the Commission's proposed decision and rule. The comments were consolidated into a total of 19 issues to be addressed. Each of these issues is discussed under the Commission finding to which it relates. Two additional issues, not raised by commenters, are treated under the heading "Other Relevant Issues." The "Other Relevant Issues" section includes consideration of the petition by the State of Vermont to intervene in the consideration of the extension of the operating license for Vermont Yankee and the potential for non-payment of the one-time fee for spent nuclear fuel generated prior to April 1983 into the Nuclear Waste Fund.

2.0 Analysis of Issues Related to Commission Findings

2.1 The Commission's First Finding

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

Issue No. 1: Technical Feasibility of Safe Disposal in a Mined Geologic Repository

Comment

The commenter representing Public Citizen (PC) stated that there is still not adequate assurance that permanent, safe disposal of high-level radioactive waste in a mined geologic repository is technically feasible. In support of this, the commenter indicated that a number of major scientific panels have pointed out that there is no technical or scientific basis for knowing for sure that geologic disposal is possible. As an example, PC stated that President Carter's Office of Science and Technology Policy (OSTP) found in 1979 a rather general consensus among scientists that a technology base "sufficient to permit complete confidence in the safety of any particular repository design or the suitability of any particular site" was still lacking. PC further stated that more recently, a Waste Isolation Systems Panel of the National Academy of Sciences pointed out many areas of the geologic disposal problem where technical uncertainties exist, and where "more information is needed." PC also stated that the technical difficulties presented by a million-year disposal problem are unprecedented and enormous, and that there have been no major findings since (the above studies) that have resolved the uncertainties to the point where it is possible to be *assured* that geologic disposal is technically feasible.

NRC Response

The issue of the technical feasibility of the safe disposal of spent nuclear fuel and radioactive waste has been addressed at length in the Commission's 1989 Proposed Waste Confidence Decision Review (54 FR 39767; September 28, 1989) as well as in the original 1984 Waste Confidence Decision (49 FR 34658; August 31, 1984). While those discussions addressed the concerns raised by the comment, it is useful to provide additional specific responses to them. The comment that major scientific panels have pointed out that there is no technical or scientific basis for knowing for sure that geologic disposal is possible makes reference to President Carter's OSTP statement in 1979. Contrary to the comment, the OSTP statement does not support the contention that there is no technical or scientific basis for knowing for sure that geologic disposal is possible. Rather, it remarks on the lack of a technology base sufficient to permit complete confidence in the safety of any particular repository design or the suitability of any particular site. The information base necessary to license a repository is still being developed. This includes information on site characterization, repository design, waste package design, and the performance assessment of the entire disposal system. The complete body of such necessary information is expected to be in hand only at the completion of the developmental studies and characterization work being undertaken by the DOE. It is at this point that the DOE will be in a position to apply for a license from the NRC and seek NRC's approval of the safety of its proposed site and repository design.

The Commission also notes that the OSTP statement was made over a decade ago, prior to the completion of a substantial amount of work which has addressed many of the issues related to disposal technology. While the Commission recognizes that more information is needed and that the technical difficulties are challenging, there is no basis to believe that safe disposal in a repository is impossible, or even that it is not likely. No major breakthrough in technology is required to develop a mined geologic repository. Rather, there is a need to add to the current extensive body of technical

information already available and apply it to an evaluation of specific sites and engineering designs.

Regarding the commenter's emphasis on the need for resolution of uncertainties to assure the technical feasibility of geologic disposal, we would respond that the Commission did not state that the feasibility of a mined geologic repository was assured, in the absolute sense, but that it had found reasonable assurance in the feasibility of mined geologic disposal on the basis of a thorough review of the technologies needed to achieve this disposal.

Issue No. 2: Difficulty in Evaluating Compliance with Repository Safety Standards Over Long Time Periods

Comment

The PC commenter also raised the issue of what he termed the "inability to predict with a reasonable degree of certainty that, once buried, the waste will remain contained [in the geologic repository] for the required time period." The commenter noted uncertainties related to geologic stability, engineered barriers, rock-waste interactions, and groundwater hydrology which contribute to the difficulty of evaluating compliance with safety standards over the long time periods involved in radioactive waste isolation. The commenter concluded that although these problems may be able to be resolved, there is not a basis for assurance that this will be the case.

NRC Response

The NRC believes that existing safety assessment techniques have the potential to provide a basis for deciding whether proposed radioactive waste disposal systems are acceptable. We recognize the difficulty of predicting with a high degree of accuracy the maximum impacts a repository would have on human health and the environment, especially in the very far future. It will likely not be possible to test empirically the ability of models to predict long-term repository performance to the same extent as models for short-term performance. However, we believe existing technology can provide a sufficient level of safety for present and future generations under certain conditions. These conditions include addressing the uncertainties inherent in projecting far into the future and in modelling complex heterogeneous natural systems, and acquiring and evaluating data on specific sites.

We also note that the language of the original Environmental Protection Agency's (EPA) Environmental Radiation Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Wastes (40 CFR part 191) does not require absolute assurance that containment requirements will be met. Rather, it recognizes the uncertainties involved in projecting repository performance far into the future, and states "Instead, what is required is a reasonable expectation, on the basis of the record before the implementing agency, that compliance with Sec.191.13(a) will be achieved."

Issue No. 3: Unanticipated Difficulties in Developing the WIPP Facility

Comment

PC also indicated that the Waste Isolation Pilot Plant (WIPP) has not opened because of numerous unanticipated difficulties, including leakage of salt water into the site. PC states that this leakage, which was not anticipated prior to the beginning of construction in the early 1980s, shows that even on a scale of a few years, geologic events in a repository are unpredictable--to say nothing of events on a time scale of hundreds of thousands of years.

NRC Response

Although the NRC does not have oversight responsibility for the WIPP project, NRC does monitor DOE progress on WIPP insofar as it may offer valuable insight into efforts to license a repository for commercial high-level waste and spent fuel. For example, DOE must demonstrate compliance with the EPA standard in order to operate the WIPP facility. NRC cognizance of DOE efforts to implement the EPA Standard at WIPP could help provide information and consensus-building in the implementation of the EPA Standard for the commercial high-level waste repository.

The NRC does not consider the occurrence of brine pockets at the WIPP site as a factor that might diminish its confidence in the technical feasibility of a mined geologic repository. The Commission does not expect that site characterization of a candidate site will proceed free from all difficulty. We have urged DOE to establish a planning mechanism for timely development and implementation of contingency plans at Yucca Mountain to address problems during site characterization as they arise. DOE has announced a new focus on surface-based testing for the Yucca Mountain site in its Reassessment Report to Congress. Under this program, the primary goal of testing is to identify features of the site which would render it unsuitable for a repository. If such features are identified, DOE would notify Congress and the State of Nevada, and terminate site specific activities. A finding that the Yucca Mountain site is unsuitable would likely lead to delays in repository availability while another candidate site is identified and characterized, however it would not diminish confidence in the technical feasibility of geologic disposal.

Issue No. 4: Impact of the BEIR V Report on the Commission's Decision

Comment

Marvin Lewis drew attention to the recent findings of the Committee on the Biological Effects of Ionizing Radiation (BEIR V) in their report on the Health Effects of Exposure to Low Levels of Ionizing Radiation. The commenter stated that the BEIR V study indicated that the danger from radioactivity is four or more times higher than previously known. The commenter further stated that the BEIR V findings will require that the NRC change many of its radiation protection guidelines and rules. He also requested that the NRC stop all action on the Waste Confidence Decision Review until the Commission can determine the effect of the BEIR V report on the Decision.

NRC Response

The Commission has been aware for some time of the scientific data underpinning the estimate of risk from radiation exposure contained in the BEIR V report. Much of this information has been incorporated in the Commission's forthcoming revisions to its radiation protection requirements (10 CFR part 20). For reasons stated below, however, the Commission does not foresee any impact of the BEIR V report on the Waste Confidence Decision.

The BEIR V report is the latest in a series of reports dealing principally with the effects of low-LET radiation in humans, e.g., radiation such as beta particles and gamma photons. The report covers radiation carcinogenesis, genetic effects, and effects on the developing embryo/fetus. The report also includes new information related to the dosimetry of the Japanese atomic bomb survivors, and new epidemiological information. The NRC staff, other Federal agencies, and national and international organizations are currently reviewing both the BEIR V report and the report issued in 1988 by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

The estimates of risk due to low-LET radiation in the BEIR V report are based principally upon effects observed in populations exposed to high doses and at high dose rates. These effects are then extrapolated using statistical modeling to predict effects at low doses

and dose rates. The extrapolations to low dose and dose rate lead to significant uncertainties in the estimates of risk in the BEIR V report. The estimates of risk for fatal cancer induction in the BEIR V report are from three to four times larger than the estimate from the preferred model of the BEIR III report in 1980. However, the new BEIR V estimate is within the overall range of risk estimates and uncertainties from the different models presented in BEIR III.

It is important to note that the BEIR V report only addresses the issue of risk estimates for radiation effects. The BEIR committee did not make any recommendations on acceptable risk or on the potential impacts of the risk estimates to dose limits or standards for radiation protection. Efforts are underway by the International Commission on Radiological Protection (ICRP), National Council on Radiation Protection and Measurements (NCRP), and the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) of the Executive Office of the President to reach some measure of consensus on the impacts of the revised risk estimates to radiation protection standards.

Under section 121(a) of the Nuclear Waste Policy Act (NWPA), NRC is required to issue technical requirements and criteria that it will apply in approving or disapproving a repository. These requirements and criteria must be consistent with the high-level waste disposal standards promulgated by the Environmental Protection Agency. Demonstration of compliance with the EPA standard was discussed under the rationale for Finding 1 in the Commission's Proposed Waste Confidence Decision Review.

The NRC does not believe that numerical criteria for individual protection requirements are at issue in its Waste Confidence Proceeding. The broader issue of demonstrating compliance with EPA release limits using probabilistic analyses was a concern of the NRC staff and the NRC's Advisory Committee on Nuclear Waste in preparing the Proposed Waste Confidence Decision Review. As stated in the Proposed Waste Confidence Decision Review, the NRC staff is closely monitoring EPA's progress on issuing its revised standards to assure that EPA methodologies for demonstrating compliance with them can be applied by NRC to evaluate DOE's demonstration of compliance. NRC will also monitor DOE efforts to demonstrate compliance with the EPA standard at the Waste Isolation Pilot Plant facility for transuranic wastes.

2.2 The Commission's Second Finding

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 (which may include the term of a revised or renewed license) 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.

Issue No. 5: Expected Date for Repository Availability

Comment

Malachy Murphy (State of Nevada) and Public Citizen expressed a lack of support for the Commission's proposed second finding. These commenters argue that the finding should be revised to reflect the 2010 date for repository availability announced in DOE's November 1989 Reassessment Report to Congress. They believe that the NRC's "confidence" date of 2025 for repository availability may be exceeded if the Yucca Mountain site is found to be unsuitable sometime after the year 2000 because there might not be enough time to locate, characterize, license and construct a repository at another site by 2025. The commenter from Public Citizen also finds that even if the Yucca Mountain site were found to be suitable, a repository there might not be available until after 2025. This commenter concluded that it would be more conservative to assume that four candidate sites would be found to be unsuitable during the course of site characterization and that there is no basis for assurance that a repository would be available before 2055.

NRC Response

The NRC does not believe it is necessary to change the proposed second finding to reflect DOE's revised date for repository availability of 2010. NRC anticipated an extension of several years in DOE's schedule when it issued its proposed revised second finding. NRC took the position that if the Yucca Mountain site were found to be unsuitable on or before the year 2000, it was reasonable to expect that an alternative site could be identified and developed in time for repository availability by 2025.

NRC continues to believe that if DOE determines that the Yucca Mountain site is unsuitable, it will make this determination by about the year 2000. DOE's program is now focused on surface-based testing designed to identify features of the site which would render it unsuitable for a repository. The only significant barriers to DOE proceeding with site characterization at Yucca Mountain are the development of a quality assurance (QA) program acceptable to NRC, completion of study plans for site characterization activities they wish to begin, and resolution of the impasse between DOE and the State of Nevada regarding permits for drilling. DOE has made significant progress in the development of a QA program for its site characterization activities. It is possible that this work will be completed and accepted by late 1990 or early 1991. Regarding the impasse with the State of Nevada, both DOE and the State of Nevada have filed lawsuits in Federal Court in an effort to resolve the question of site access. While any litigation of this matter has the possibility of an unfavorable outcome for DOE, the Commission believes that Congress has aggressively demonstrated in both the Nuclear Waste Policy Act of 1982 and the Nuclear Waste Policy Amendments Act of 1987 that it is committed to an orderly progression of the repository program and a resolution of the radioactive waste disposal problem. Accordingly, NRC believes that it is reasonable to assume that Congress will not allow the uncertainties related to the start of site characterization to continue for many more years.

For these reasons, NRC believes that the coming decade will be ample time for the DOE to determine whether or not Yucca Mountain is unsuitable and to begin work on an alternate site, if necessary. We believe that Congress is committed to a resolution of the waste problem and will take measures to bring this issue to a close.

We would also point out here that the Court decision that led to the Waste Confidence Proceeding did not require NRC to determine when a repository would be available. The Court 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 [Prairie Island and Vermont Yankee's] operating licenses, and if not, whether there is reasonable assurance that the fuel can be safely stored at the reactor sites beyond those dates." NRC chose as a matter of policy not to confine itself to the storage-related questions in the Court's remand, but to address the broader issues of whether radioactive wastes could be safely disposed of, when such disposal would be available, and whether such wastes can be safely stored until they are disposed of. NRC

was not requested to determine nor has it made a determination that a repository must be available by 2025 in order to protect public health and safety.

NRC does not find a reasonable basis for the argument that even if the Yucca Mountain site were found to be suitable, it might not be available by the year 2025. Surface-based and in-situ testing are expected to take approximately ten years. The NWPA provides that NRC's review of DOE's license application is to be completed in three years (with the possibility of an additional year). Construction is scheduled to take another six years. Even if each of these activities were to take several years longer than planned, a repository at Yucca Mountain could be available well before the year 2025. The limiting condition appears to be the timing of DOE's access to the site to begin testing.

Finally, we do not believe it is realistic to assume for conservatism that four candidate sites will be found unsuitable before an acceptable site is characterized, licensed and built. To date, no candidate site for a repository has been found to be unsuitable for technical reasons. However, if the Yucca Mountain site is found to be unsuitable, an alternative site would have to undergo a similar process of site-screening and characterization to determine its suitability. We believe it is reasonable to expect that experience gained in the Yucca Mountain site characterization effort would provide a better basis for choosing an alternative site. Furthermore, it may be possible to complete site suitability testing at another site at a faster pace than at Yucca Mountain given the benefits of lessons-learned at that site.

Issue No. 6: Clarification of the NRC's Role in the Licensing Support System (LSS)

Comment

The DOE commented that it was not clear what NRC meant by the words "implementing it" in the statement "DOE has the responsibility for designing the LSS and bearing the costs associated with it and NRC will be responsible for implementing it."

NRC Response

In its Proposed Waste Confidence Decision Review, NRC included a description of the Licensing Support System (LSS) under its discussion of "Measures for dealing with Federal-State-Local concerns." The LSS is intended to provide participants in the repository licensing proceeding early access to documents relevant to the licensing decision.

To eliminate any confusion regarding NRC's responsibilities for the LSS, the above sentence in the Proposed Decision Review will be eliminated and the following description will be inserted in its place: "DOE is responsible for the design, development, procurement and testing of the LSS. LSS design and development must be consistent with objectives and requirements of the Commission's LSS rulemaking and must be carried out in consultation with the LSS Administrator and with the advice of the Licensing Support System Advisory Review Panel. NRC (LSS Administrator) is responsible for the management and operation of the LSS after completion of the DOE design and development process."

Issue No. 7: Suggestion for Reducing Licensing Uncertainties Related to Spent Fuel Transshipments

Comment

Commonwealth Edison commented that in order to enhance the viability of the option of transferring spent fuel from retired reactors to others under active management, the NRC should reduce, to the maximum extent possible, licensing uncertainties related to such fuel transfers. The commenter also stated that by predetermining that spent fuel pool densification and alternative on-site spent fuel storage methods do not raise any significant hazards considerations, the NRC's final decision would be strengthened.

NRC Response

The Commission evaluates applications for modification of spent fuel storage at licensee's facilities or for transshipment from one site to another on an individual basis. Such a case-by-case consideration of the merits of each application ensures that all significant safety issues are addressed in a thorough manner and provides a conservative approach for arriving at a decision on the merits of the license application.

Issue No. 8: Appropriate Use of Nuclear Waste Fund Monies

Comment

Commonwealth Edison Company (CECo) refers to the NRC's statement that DOE could accept responsibility for management of spent fuel until a repository is available in the event that a licensee becomes insolvent prior to the time a geologic repository is ready to accept spent fuel. Funds from either the Nuclear Waste Fund (NWF) or from the utility itself could be used (54 FR 39767, at 39786 and 39790). CECo comments that the use of the NWF monies for this purpose would involve the solvent utilities funding the storage of spent fuel generated by the bankrupt licensees. CECo believes that it is not clear whether the Nuclear Waste Policy Act would allow NWF monies to be used for this purpose and suggests that NRC should seek and analyze comments on this issue. Until further evaluation and analysis has taken place, CECo believes NRC should delete this as a basis for confidence.

NRC Response

The Commission believes that there are two related issues presented in the above comment. The first is whether DOE can accept responsibility for spent fuel if a utility is insolvent or otherwise no longer capable of managing it. A second related issue is, given DOE's acceptance of responsibility for the spent fuel, where would DOE obtain the funds needed to pay the costs of this responsibility? The NRC continues to believe that DOE would accept responsibility for spent fuel management in the event that a licensee is unable to exercise its own responsibility. Further, the NRC believes that DOE would have sufficient resources to carry out any safety-related measures.

As indicated in the discussion under Issue 21, because DOE is not precluded from accepting responsibility for the waste in those situations, default is an issue of equity rather than public health and safety. As such, the Commission does not believe that a licensee's potential default has a direct bearing on the Commission's Waste Confidence Decision.

Nevertheless, because the source of funds, but not DOE's ultimate responsibility is ambiguous, the NRC has decided to change the references that CECo cites with the bracketed words to be deleted in the Final Waste Confidence Decision Review:

> 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]. (p.39786, col.1)

> 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. (p.39390, col.1)

Issue No. 9: Costs Incurred Due to Delayed Acceptance of Spent Fuel at Repository

Comment

Commonwealth Edison Company (CECo) observed that additional costs will be incurred by licensees as a result of delayed acceptance of spent fuel at the repository. CECo believes that consideration should be given as to whether these costs will be covered by the Nuclear Waste Fund or whether the costs will be incurred directly by the licensee.

NRC Response

The Commission believes that this is a matter which will have to be resolved in another forum in the context of the contracts between DOE and the utilities/owners of spent fuel. The individual contracts currently specify the dates by which DOE has agreed to accept responsibility for the disposal of spent fuel. If DOE must delay its acceptance of spent fuel, the responsibility for the financial consequences of that default would have to be determined at that time by reference to and interpretation of the pertinent contracts. The ultimate answer to this question will not affect the findings of the Waste Confidence Decision.

Issue No. 10: Clarification of Discussion of Period of Safe Spent Fuel Storage at Dresden 1

Comment

Commonwealth Edison Company (CECo) comments that the discussion in the Proposed Decision Review of the possible extended storage of spent fuel from Dresden 1 is not clear and should be clarified. On the basis of assumptions discussed in the Proposed Decision Review, CECo concludes that three different dates could be derived to indicate the maximum time for onsite spent fuel storage. For Dresden 1, which was licensed to operate in 1959 and permanently shut down in 1978, 30 years after shutdown would yield a maximum date of 2008; 30 years after a full 40-year license term yields a maximum date of 2029; and 30 years after a full 40-year license term plus a 30-year extension of the operating license would yield a date of 2059.

NRC Response

The NRC believes that CECo has misinterpreted the discussion pertaining to the maximum term of onsite spent fuel storage in the Waste Confidence Decision and the bases and assumptions underlying that discussion as they pertain to the specific circumstances of Dresden 1. The *generic* discussion of the derivation of the maximum safe storage term for the purposes of the Waste Confidence Decision is contained in pp.39785-90 and pp.39783-96. The Commission concluded on a generic basis 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 30 years beyond the licensed life for operation (which may include the term of a revised license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations" (proposed 10 CFR 51.23(a) at p. 39968 (Finding 4) (emphasis added)). The discussion and findings were based on technical and institutional considerations that, for the sake of completeness, considered situations like those at Dresden 1 that differ from those with most reactors that are expected to operate to full term plus a possible extended license term. For Dresden 1, based on proposed § 51.23(a), the applicable storage period would be 30 years beyond the licensed life of operation, or until 2029.

2.3 The Commission's Third Finding

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.

Issue No. 11: Resolution of Contractual Conflicts Between DOE and Licensees

Comment

Commonwealth Edison Company (CECo) comments that the NRC has unnecessarily interjected itself into issues involved in the contracts between the DOE and licensees by NRC's statement that it would have more confidence if the DOE and licensees could resolve any uncertainties by reaching an early and amicable resolution as to how and when the DOE will accept responsibility for spent fuel. CECo believes that the implication in this statement is that licensees should amend their contracts with DOE to allow DOE additional time to perform under the contracts or that licensees should refrain taking action against DOE if it defaults under the contracts. CECo notes that NRC has stated that its confidence in safe storage is unaffected by potential contractual disputes between DOE and the spent fuel owners (54 FR 39792), therefore CECo believes that it would be appropriate for NRC to strike the statement and express no opinion regarding possible future disputes between DOE and licensees.

NRC Response

The Commission did not intend the implication that CECo perceives regarding any particular preferred outcome or suggested resolution of future potential contract disputes between DOE and contract holders. The Commission has stated that its 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. The Commission's further statement that it would be helpful if any future potential contract disputes could be resolved amicably merely expressed a concern that the waste management system operates smoothly and efficiently. The statement did not imply any additional impact on or repercussion from the Waste Confidence Decision upon the resolution of future potential contract disputes between DOE and contract holders.

The Commission believes that it has made its position clear that its confidence is not diminished by any potential contractual disputes between DOE and spent fuel owners. However, in order to avoid any further misunderstanding in this regard, the Commission has decided to delete the following statements in its Proposed Waste Confidence Decision Review from its Final Waste Confidence Decision Review:

> 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 resolution 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. (54 FR 39792); and
>
> 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. (54 FR 39797)

Issue No. 12: NRC Responsibility to Identify Need for Utilities to Provide Interim Storage and to Notify Congress of This Requirement

Comment

Malachy Murphy (State of Nevada) comments that, in light of DOE's Reassessment Report to Congress, the NRC should explicitly state that utilities will need to have interim spent fuel storage available well into the next century. The commenter also states that NRC should explicity request that Congress take note of this requirement. The commenter believes that such action would be in keeping with NRC's responsibilities to the public and to nuclear utilities.

NRC Response

The standard contracts between DOE and generators of spent nuclear fuel or persons holding title to spent fuel currently provide that in return for payment to the Nuclear Waste Fund, DOE will dispose of high-level waste and spent fuel beginning no later than January 31, 1998. The Commission believes it would be inappropriate for NRC to take any position on the need for generators and those holding title to such material to provide interim storage for it beyond 1998. This is a matter that will have to be resolved between the parties to the standard contracts. NRC, in its original Waste Confidence Decision and in the Proposed Waste Confidence Decision Review, addressed the issue of storage of spent fuel until a repository becomes available and has expressed its confidence that spent fuel will be safely managed until a repository is available. Furthermore, in its original Waste Confidence Proceeding, NRC amended its reactor licensing rule, 10 CFR part 50 to require each licensed reactor operator to submit, no later than five years before expiration of the operating license, plans for managing spent fuel at the reactor site until the spent fuel is transferred to DOE for disposal.

In the Nuclear Waste Policy Act (NWPA), Congress placed primary responsibility for interim storage of spent fuel on the nuclear utilities until disposal becomes available. Section 132 of the NWPA requires that DOE, NRC, and other authorized Federal officials take such actions as they believe are necessary to encourage and expedite the effective use of available storage, and necessary additional storage, at the site of each civilian nuclear power reactor.

Sections 218(a) and 133 of the NWPA also provide that NRC by rule establish procedures for the licensing of any technology approved by NRC for use at the site of any civilian nuclear power reactor. NRC may by rule approve one or more dry spent fuel storage technologies for use at the sites of civilian power reactors without, to the maximum extent practicable, the need for additional site-specific approvals. Congress is eminently aware of the likely need for at-reactor storage of spent fuel and has taken legislative action with respect to this matter. Therefore, the NRC believes it is not necessary to inform Congress of this need. However, the NRC will continue to exercise its responsibility to assure that spent fuel is managed safely until a repository is available and will notify Congress of any actions it believes are necessary to provide this assurance.

2.4 The Commission's Fourth Finding

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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

Issue No. 13: Consideration of the Cumulative Impacts on Waste Management in the NRC's NEPA Documentation

Comment

DOE commented that the cumulative impacts on waste management of potential reactor operating license extensions should be considered in the NRC's National Environmental Policy Act (NEPA) documentation for license renewals.

NRC Response

DOE has observed that renewal of operating licenses would increase the total amount of spent fuel requiring disposal or interim storage which would be taken into account in DOE program planning and should be considered in NRC's NEPA documentation for license renewals. This is generally consistent with the discussion in the Commission's proposed decision, especially 54 FR 39795 (third column). The greater amount of spent fuel which must be stored as a result of license renewal does not affect the Commission's overall finding of no significant environmental impacts.

Issue No. 14: Need for NRC to Facilitate ISFSI License Extensions to Reflect the Commission's Revised Fourth Finding

Comment

The Virginia Electric & Power Company (VEPCo) states that the current license on the Independent Spent Fuel Storage Installation (ISFSI) for its Surry nuclear power plant expires on July 31, 2008. VEPCo states that the NRC should initiate actions to facilitate ISFSI license extensions to reflect the proposed revised Fourth Finding that spent fuel generated in any reactor can be safely stored for at least 30 years beyond the licensed life for operation of that reactor either onsite or offsite.

NRC Response

The Commission's Waste Confidence finding on the duration of safe storage of spent fuel is generic in nature. Site-specific licensing procedures remain effective. Pursuant to § 72.42, an ISFSI license is issued for a period of 20 years but may be renewed upon application by the licensee. Part 72 in no way precludes licensees from requesting additional extensions of license terms for ISFSIs. The licensee thus has the option of requesting an ISFSI license renewal to coincide with whatever operating term and post-operation spent fuel storage period is in effect for a particular reactor. For example, a single renewal could extend the Surry ISFSI license expiration date to the year 2028. The NRC does not believe that further revisions to § 72.42 to facilitate these license extensions are warranted at this time.

Issue No. 15: Insufficient Assurance on Duration of Safe Storage and Risk of Fire at a Spent Fuel Pool

Comment

Public Citizen stated that there is not adequate assurance that spent fuel will be stored safely at reactor sites for up to 30 years beyond the expiration of reactor operating licenses. This is even more the case if license extensions of up to 30 years are included. Public Citizen further stated that "the (Waste Confidence) policy statement fails to recognize that spent fuel buildup at reactor sites poses a growing safety hazard. The pools are not well protected from the environment (in many cases they are outside the reactor's containment structure) and have leaked in the past. For example, in December 1986 at the Hatch nuclear power plant in Baxley, Georgia, 141,000 gallons of radioactive water leaked out of the plant's fuel pool. More than 80,000 gallons of the water drained into a swamp and from there into the Altamaha River near the plant." Public Citizen added that "More recently, on August 16, 1988, a seal on a fuel pool pump failed at the Turkey Point nuclear plant near Miami, FL, causing some 3,000 gallons of radioactive water to leak into a nearby storm sewer. The shoes and clothing of approximately 15 workers were contaminated."

Public Citizen also stated that the danger posed by an accident in which enough pool water escaped to uncover the irradiated fuel assemblies would be greater than the operational incidents described above. According to the commenter, if a leak or pump failure caused the water level in a spent fuel pool to drop to a level which exposed the fuel assemblies, the remaining water might be insufficient to provide adequate cooling. The pool water could then heat to the boiling point, producing steam and causing more water to boil away. The danger then is that heat could continue to build up even further until the cladding which encloses the irradiated fuel pellets catches fire. The commenter continued saying that the

NRC itself, in the time since the original Waste Confidence Decision, has studied the issue of storage in reracked spent fuel pools and concluded in a 1987 report that the consequence of such a cladding fire could be a "significant" radiation release. The NRC report found:

(1) the natural air flow permitted by high-density storage racks is so restricted that potential for self-sustaining cladding fire exists; and

(2) with high-density racks providing "severely restricted air flow" the oxidation (burning) would be "very vigorous" and "failure of both the fuel rods and the fuel rod racks is expected."

Public Citizen states that nowhere in the Proposed Waste Confidence Decision Review does the NRC take into account the findings of this report, which should have been included.

NRC Response

The Commission has addressed the safety of extended post-operational spent fuel storage at considerable length in the discussion of its proposed revised Fourth Finding.

Operational occurrences cited in Public Citizen's comment have been addressed by the NRC staff at the plants listed. The NRC has taken inspection and enforcement actions to reduce the potential for such operational occurrences in the future. We would like to note, however, that the event at the Hatch plant occurred in a transfer canal between spent fuel pools during an operation that would not normally be performed following expiration of a reactor operating license. In the case of the event at Turkey Point, the water that flowed outside the building went back into the intake of the plant cooling canal. The canal is a large, closed loop onsite flow path. There was no radiation release offsite, and the safety significance of the event appears to have been very low.

Regarding the risk of fire at spent fuel pools, the NRC staff has spent several years studying in detail catastrophic loss of reactor spent fuel pool water possibly resulting in a fuel fire in a dry pool. The 1987 report, "Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82" (NUREG/CR-4982), referred to in Public Citizen's comment represents an early part of the NRC's study. Its findings were based on generic data on seismic hazards and response of spent fuel pools, which resulted in calculated risk numbers with wide ranges of uncertainty. (See p. xiii.) Subsequent study of the consequences and risks due to a loss of coolant water from spent fuel pools was conducted by the NRC, and the results were published in NUREG/CR-5176, "Seismic Failure and Cask Drop Analysis of the Spent Fuel Pools at Two Representative Nuclear Power Plants," January 1989, and NUREG-1353, "Regulatory Analysis for the Resolution of Generic Issue 82, >Beyond Design Basis Accidents in Spent Fuel Pools'," April 1989. These reports were cited in the Commission's Proposed Waste Confidence Decision Review (54 FR 39767-39797, at p.39795, September 28, 1989). Also issued in 1989, as part of the NRC staff's study, was "Value/Impact Analyses of Accident Preventive and Mitigative Options for Spent Fuel Pools" (NUREG/CR-5281).

The analyses reported in these studies indicate that the dominant accident sequence which contributes to risk in a spent fuel pool is gross structural failure of the pool due to seismic events. Risks due to other accident scenarios (such as pneumatic seal failures, inadvertent drainage, loss of cooling or make-up water, and structural failures due to missiles, aircraft crashes and heavy load drops) are at least an order of magnitude smaller. For this study, older nuclear power plants were selected, since the older plants are more vulnerable to seismic-induced failures.

It should be noted that for a zircaloy cladding fire in a spent fuel storage pool, an earthquake or other event causing a major loss of cooling water would have to occur within two years after operation of a PWR or six months after operation of a BWR. (See NUREG-1353, p. 4-11.) Thus, during the decades of post-operational storage, even a major loss of cooling water would not be sufficient to cause a cladding fire. During the time the pool would be most vulnerable to a fire, the most-recently discharged fuel assemblies would have to be adjacent to other recently discharged assemblies for a fire to propagate to the older fuel. Considering that a third of the reactor core is typically unloaded as spent fuel each year, the probability of a fire involving even the equivalent of a reactor core--a small portion of a pool's capacity--is quite remote.

It should also be noted that even if the timing of a spent fuel pool failure were conducive to fire, a fire could occur only with a relatively sudden and substantial loss of coolant--a loss great enough to uncover all or most of the fuel, damaging enough to admit enough air from outside the pool to keep a large fire going, and sudden enough to deny the operators time to restore the pool to a safe condition. Such a severe loss of cooling water is likely to result only from an earthquake well beyond the conservatively estimated earthquake for which reactors are designed. Earthquakes of that magnitude are extremely rare.

The plant-specific studies following the 1987 generic study found that, because of the large safety margins inherent in the design and construction of their spent fuel pools, even the more vulnerable older reactors could safely withstand earthquakes several times more severe than their design basis earthquake. Factoring in the annual probability of such beyond-design-basis earthquakes, the plant-specific and generic followup studies calculated that the average annual probability of a major spent fuel pool failure at an operating reactor was ten to thirty times lower than the average probabilities in the 1987 study. (See NUREG/CR-5176, p. xiii, and NUREG-1353, pp. ES-2-3.) For either BWR or PWR designs, this probability was calculated at two chances in a million per year of reactor operation. (See NUREG-1353, pp. ES-3-4.)

After evaluating several regulatory options for reducing the risk of spent fuel pool fires, the NRC regulatory analysis concluded that "[t]he risk[s] due to beyond design basis accidents in spent fuel pools, while not negligible, are sufficiently low that the added costs involved with further risk reductions are not warranted." (See NUREG-1353, pp. ES-6-8.)

Issue No. 16: Need for NRC Requirement for Dry Cask Storage Instead of Storage in Spent Fuel Pools

Comment

Public Citizen states that the use of dry cask storage for spent fuel would help address some of the concerns described above, but that NRC has no plans to require dry cask storage instead of storage in spent fuel pools. The commenter notes that NRC has explicitly stated in its Proposed Decision Review that storage in a reactor's "spent fuel storage basin" is considered safe, and (the commenter) apparently disagrees with this conclusion.

NRC Response

The record of operational experience with reactor spent fuel storage pools, as discussed in the Commission's Proposed Decision Review and in response to the preceding comments, strongly supports the conclusion that reactor spent fuel pool storage, which has continued for decades, is safe. Accordingly, the NRC has reached the conclusion that past experience and available information amply support the safety of spent fuel storage, both in pools and dry storage casks, for at least 30 years past the expiration of reactor operating licenses (including the term of a revised license).

Issue No. 17: Suggestion to Revise Proposed Fourth Finding to Reflect Reasonable Assurance That Spent Fuel Can Be Safely Stored in Dry Casks at Reactor Sites for Up to One Hundred Years

Comment

Malachy Murphy (State of Nevada) commented that NRC's Proposed Revised Fourth Finding did not go far enough with respect to the duration of safe storage in dry storage casks. The commenter suggested that both the proposed finding and the Proposed Amendment to 10 CFR 51.23 be amended to reflect reasonable assurance that spent fuel can be stored safely and without significant environmental risk in dry casks at reactor sites for up to one hundred (100) years.

NRC Response

The Commission does not dispute a conclusion that dry spent fuel storage is safe and environmentally acceptable for a period of 100 years. Evidence supports safe storage for this period. A European study published in 1988 states, "In conclusion, present-day technology allows wet or dry storage over very long periods, and up to 100 years without undue danger to workers and population." (See Fettel, W., Kaspar, G., and Gunther, H., "Long-Term Storage of Spent Fuel from Light-Water Reactors" (EUR 11866 EN), Executive Summary, p.v, 1988.)

Although spent fuel can probably be safely stored without significant environmental impact for longer periods, the Commission does not find it necessary to make a specific conclusion regarding dry cask storage in this proceeding, as suggested by the commenter, in part because the Commission's Proposed Fourth Finding states that the period of safe storage is "at least" 30 years after expiration of a reactor's operating license. The Commission supports timely disposal of spent fuel and high-level waste in a geologic repository, and by this Decision does not intend to support storage of spent fuel for an indefinitely long period.

Issue No. 18: Maintenance of Institutional Controls for One Hundred Years

Comment

Marvin Lewis commented that the Commission's Proposed Revised Decision and Amendment to 10 CFR part 51 both require that at-reactor storage be available and safe for at least 100 years, which is an excessive amount of time to depend on institutional memory. The commenter states that to look into the future and have confidence that our institutions will survive in a form which will provide that safe onsite storage is available for at least 100 years into the future lacks any merit. The commenter asked that the Commission arrive at the opposite conclusion, namely that "Due to the Department of Energy's lack of quality control of data and analysis, inability to qualify acceptable sites, accusation against subcontractors when data contradicts DOE's preconceived assumptions, and general adherence to the political solution instead of scientific veracity, the NRC cannot find that temporary storage at reactors will ensure that geological storage for spent fuel will be available and safe when needed."

NRC Response

The Commission believes there is an adequate basis from the record of Federal regulations, historical experience and current practice to support the Commission's finding regarding institutional controls over spent fuel storage activities.

The Environmental Protection Agency's standards for high-level waste disposal provide that "active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contributions from active institutional controls for more than 100 years after disposal" (40 CFR 191.14(a)). The finding that repository licensing performance assessments can take credit for active institutional controls for 100 years is not one of the issues involved in the judicial action which vacated the EPA standard, and it is not expected that this section will be disturbed when the standard is reissued. It should also be noted that this language does not suggest that active institutional controls are unlikely for a period greater than 100 years. In the summary of the Final Rule (50 FR 38066; September 19, 1985), EPA noted that many commenters on the Proposed Rule felt that "a few hundred years" which was the proposed period for reliance on active institutional controls was too long. EPA agreed to limit the period to 100 years, noting that "this was the time period [EPA] considered in criteria for radioactive waste disposal that were proposed for public comment in 1978 (43 FR 53262), a period that was generally supported by the commenters on that proposal" (50 FR 38066, at p. 38080).

NRC would add that there are abundant examples of institutions in human society which have maintained a continuity in institutional controls far exceeding 100 years. The government of the United States, which is relatively young, is over 200 years old. The governments of some European countries have been in existence for time periods between 700 to 1000 years. While invading armies and civil wars have been disruptive, archival information of interest to the safety of the population can be expected to be preserved. In the United States today, real estate contracts are commonly executed to cover a period of 100 years, or a significant fraction thereof. One hundred-year land-lease agreements are common. Major civil construction projects such as harbors, bridges, flood control systems, and dams are often planned and executed--and investments made in them--with the view of recovering the benefits over a period of 100 years or more.

2.5 The Commission's Fifth Finding

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

Issue No. 19: Impact of Extension of Time for Repository Availability on the Increased Generation of Low-Level Radioactive Waste

Comment

Commonwealth Edison (CECo) commented that the Proposed Waste Confidence Review does not address low-level waste concerns resulting from delayed acceptance of spent fuel by the repository under DOE's extended schedule for repository availability. CECo commented that if they store spent fuel in pools and implement rod consolidation to conserve space during the extension, additional low-level waste may be generated. CECo believes that NRC should determine if this additional low-level waste should go to a Federal Repository or to a sited compact for disposal.

NRC Response

The disposition of high-level and low-level radioactive wastes has already been determined by Congress in the Nuclear Waste Policy Act of 1982 (NWPA) and in the Low-Level Radioactive Waste Policy Act (LLWPA). Congressional designation of the method of disposal of each type of waste was not dependent on the DOE's schedule for development of the repository; rather, Congress designated the method of disposal according to characteristics of the waste which are associated with its hazard (i.e., radioactive source strength, radioactive species of the emanating radiation, and half-life). It is not within the NRC's regulatory

jurisdiction to change the directives provided by Congress in the NWPA and the LLWPA.

3.0 Consideration of Other Events Relevant to the Commission's Decision

Issue No. 20: Petition by the State of Vermont to Intervene in the Consideration of the Extension of the Operating License for Vermont Yankee

In the Commission's Proposed Waste Confidence Decision Review, it was stated that the basis for the 2007-2009 timeframe in the Court remand leading to the Waste Confidence Proceeding had changed since the original Decision. This discussion was based on the fact that it appeared likely that these dates no longer represented the expected expiration dates for the operating licenses of the Vermont Yankee and Prairie Island nuclear plants. The NRC staff has been granting extensions of the dates of expiration of nuclear plant operating licenses to reflect a 40-year period from the date of issuance of the operating license rather than from the date of the construction permit. The dates of expiration of the Prairie Island Units 1 and 2 had already been extended from the year 2006 to the years 2013 and 2014. The NRC staff anticipated that on the basis of the date of issuance of its operating license, Vermont Yankee would be eligible for an extension of its operating license to March 2012.

In the time since the drafting of the Proposed Decision Review, several pertinent events have occurred. NRC published a notice of consideration of amendment to the Vermont Yankee Operating License, a proposed "no significant hazards" consideration determination, and opportunity for a hearing (54 FR 31120; July 26, 1989). On August 22, 1989, the State of Vermont filed a petition for leave to intervene. On October 30, 1989, Vermont filed a supplement to its petition to intervene proposing nine contentions for litigation on Vermont Yankee Nuclear Power Corporation's application to extend its operating license. On November 15, 1989, the NRC's Atomic Safety and Licensing Board (ASLB) heard oral argument by counsel for the licensee, the NRC staff, and the State of Vermont concerning the State's petition for leave to intervene and supplemental petition for leave to intervene. The ASLB granted the State of Vermont's petition for leave to intervene, admitted one contention (which did not concern waste disposal) as an issue in controversy for litigation, and granted the request for hearing. The ASLB's ruling was issued in a Prehearing Conference Memorandum and Order dated January 26, 1990 (Docket No.50-271-OLA-4).

It is now apparent that the extension of Vermont Yankee's operating license expiration date will be dependent on the outcome of this contested hearing. There is the possibility that a shorter extension or that no extension will be granted. In view of the uncertain outcome, the Commission will delete all discussion of a possible revised date for the Vermont Yankee operating license expiration and the revised date for expiration of the Prairie Island operating license. This deletion, however, does not affect the Commission's Proposed Revised Second Finding in its Waste Confidence Decision Review. Assuming that no extension or a lesser extension is granted and Vermont Yankee's operating license expires in 2007, the basis for the Commission's finding 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 any reactor, would be unaffected.

Issue No. 21: Potential Need for Additional Financial Security for the Nuclear Waste Fund

The NRC staff has been informed by DOE's Office of Civilian Radioactive Waste Management that a pending final report from DOE's Inspector General has indicated a potential problem for certain nuclear utility licensees to pay the one-time fee into the Nuclear Waste Fund (NWF) for spent fuel generated prior to April 1983. This issue arises because several utilities elected to defer payment into the fund and, instead, themselves hold the money that was collected from ratepayers for the one-time fee. DOE's Inspector General believes that some of those utilities may not be able to make their payments when due.

The NRC staff met with DOE's Office of Civilian Radioactive Waste Management (OCRWM) on December 13, 1989 to discuss this issue and determine the potential impact on both NRC's Decommissioning Rulemaking and on the Waste Confidence Decision, and, more generally, on protection of public health and safety. In addition, NRC discussed at that meeting and in follow-up telephone conversations potential actions that DOE might take. These actions could include modifying DOE's spent fuel contracts with electric utilities, seeking legislative amendments, and working with the National Association of Regulatory Utility Commissioners to increase assurance of one-time contributions into the NWF.

The NRC understands from OCRWM staff that, if a nuclear utility licensee were to default on its one-time contribution to the NWF, DOE is not precluded from accepting for disposal all spent fuel from that utility. Thus, the NRC does not view this issue as affecting its confidence that the spent fuel will be disposed of. Rather, the issue is one of equity--that is, will a utility and its customers and investors or U.S. taxpayers and/or other utilities ultimately pay for disposal of spent fuel generated prior to April 1983.

Background

In November 1976, the Natural Resources Defense Council (NRDC) petitioned 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, 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. 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 before 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 five 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 DOE; and (2) an amendment to 10 CFR part 51 which provided that environmental consequences of spent fuel storage after 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 NWPA 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 NWPA 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 before disposal. The Commission's licensing and regulatory authority over both storage and disposal facilities was preserved by the Act.

In the four years after enactment of the NWPA, 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 NWPA 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 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. The Commission issued its proposed Waste Confidence Decision Review and proposed revised findings for public comment on September 28, 1989. The comment period expired December 27, 1989. A total of eleven comments were received.

In this document, the Commission supplements the basis for its earlier findings and the environmental analysis of the 1984 Decision. The Commission is amending 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 revisions are based on the following considerations:

(1) the five-year slippage, from 1998 to 2003, in the DOE schedule for repository availability prior to issuance of its November 1989 "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program" and its new target date of 2010 for repository availability announced in that report;

(2) the additional slip of four and one-half years since the January 1987 Draft Mission Plan Amendment in the DOE schedule for 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 issuing an amendment to 10 CFR 51.23(a) to conform with the revisions to Findings 2 and 4 elsewhere in this issue of the Federal Register.

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 lengthy discussions of Findings 1 and 2 have been organized to address each original and new issue under subheadings.)

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

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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 NWPAA; License renewals; Options for offsite storage under NWPAA

Reaffirmed 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.

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

I.A.1. The identification of acceptable sites

Under the Nuclear Waste Policy Act of 1982 (NWPA), 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 NWPA. 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 NWPA required that each site nomination be accompanied by an environmental assessment (EA). In December 1984, DOE published Draft EAs (DEAs) 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 EAs (FEAs) for the five 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 NWPA, before 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 NWPAA was enacted. In a major departure from the initial intent of the NWPA, 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, 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, in the draft and final Point Papers on the Consultation Draft Site Characterization Plan, and in the Site Characterization Analysis for the Yucca Mountain site. 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 NWPA, 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."

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 were found to be unlicenseable. 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 NWPAA 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 vacated in July, 1987, by the U.S. Court of Appeals, and remanded to EPA for further consideration (see *NRDC* v. *EPA*, 824 F. 2d 1258). As originally promulgated, the standards 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 on to demonstrate compliance with EPA release limits. NRC's comments said in part that "...[t]he numerical probabilities in [the standards] would require a degree of precision which is unlikely to be achievable in evaluating a real waste disposal system." The comments went on to explain that "...identification of the relevant processes and events affecting a particular site will require considerable judgment and will not be amenable to accurate quantification, by statistical analysis, of their probability of occurrence." 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.

In response to NRC concerns, EPA incorporated language into its 1985 standards that appeared to allow flexibility to combine qualitative judgments with numerical probability estimates in a way that might have made implementation of the EPA standards practicable. The text of those standards recognized that "proof of the future performance of a disposal system is not to be had in the ordinary sense of the word" with the substantial uncertainties and very long performance period involved. The 1985 standards emphasized that a "reasonable expectation"--rather than absolute proof--is to be the test of compliance. "What is required," the text of the standards said, "is a reasonable expectation, on the basis of the record..., that compliance...will be achieved." In an additional attempt to provide flexibility for implementation of the standards, EPA also provided that numerical analyses of releases from a repository were to be incorporated into an overall probability distribution only "to the extent practicable." This phrase appeared to allow some discretion for NRC to incorporate qualitative considerations into its license decision-making, rather than having to rely solely on numerical projections of repository performance. On the strength of these and other EPA assurances, the Commission did not object when the final standards were published in 1985.

The Commission also notes that the EPA standards, as promulgated in 1985, contained a provision for development of alternative standards by EPA. The **Federal Register** text (50 FR 38074, September 19, 1985) describing this alternative standards provision stated:

> There are several areas of uncertainty the Agency [EPA] is aware of that might cause suggested modifications of the standards in the future. One of these concerns is implementation of the containment requirements for mined geologic repositories. This will require collection of a great deal of data during site characterization, resolution of the inevitable uncertainties in such information, and adaptation of this information into probabilistic risk assessments. Although the Agency is currently confident that this will be successfully accomplished, such projections over thousands of years to determine compliance with an environmental regulation are unprecedented. If--after substantial experience with these analyses is acquired--disposal systems that clearly provide good isolation cannot reasonably be shown to comply with the containment requirements, the Agency would consider whether modifications to [the standards] were appropriate.

This statement suggests to the Commission that EPA would be willing to consider modifications to the standard's containment requirements in the event that their probabilistic formulation is found to hamper or preclude an adequate evaluation of a proposed repository's capability to isolate radioactive waste.

Pursuant to the remand by the Federal court in 1987, EPA is currently revising its standards for disposal of spent fuel and high-level waste. The court's decision directed that the remand focus on the ground water and individual protection requirements of the standards. **Although the EPA standards are still undergoing development at this time, the Commission does not currently see a sufficient basis to withdraw its confidence in the feasibility of evaluating compliance with such standards. NRC staff will closely monitor the development of the repromulgated standards.**

In sum, considering both past and current programs for characterizing sites, the Commission concludes that technically acceptable sites for a repository can be found. The Commission is confident that, given adequate time and resources, such sites can be identified, evaluated, and accepted or rejected on their merits, even if no more than one site is undergoing site characterization. This judgment does not rest on the acceptability of the Yucca Mountain site or any one future candidate site.

I.A.2. The development of effective waste packages.

I.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." Before 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 ground water that will affect waste package and overall repository performance.

Under the NWPAA, 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 ten-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 (GTCC) low-level waste. 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 American Iron and Steel Institute (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. In addition to these six materials, DOE also plans to assess the merits of alternative waste package materials and designs.

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 (plus or minus) 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 ground water. 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. SKB estimates that the copper canister waste package has a million-year lifetime. (See also I.B.3. below.)

As noted in 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. Since that time, the NRC staff has completed its review of the December 1988 Site Characterization Plan for Yucca Mountain. Although the Commission continues to have concerns about DOE's waste package program, 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.

I.A.2.b. Effect of reprocessing on waste form and waste package.

The Draft 1988 Mission Plan Amendment estimates that about 77,800 metric tons of heavy metal (MTHM) of spent nuclear fuel 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.) Also, approximately 9400 MTHM of reprocessed defense waste and a small amount of commercial reprocessed waste from the West Valley Demonstration Project is estimated to be available for disposal by 2020. 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, a 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 glass compositions are designed 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 compositions 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.

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

I.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 subsection 60.113(a)(1)(ii)(B)], and that the entire engineered barrier system meet the release rate performance objective of 1 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 before 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.

I.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 section 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 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 at the repository horizon. Currently, DOE is reviewing its plans for construction of exploratory shafts. According to the 1989 "Reassessment Report," DOE is reevaluating the "locations chosen for the two exploratory shafts, the method chosen (drilling and blasting) for the construction of the shafts, the means of access (ramps or shafts) to the repository horizon, the need for additional exploratory drifts, and the design of the shafts and other components of the exploratory shaft facility." This reevaluation of plans for the shaft facility is in response to concerns from the NRC staff and the Nuclear Waste Technical Review Board (NWTRB).

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 after 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 SCP 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 part 60 performance objectives.

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

I.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 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 aforementioned 1984 statement in light of the NWPAA will be discussed under Finding 2.

I.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 offsite storage would be available by 2007-2009, or, if not, whether spent fuel could be safely stored onsite 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.

NRC is preparing to amend 10 CFR 51.51, adding new estimates for releases of Tc-99 and Rn-222, and a revised narrative explanation describing the basis for values contained in Table S-3. The amendment would also explain the environmental effects of potential releases from the light water reactor (LWR) fuel cycle, and postulate the potential radiation doses, health effects, and environmental impacts of these releases. 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.

I.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 high-level waste 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, whereas 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 ground water 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 before 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 ground water.

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.

One of the Swedish canister designs is a 0.1-m thick copper container (as described previously in section I.A.2.a.), 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 ground water; (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 unreprocessed 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 ground water 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 ground water 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 ground water. 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 ground water, 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 using 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 uses 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 just described 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 high-level waste and spent fuel.

I.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 NWPAA 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 before 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 before 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 reference design for the waste package in the December 1988 Site Characterization Plan 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 December 1988 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 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.

No major breakthrough in technology is required to develop a mined geologic repository. NRC will not be able to license a repository at a particular site, however, until there is sufficient information available for that site. The information needed to license a site includes site characterization data, data on repository design, and waste package design sufficient for performance assessment of the entire waste disposal system. Further, the Commission recognizes the challenge posed by the need to predict impacts of a repository on human health and the environment over very long periods of time. It will not be possible to test the accuracy of long-term repository performance assessment models in an absolute sense. The NRC does believe that existing performance assessment models have the potential to provide a basis for deciding whether a system for geologic disposal of high-level waste is acceptable, and can provide a sufficient level of safety for present and future generations under certain conditions. These conditions include addressing uncertainties, and gathering data from specific sites.

Overall, from its reexamination of issues related to the technical feasibility of geologic disposal, the Commission concludes 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.

Revised 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 (which may include the term of a revised or renewed license) 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.

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

II.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 surface-based testing, 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, in addition to the construction authorization permit, a license to receive and possess waste at the geologic repository operations area in order to commence repository operations. These considerations argue for maintaining the ready availability of alternative sites if, after 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 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 schedular 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 NWPAA has essentially made it necessary for that site to be found suitable if the 2007-2009 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 schedular 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 has slipped by more than five years since the issuance of the PDS in March 1986. In the past several years, DOE has cited numerous reasons for 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 EIS and license application would require more technical information than previously planned.

In the November 1989 "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program," DOE announced a further extension of three years until 1992 for sinking the exploratory shaft, and extensions until 2001 for submittal of the license application and 2010 for repository availability. DOE attributes the causes for these delays to prolonging the schedule for site characterization and repository development activities, and to the unwillingness, to date, of the State of Nevada to issue the permits required for DOE to begin testing. In the "Reassessment Report," DOE proposes to focus the repository program on the evaluation of features of the site that can be studied through surface-based testing, beginning in January 1991. The aim of this surface-based testing program is to make an early determination as to whether there are any features of the site that would render it unsuitable for development as a repository. Of course, the site may be found unsuitable or unlicenseable at any time during the site characterization or licensing process. **The NRC supports DOE's efforts to reach an early determination that this may be the case.** If the Yucca Mountain site is unsuitable, it will be necessary to begin work to identify and characterize another candidate site for a repository. The sooner this determination is made, the sooner DOE will have an alternative site available for disposal of high-level waste.

The NRC had anticipated additional delays in repository program milestones when it issued its Proposed Waste Confidence Decision Review (54 FR 39767). One of the key issues in the repository program to date has been the need for DOE to develop a qualified quality assurance (QA) program. 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 DOE's aggressive, success-oriented schedule for this milestone did not allow for unexpected developments. Indeed, the effort to develop an acceptable QA program has, in itself, identified problems in design control and other processes that must be resolved in order to establish a qualified program that addresses all applicable NRC licensing requirements. DOE has made progress in development of its QA program with seven contractor plans accepted in October and November 1989. **NRC expects that DOE should be able to have the study plans and technical procedures which implement the contractor plans ready in time for surface-based testing at the Yucca Mountain site to begin by January 1991, consistent with the schedule for starting surface-based testing** in the Reassessment Report.

DOE's current schedule appears to be more realistic than previous schedules. **Yet even this schedule could prove unattainable due to difficulties of a non-technical nature that are outside of DOE's control, for example litigation over gaining access to the Yucca Mountain site.** Although the NWPAA 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.

In view of DOE's new schedule, it no longer appears feasible for repository operation to commence prior to 2010. As stated in the Proposed Decision Review, 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 approximately 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.

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.

NRC will reassess progress towards attaining repository operation by 2025 prior to 2000 during its next scheduled review of its Waste Confidence Findings, if not sooner. DOE's current focus on surface-based testing as an early indicator of repository suitability should help provide a strong basis for evaluating the likelihood of meeting the 2025 estimate of repository availability.

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

The November 1989 Reassessment Report announced that "major activities related to the design of a repository at the Yucca Mountain site and waste package are being deferred. They will be resumed when more information is available concerning the suitability of the site. This approach will conserve resources and allow the DOE to concentrate efforts on scientific investigations." Prior to the Reassessment Report, DOE's most recent conceptual design for the waste package was 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 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-ground water 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. Development of acceptable waste packages and engineered barriers for a repository in the 2010 timeframe will 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 NWPAA, 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 depend on the schedule for this testing. The schedule for *in-situ* testing depends on when DOE is able to resolve outstanding issues which have impeded shaft sinking and *in-situ* testing, and on DOE's being granted access to the site to begin surface-based 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 by the turn of the century), 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.

II.A.3. Institutional Uncertainties.

II.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 PDS as required by the NWPA, and NRC concurred on those documents. NRC also reviewed and provided comments to DOE on the DEAs and FEAs. In the December 22, 1988 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. Although the December 1988 SCP shows improvement over the CDSCP, NRC continues to have an objection involving the need for implementing a baselined QA program before beginning site characterization and an objection involving the need for DOE to demonstrate the adequacy of both the ESF design and the design control process. Prior to the November 1989 Reassessment Report, DOE had committed to having a qualified QA program in place before sinking the exploratory shaft at the Yucca Mountain site.

This commitment has not changed. However, in view of the extension in the schedule for shaft sinking from November 1989 to November 1992, qualified QA plans are needed in the near term for meeting the January 1991 schedule for surface-based testing. In addition to having a qualified QA program in place, DOE must also have issued the pertinent study plans for site characterization activities they wish to begin.

DOE has 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 about 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 eligible to receive 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 before 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. In 1989, the State of Nevada requested $23 million for work on Yucca Mountain. Congress appropriated $5 million and authorized DOE to release an additional $6 million at the discretion of the Secretary on the basis of good faith efforts of the State to allow technical investigations to begin at the site.

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 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.

Secretary of Energy James Watkins has emphasized the importance of the Negotiator to the success of the program. 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 that would enjoy the advantage of reduced institutional uncertainties resulting from opposition of State or affected Indian tribes. The President nominated and the Senate recently confirmed David Leroy to be the Negotiator.

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 primary purpose of the LSS is to expedite NRC's review of the construction authorization application for a repository, it will be an effective mechanism by which all LSS participants, including the State and local governments, can acquire early access to documents relevant to a repository licensing decision. DOE is responsible for the design, development, procurement and testing of the LSS. LSS design and development must be consistent with objectives and requirements of the Commission's LSS rulemaking and must be carried out in consultation with the LSS Administrator and with the advice of the Licensing Support System Advisory Review Panel. NRC (LSS Administrator) is responsible for the management and operation of the

LSS after completion of the DOE design and development process.

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, 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.

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 NWPA, 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.

II.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 DOE functions 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 NWPAA, 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 an MRS. Congress did establish several new entities for the purpose of advising DOE on matters related to the waste program, such as the NWTRB and the Review Panel, to be established if DOE and a State or tribe enter into a benefits agreement under Section 170 of the NWPAA. 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.

In the November 1989 Reassessment Report, DOE discussed several new initiatives for improving its management of the repository program. The initiatives include "direct-line" reporting from the Yucca Mountain Project Office to the Office of Civilian Radioactive Waste Management (OCRWM), and an independent contractor review of OCRWM management structures, systems and procedures to identify program redundancies, gaps, and

strengths. The OCRWM is also implementing improvements in the overall Program Management System, the QA program, and establishment of program cost and schedule baselines.

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 2010 timeframe than before it. Neither the problems of a new management structure nor those of the existing one are likely to prevent the achievement of repository operations within the first quarter of the next century, however.

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

Section 302 of the NWPA 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.

DOE has not issued a fee adequacy report since the June 1987 report. When the updated report is released, it is expected to 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. OL 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. It is expected that the new report may reflect a recent Court decision which found that fees paid into the Nuclear Waste Fund be adjusted to reflect transmission and distribution losses.

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 NWPA. These costs would be further increased if one or more licensee was to become insolvent and DOE was required to assume responsibility for storage at affected reactors before 1998.

In the event of insolvency, DOE would still have sufficient funds to take over responsibility for managing spent fuel until a repository is available. Because spent fuel disposal costs are directly related to the amount of electricity generated, with contributions to the NWF based on a kilowatt-hour surcharge that must be paid in short-term installments, utilities can be presumed to be mostly up-to-date with their contributions. It is highly unlikely that a utility would jeopardize its contract for spent fuel disposal with DOE by defaulting on a periodic payment to save a few million dollars. Even if a utility were to default, it would not be much in arrears for its spent fuel before it would trigger close DOE scrutiny and mitigative action.

Larger amounts in default could possibly occur with those relatively few utilities that have not paid their full share of pre-1983 collections. This issue arises because several utilities elected to defer payment for spent fuel generated prior to April 1983 into the fund and, instead, themselves hold the money that was collected from ratepayers for the one-time fee. DOE's Inspector General believes that some of those utilities may not be able to make their payments when due. The NRC understands from OCRWM staff that, if a nuclear utility licensee were to default on its one-time contribution to the NWF, DOE is not precluded from accepting for disposal all spent fuel from that utility. Thus, the NRC does not view this issue as affecting its confidence that the spent fuel will be disposed of. Rather, the issue is one of equity--that is, will a utility and its customers and investors or U.S. taxpayers and/or other utilities ultimately pay for disposal of spent fuel generated prior to April 1983. The Commission does not believe that a licensee's potential default has a direct bearing on the Commission's Waste Confidence Decision.

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 NWPA 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.

II.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 OLs 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 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. Since the NRC published the Proposed Waste Confidence Review (54 FR 39767) for comment, the schedule for shaft sinking has been changed from November 1989 to November 1992. Issues requiring DOE attention before site characterization can begin have been identified, and it is possible that additional issues affecting DOE's readiness will come to light. However, DOE has made progress in completing QA plans since September 1989, and it is reasonable to expect that study plans and technical procedures needed for surface-based testing will be ready in time for testing to begin by January 1991.

Heretofore, the repository schedule has always been agressive 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 had not shown how it would be able to meet the 2003 milestone for repository operation. The revised schedule announced in the November 1989 Reassessment Report includes a new reference schedule for the restructured repository, MRS, and transportation programs. Under the restructured program, the schedule for submittal of a construction authorization application to NRC has been extended from 1995 to 2001, and the schedule for repository operation at Yucca Mountain, if that site is found to be suitable, is 2010. DOE believes that this reference schedule is the first repository program schedule since passage of the NWPA that is based on a "realistic assessment of activity duration and past experience." The new schedule allows more time for scientific investigations than earlier schedules. NRC believes that the restructured program has been responsive to NRC concerns that the quality and completeness of site investigations were being compromised in order to satisfy unrealistic schedule requirements.

Another potential source of delay in repository availability may arise from NRC regulations. Given the revised schedule, however, the NRC does not believe this is likely. 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 permit DOE to prepare and submit an application for repository construction authorization under its current schedule. The Commission fully intends 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, 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, the Commission believed it was optimistic to expect that Phase 1 of repository operations would 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. Given additional delays in shaft sinking and DOE's revised program schedule, NRC believes that 2010 is the earliest date for repository availability at Yucca Mountain. Yet, the Commission recognizes that DOE is committed to improving the schedule where possible without sacrificing quality and completeness of scientific investigations.

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 section 60.112, 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 part 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 the aforementioned I.A.1., 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 part 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 DOE program schedule, and assuming that the QA program can be qualified and surface-based testing begun within the next year, the Commission finds that although it is not impossible that a repository at Yucca Mountain will be available by 2007-2009, it is more likely that the earliest date for a repository there is 2010. If DOE determines that the Yucca Mountain site is unsuitable, and if DOE makes this determination by the year 2000, the NRC believes that a repository at another site could be available within the first quarter of the next century. The Commission will reevaluate these dates during the next scheduled Waste Confidence Review in 1999.

II.B. Relevant Issues That Have Arisen since the Commission's Original Decision

II.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 NWPA, 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 next, 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 DOE. The Amendments Act also provides funding for technical assistance to States, tribes, and affected units of local government. Finally, section 160(l) 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 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 was 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 relevant dates in the original Waste Confidence Proceeding, or on availability by 2010, DOE's current date. The Commission's reservations about affirming 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 2007-2009 or 2010 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 in this period would imply 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. Therefore, the Commission declines to reaffirm the 2007-2009 timeframe in the original decision or to affirm the current 2010 date for repository operation.

II.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?

II.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 OL 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 NWPAA did not change the requirement that no more

than 70,000 MTHM could be emplaced in the first repository before operation of the second. 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, OLs 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 OLs. 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. If a repository is not available until about 2025, these reactors 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 of any reactor OL 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 OL. In finding that spent fuel could be safely stored at any reactor site for at least 30 years after expiration of the OL 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 (MTIHM), 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 OL expired. (MTIHM 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 1384 and 1985 campaigns to return spent fuel from the defunct West Valley reprocessing facility to the reactors of origin, 70 metric tons of 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 after the expiration of the facility OL. 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 after the expiration of any reactor OL. (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 onsite 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 just cited, 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.

Nor does the Commission see a significant safety or environmental problem with premature retirements of additional reactors. In the Commission's original Waste Confidence Decision, it found reasonable assurance that spent fuel would have to spend no more than 30 years in post-operational storage pending the availability of a repository. For a repository conservatively assumed to be available in 2025, this expected 30-year maximum storage duration remains valid for most reactors, and would be true for all reactors that were prematurely retired after 1995. Based on the past history of 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.

Historically, 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. These early retirements included many low-power developmental reactors, which may make the ratio of 14 to 125 disproportionately high as a basis for projecting future premature shutdowns.

The Commission is aware of currently operating reactors that may be retired before the expiration of their OLs, including: the recently-licensed Shoreham reactor, which has generated very little spent fuel; the Fort St. Vrain high-temperature gas-cooled reactor, which its owner plans to decommission; and the Rancho Seco reactor, which has operated for the past 12 years and may or may not be retired. Assuming that these and perhaps a few more reactors do retire in the next several years, their total spent fuel storage requirements would not impose an unacceptable safety or environmental problem, even in the unlikely event that all these reactors' owners were rendered financially or otherwise unable to provide adequate care, and DOE were required to assume custody earlier than currently envisioned under the NWPA.

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 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 after the effective expiration of the OLs 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.

II.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 OLs.

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 OLs for an additional 20 to 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.

II.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.

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, under Finding 3 in the 1984 Waste Confidence Decision, that 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 OLs 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 for 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. The Commission's proposed finding also implies 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.

II.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 PDS, the three-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 LSS for expedited document discovery during the licensing proceeding.

In the same correspondence on the PDS, NRC also stated that the adequacy of the three-year review period depends

on DOE's submittal 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.

In the November 1989 Reassessment Report, DOE announced extensions in all major repository program milestones. The current target date for repository availability is 2010. In a speech before the 1989 Nuclear Energy Forum, W. Henson Moore, Deputy Secretary of Energy, stated that a permanent repository at Yucca Mountain could not be operational before 2010, under optimum circumstances. The 2010 at-the-earliest timeframe falls outside of the 2007-2009 timeframe for an "offsite storage solution" in the 1979 Court remand which precipitated the NRC's Waste Confidence Proceeding. In the Reassessment Report, DOE noted that in developing its current schedule, certain activities, one of which was NRC's review of the license application, were outside of DOE's control. However, DOE also stated that it would continue its ongoing interactions with NRC and EPA "to reduce the number of unresolved issues remaining at the time of licensing, which should enhance confidence that the license application can be reviewed in three years, as called for in the Nuclear Waste Policy Act." The NRC does not believe that it is likely that NRC's emphasis on completeness and quality of the license application will contribute to substantial delays in submitting the license application and in the licensing proceeding that would delay repository availability much beyond 2010 at the Yucca Mountain site.

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.

II.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, several 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 twelve-year slip in DOE's estimate of repository availability from 1998 to 2010, 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.

In predicting the timing of repository availability, 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 in the original Waste Confidence Decision could have been met only if Yucca Mountain survived the repository development process as a licensed site without major delays in site characterization and licensing. 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 before 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. Given DOE's revised schedule, which provides 11 years for site characterization activities instead of six, it is possible that the Yucca Mountain site could be found unsuitable after the year 2000. In this case, DOE would have fewer than 25 years to initiate site screening and develop a repository for availability by 2025. The NRC will evaluate the likelihood of this

development during the next scheduled review of the Waste Confidence Decision in 1999.

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 OL 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 before 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 OLs, 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 OLs. 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 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 were 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 in 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 in 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 OL 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 OL 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 OL 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 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 OL, 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 OL. 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 2007-2009 timeframe at issue in the Commission's original proceeding.

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 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 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.

To find reasonable assurance that a repository will be available by 2007-2009, 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 could not prudently describe a basis for assurance that the previous DOE schedule for repository operation in 2003 would not slip another four to six years under any reasonably foreseeable circumstances. The NRC believes it is more realistic to expect that a repository at the Yucca Mountain site could be available by the year 2010 or a few years thereafter, if the Yucca Mountain site is found to be suitable. 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 (which may include the term of a revised or renewed license)[1] 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.

Reaffirmed 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.

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

In the Commission's discussion of Finding 3 in its Waste Confidence Decision (49 FR 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

[1] The parenthetical phrase "which may include the term of a revised or renewed license" has been added to revised Finding 2 to make it consistent with revised Finding 4.

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 just stated 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 an MRS until sufficient repository capacity is available.

10 CFR subsection 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 published for public comment a proposed amendment to part 72 to issue a general license to reactor licensees to use approved spent fuel storage casks at reactor sites. Currently, the Commission is considering the draft final amendment for this rulemaking action. If this amendment is promulgated, 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, previously discussed), 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 subsection 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 OL, 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. No applications were received by the June 30, 1989 NWPA deadline incorporated into the Commission's rule, and it seems unlikely that any applications will be made to NRC for interim storage by DOE. Even if NRC had made an exception for a late application, a determination would have to have been made before January 1, 1990 to comply with the NWPA.

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

Although a DOE facility may not be available to enable the Department to begin accepting spent fuel in 1998, as currently 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.

The Commission recognizes that the NWPA limitation of 70,000 MTHM for the first repository will not provide adequate capacity 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 about 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, renewals might increase spent fuel generation well into the latter half of the twenty-first century. Nonetheless, nothing in this situation diminishes the Commission's assurance that safe storage will be made available as needed.

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.

Revised 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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

IV.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 60 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 discussed above, the Commission arrived at a provisional figure of 70 years or more for storage (i.e., a 40-year reactor OL span, plus 30 years or more).

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).

If a reactor with a 40-year initial license were to have that license 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.

In making the original Fourth Finding, 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]." Similarly, in using the words "at least" in its revised Finding Four, the Commission is not suggesting 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) represents any technical limitation for safe and environmentally benign storage. Degradation rates of spent fuel in storage, for example, 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.

The Commission's 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 next.

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 NWPA 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 three sites: the H. B. Robinson Steam Electric Plant, Unit 2, in South Carolina, and the Surry Nuclear Station in Virginia. A license was recently granted for a modular system at Duke Power Company's Oconee Nuclear Station site. New applications have been received in 1989 for CP&L's Brunswick site, for the Baltimore Gas and Electric Company's Calvert Cliffs site, and in 1990 for Consumer Power Company's Palisades site. 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 NWPA. 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, 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 [its] 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. Although the Commission does not believe storage in excess of a century to be likely, with or without an MRS, 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 OL, 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 (EPRI), 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; International Atomic Energy Agency (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 just cited also 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).]

The Commission is aware that in December 1986 at the Hatch nuclear power plant, radioactive water leaked out of a spent fuel transfer canal between spent fuel pools. Contaminated water drained into a swamp and from there into the Altamaha River. Also, more recently, on August 16, 1988, a spent fuel pool cooling pump failed at the Turkey Point nuclear power plant, causing about 3000 gallons of radioactive water to leak into the spent fuel pool heat exchanger room. Approximately 1500 gallons leaked from that room to adjacent areas. Approximately six to seven gallons entered the plant intake canal via storm drains. There was no radiation release offsite in this event. However, the shoes and clothing of approximately 15 workers were contaminated.

The occurrence of operational events like these have been addressed by the NRC staff at the plants listed. The staff has taken inspection and enforcement actions to reduce the potential for such operational occurrences in the future.

The NRC staff has spent several years studying in detail catastrophic loss of reactor spent fuel pool water possibly resulting in a fuel fire in a dry pool, and recently participated in litigation over this issue relative to Vermont Yankee. The 1987 report, "Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82" (NUREG/CR-4982), referred to in Public Citizen's comment represents an early part of the NRC's study. Subsequent study of the consequences and risks due to a loss of coolant water from spent fuel pools was conducted by the NRC, and the results were published in NUREG/CR-5176, "Seismic Failure and Cask Drop Analysis of the Spent Fuel Pools at Two Representative Nuclear Power Plants," January 1989, and NUREG-1353, "Regulatory Analysis for the Resolution of Generic Issue 82, >Beyond Design Basis Accidents in Spent Fuel Pools'," April 1989. These reports were cited in the Commission's Proposed Waste Confidence Decision Review (54 FR 39767-39797, at p.39795, September 28, 1989). Also issued in 1989, as part of the NRC staff's study, was "Value/Impact Analyses of Accident Preventive and Mitigative Options for Spent Fuel Pools" (NUREG/CR-5281).

The primary concern regarding accidents in spent fuel pools is the loss of water and its capability to cool the radioactive fuel. Without sufficient water cooling, some performance assessment models suggest that the fuel's zircaloy cladding may initiate and sustain rapid oxidation (fire) that may spread to adjacent fuel assemblies, with the potential of releasing large amounts of radioactivity.

The analyses reported in these NUREGs indicate that the dominant accident sequence which contributes to risk in a spent fuel pool is gross structural failure of the pool due to seismic events. Risks due to other accident scenarios (such as pneumatic seal failures, inadvertent drainage, loss of cooling or make-up water, and structural failures due to missiles, aircraft crashes and heavy load drops) are at least an order of magnitude smaller. For this study, older nuclear power plants were selected, since the older plants are more vulnerable to seismic-induced failures. The selected plants included the Vermont Yankee and the H.B. Robinson plants.

Although these studies conclude that most of the spent fuel pool risk is derived from beyond design basis earthquakes, this risk is no greater than the risk from core damage accidents due to seismic events beyond the safe-shutdown earthquake. Because of the large inherent safety margins in the design and construction of the spent fuel pool analyzed, it was determined that no action was justified to further reduce the risk (NUREG-1353). As stated in the Preface to NUREG-1353:

This report presents the regulatory analysis, including decision rationale, for the resolution of Generic Issue 82, >Beyond Design Basis Accidents in Spent Fuel Pools.' The object of this regulatory analysis is to determine whether the use of high density storage racks for the storage of spent fuel poses an unacceptable risk to the health and safety of the public. As part of this effort, the seismic hazards for two older spent fuel pools were evaluated. The risk change estimates, value/impact and cost-benefit analyses, and other insights gained during this effort, have shown that no new regulatory requirements are warranted in relation to this generic issue.

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.

Although 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 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. 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 for 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 to establish licensing requirements for an MRS, 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, 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.

IV.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 OL 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 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 their OLs, 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. Under existing licenses, projected spent fuel generation could exceed 70,000 MTHM as early as the year 2010. Possible extensions or renewals of OLs 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 before about the year 2040 to avoid storing spent fuel at a reactor for more than 30 years after expiration of reactor OLs.

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 OLs 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 OLs, 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 56,000 metric tons of uranium" (see "Spent Fuel Storage Requirements" (Update of DOE/RL-82-17) DOE/RL-83-1, January, 1983). Today, that figure has declined to 40,200 metric tons, the lower reference case which represents the conservative upper bound of commercial nuclear power growth (see "Integrated Data Base for 1989: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics," DOE/RW-0006, Rev. 5, November 1989). 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 the end of calendar year 2010, 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 is revising 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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations."

Reaffirmed 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.

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

In its discussion of Finding 5 of its Waste Confidence Decision (49 FR 34658; August 31, 1984), 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 an MRS. The 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.

The NWPAA established a Monitored Retrievable Storage Review Commission tasked with preparing a report on the need for an MRS facility as part of the national nuclear waste management system (section 143(a)). In its November 1989 report "Nuclear Waste: Is There a Need for Federal Interim Storage?", the MRS Commission reached the following conclusion:

> An MRS linked as provided in current law would not be justified, especially in light of uncertainties in the completion time for the repository. Consequently, the Commission does not recommend a linked MRS as required by current law and as proposed by DOE.

In the November 1989 Reassessment Report, DOE stated that

> current linkages between the repository and MRS program make it impossible for the DOE to accept waste at an MRS facility on a schedule that is independent from that of the repository. Therefore, the DOE plans to work with the Congress to modify the current linkages between the repository and the MRS facility and to embark on an aggressive program to develop an integrated MRS facility for spent fuel. The DOE believes that if the linkages are modified, it is likely that waste acceptance at an MRS facility could begin by 1998 or soon thereafter.

Although 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, unless Congress is willing to modify these linkages. The potential impact of the uncertainty surrounding 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 current 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 the MRS essential to protect public health and safety. If any offsite storage capacity is required, 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.

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

DOE will probably not be able to begin operation of a repository before 2010 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, unless DOE is successful in its efforts to work with Congress to modify the linkages. (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.

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, p. 34697, August 31, 1984.) More recently, DOE estimated 40,200 metric tons the lower reference case which represents the conservative upper bound of commercial nuclear power growth (see "Integrated Data Base for 1989: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics," DOE/RW-0006, Rev. 5, November 1989). Although 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 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 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 three reactor sites, and three new applications are 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). A license was recently granted for a similar modular system at Duke Power Company's Oconee Nuclear Station site. New applications have been received in 1989 for CP&L's Brunswick site, the Baltimore Gas and Electric Company's Calvert Cliffs site, and in 1990 for Consumer Power Company's Palisades site. Applications are also expected for CP&L's Robinson 2 site (at another onsite location to allow for greater storage capacity) and Wisconsin Electric Power Company's Point Beach site. The Tennessee Valley Authority has indicated that it will apply for a licensed dry storage installation at 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 OLs 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 may 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."

Dated at Rockville, Maryland, this 11th day of September 1990.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

[FR Doc. 90-21890 Filed 9-17-90; 8:45 a.m.]

BILLING CODE 7590-01-D

NRC Waste Confidence Position: 1999

Paperwork Reduction Act

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*), the information collection or recordkeeping requirements included in this rule have been approved by the Office of Management and Budget (OMB) under OMB control number 0579–0129.

List of Subjects in 7 CFR Part 319

Bees, Coffee, Cotton, Fruits, Honey, Imports, Logs, Nursery Stock, Plant diseases and pests, Quarantine, Reporting and recordkeeping requirements, Rice, Vegetables.

Accordingly, we are amending 7 CFR part 319 as follows:

PART 319—FOREIGN QUARANTINE NOTICES

1. The authority citation for part 319 continues to read as follows:

Authority: 7 U.S.C. 150dd, 150ee, 150ff, 151–167, 450, 2803, and 2809; 21 U.S.C. 136 and 136a; 7 CFR 2.22, 2.80, and 371.2(c).

2. In § 319.56–2ff, new paragraphs (j) and (k) are added to read as follows:

§ 319.56–2ff Administrative instructions governing movement of Hass avocados from Mexico to the Northeastern United States.

* * * * *

(j) *Repackaging.* If any avocados are removed from their original shipping boxes and repackaged, the stickers required by paragraph (c)(3)(vi) of this section may not be removed or obscured and the new boxes must be clearly marked with all the information required by paragraph (c)(3)(vii) of this section.

(k) *Compliance agreements.* (1) Any person, other than the permittee, who moves or distributes the avocados following their importation into the United States (i.e., a second-party or subsequent handler) must enter into a compliance agreement with APHIS. In the compliance agreement, the person must acknowledge, and agree to observe, the requirements of paragraph (a) and paragraphs (f) through (k) of this section. Compliance agreement forms are available, free of charge, from local offices of Plant Protection and Quarantine, which are listed in local telephone directories. A compliance agreement will not be required for an individual place of business that only offers the avocados for sale directly to consumers.

(2) Before transferring the avocados to any person (i.e., a second-party handler) for movement or distribution, the permittee must confirm that the second-party handler has entered into a compliance agreement with APHIS as required by paragraph (k)(1) of this section. If the permittee transfers the avocados to a second-party handler who has not entered into a compliance agreement, APHIS may revoke the permittee's import permit for the remainder of the current shipping season.

(3) Any second-party or subsequent handler who transfers the avocados to another person for movement or distribution must confirm that the person receiving the avocados has entered into a compliance agreement with APHIS as required by paragraph (k)(1) of this section. If the second-party or subsequent handler transfers the avocados to a person who has not entered into a compliance agreement, APHIS may revoke the handler's compliance agreement for the remainder of the current shipping season.

(4) *Action on repeat violators.* APHIS may deny an application for an import permit from, or refuse to enter into a compliance agreement with, any person who has had his or her import permit or compliance agreement revoked under paragraph (k)(2) or (k)(3) of this section twice within any 5-year period.

(Approved by the Office of Management and Budget under control number 0579–0129.)

Done in Washington, DC, this 30th day of November 1999.

Craig A. Reed,

Administrator, Animal and Plant Health Inspection Service.

[FR Doc. 99–31513 Filed 12–3–99; 8:45 am]

BILLING CODE 3410–34–U

NUCLEAR REGULATORY COMMISSION

10 CFR Part 51

Waste Confidence Decision Review: Status

AGENCY: Nuclear Regulatory Commission.

ACTION: Status report on the review of the Waste Confidence Decision.

SUMMARY: On September 18, 1990 (55 FR 38474), the Nuclear Regulatory Commission (NRC) issued the results of the first review of its Waste Confidence Decision, originally issued on August 31, 1984 (49 FR 34658). The purpose of the original Waste Confidence Decision was "to assess the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or offsite storage will be available and to determine whether radioactive waste can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available." (49 FR 34658). In 1984, the Commission concluded that there was reasonable assurance that safe disposal in a geologic repository is technically feasible, one or more repositories would be available by the years 2007–2009, and spent fuel will be managed in a safe manner until sufficient repository capacity is available. The 1990 review of this decision basically affirmed the findings of the original decision and further determined that spent fuel could be safely stored and managed under existing processes through the first quarter of the 21st century and 30 years beyond the licensed life for power reactor operation. In its 1990 review, the Commission stated that its next review of the waste confidence issues would occur in ten years. As the ten year period for review approaches, the Commission is issuing this notice on its intent with regard to further Waste Confidence reviews. The Commission is of the view that experience and developments since 1990 confirm the Commission's 1990 Waste Confidence findings. Thus, the Commission has decided that a comprehensive evaluation of the Waste Confidence Decision at this time is not necessary. The Commission would consider undertaking a comprehensive evaluation when the impending repository development and regulatory activities have run their course or if significant and pertinent unexpected events occur, raising substantial doubt about the continuing validity of the 1990 Waste Confidence findings.

FOR FURTHER INFORMATION CONTACT: Janet Kotra, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington DC 20555, telephone (301) 415–6674.

SUPPLEMENTARY INFORMATION:

I. Background

In 1977, the Commission denied a petition for rulemaking wherein the U.S. Nuclear Regulatory Commission (NRC) was asked to determine whether radioactive wastes generated in nuclear power reactors can be disposed of without undue risk to public health and safety and to refrain from granting pending or future requests for reactor operating licenses until such finding of disposal safety was made. The Commission noted in its denial 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."

At about the same time, the Commission granted license amendments permitting expansion of the capacity of spent fuel storage pools at two nuclear power plants, finding that the actions would not endanger public health and safety. The Commission did not address the potential environmental consequences of such storage beyond the expiration of the reactors' operating licenses. Upon appeal of the license amendment decisions, the US Court of Appeals declined to stay or vacate the license amendments but remanded to NRC the question of whether reasonable assurance exists that an offsite storage solution will be available by the years 2007–2009, the expiration dates of the plants' operating licenses, and, if not, whether there is reasonable assurance that spent fuel can be stored safely at the reactor sites beyond those dates.

In response to the Court's remand, NRC conducted a generic rulemaking to assess the degree of assurance that radioactive wastes can be disposed of safely, to determine when disposal or offsite storage will be available, and to determine whether the wastes can be stored safely at reactor sites beyond the expiration of existing facility licenses until offsite disposal or storage is available. This rulemaking came to be known as the "Waste Confidence" proceeding. On August 31, 1984 (49 FR 34658; 49 FR 34688), the Commission issued five findings, accompanied by a final rule, codified at 10 CFR 51.23, incorporating the findings as the basis for excluding case-by-case consideration of environmental effects of extended onsite storage of spent fuel in reactor and spent fuel storage facility licensing proceedings. The Commission's basic conclusions were that there was reasonable assurance that safe disposal in a geologic repository is technically feasible, that one or more repositories would be available by the years 2007–2009, and that spent fuel will be managed in a safe manner until sufficient repository capacity is available.

In the 1984 Decision, the Commission noted that its decision with respect to the availability of a repository for disposal was unavoidably in the nature of a prediction, and indicated that it would review its conclusions should significant and pertinent unexpected events occur or at least every five years until a repository is available. The first review was completed in 1990 (55 FR 38474; September 18, 1990). The conclusions reached and the findings made in the Commission's 1990 review of the original Waste Confidence Decision were:

1. The Commission finds reasonable assurance that safe disposal of radioactive waste and spent fuel in a mined geologic repository is technically feasible. (This finding is identical to the finding in the original Waste Confidence Decision in 1984).

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 (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up until that time. (This finding revised the finding in the original decision that a mined geologic repository would be available by the years 2007 to 2009.)

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. (This finding is identical to the finding in the original Waste Confidence Decision in 1984).

4. The Commission finds reasonable assurance that, if necessary, spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. (This finding is basically identical to that in the original Waste Confidence Decision with the addition of the consideration of license renewal and spent fuel storage 30 years beyond the licensed life for operation of a reactor).

5. The Commission finds reasonable assurance that safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed. (This finding is identical to the finding in the original Waste Confidence Decision in 1984).

In issuing the 1990 review of the Waste Confidence Decision, the Commission extended the cycle for future reviews from every five years to every ten years. The rationale for this extension was that predictions of repository availability are best expressed in terms of decades rather than years. The Commission also affirmed its original statement that it would reevaluate its Decision at any time whenever significant and pertinent unexpected events occur, such as major shifts in national policy or a major unexpected institutional development, or new technical information.

II. Ongoing Repository Development and Spent Fuel Storage Activities

We are now nearing the end of the ten year period since the last review of the Waste Confidence Decision. Since the 1990 revisions of the Waste Confidence findings, the U.S. Department of Energy's (DOE) program for characterizing a single site at Yucca Mountain, Nevada, as a potential geologic repository has progressed and is nearing completion. DOE published a viability assessment on the proposed repository in December of 1998 and a draft environmental impact statement (EIS) in August of 1999. It is expected that DOE will complete a final EIS in 2000, such that a recommendation with regard to suitability of the Yucca Mountain site, pursuant to the Nuclear Waste Policy Act of 1982, as amended (NWPA), can be made in 2001. If DOE is able to advise the President that the Yucca Mountain site is suitable for development as a repository, and the President accepts the Secretary of Energy's recommendation, DOE intends to submit a license application to NRC in 2002. In addition, NRC has proposed 10 CFR Part 63 which would establish a framework for licensing consideration of the repository. Similarly, the Environmental Protection Agency (EPA) has published its proposed standards for repository licensing. Thus, there has been substantial progress toward consideration and possible licensing of a repository.

As to spent fuel storage capabilities and capacity, the NRC has continued to review commercial dual-purpose spent fuel dry cask storage and transportation system designs and site-specific license applications for onsite dry storage of spent fuel to meet the interim storage needs of reactor licensees. In addition, the NRC is reviewing an application for an away-from-reactor Independent Spent Fuel Storage Installation (ISFSI), and a second application is expected in fiscal year 2000. The NRC staff has noted substantial advances in spent fuel storage—the certifications of a number of new spent fuel storage cask designs; additional interim dry cask storage capacity at power reactor sites; the NRC's establishment of a Spent Fuel Project Office to more effectively focus on interim spent fuel storage and management—since waste confidence findings were last reviewed in 1990.

These considerations confirm and strengthen the Commission's 1990 findings and lead the Commission to conclude that no significant and unexpected events have occurred—no major shifts in national policy, no major unexpected institutional developments, no unexpected technical information—that would cast doubt on the Commission's Waste Confidence findings or warrant a detailed reevaluation at this time. As a result, a formal review of these activities now would not call into serious question the Commission's Waste Confidence findings, as updated in 1990. The Commission, therefore, is not undertaking any modification to the findings codified in 10 CFR 51.23. However, when the nearer term activities on repository development and licensing are concluded, there may be implications for the Waste Confidence findings. If warranted, the Commission will consider undertaking a comprehensive review at that time.

III. The Next Review

The appropriate trigger for the next review could be a combination of events or it could be a single event. For example, any significant delays in DOE's repository development schedule or a decision by the Secretary of Energy to not recommend Yucca Mountain as a candidate site might necessitate a reevaluation of the Commission's Waste Confidence Decision. Thus, the Commission would consider undertaking a comprehensive reevaluation of the Waste Confidence findings when the impending repository development and regulatory activities run their course or if significant and pertinent unexpected events occur, raising substantial doubt about the continuing validity of the Waste Confidence findings.

Dated at Rockville, Maryland, this 30th day of November, 1999.

For the Nuclear Regulatory Commission.

Annette Vietti-Cook,

Secretary of the Commission.

[FR Doc. 99–31506 Filed 12–3–99; 8:45 am]

BILLING CODE 7590–01–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 71

[Airspace Docket No. 99–ACE–39]

Amendment to Class E Airspace; Emmetsburg, IA

AGENCY: Federal Aviation Administration, DOT.

ACTION: Direct final rule; confirmation of effective date.

SUMMARY: This document confirms the effective date of a direct final rule which revises Class E airspace at Emmetsburg, IA.

DATES: The direct final rule published at 64 FR 48088 is effective on 0901 UTC, December 30, 1999.

FOR FURTHER INFORMATION CONTACT: Kathy Randolph, Air Traffic Division, Airspace Branch, ACE–520C, DOT Regional Headquarters Building, Federal Aviation Administration, 901 Locust, Kansas City, MO 64106; telephone: (816) 329–2525.

SUPPLEMENTARY INFORMATION: The FAA published this direct final rule with a request for comments in the **Federal Register** on September 2, 1999 (64 FR 48088). The FAA uses the direct final rulemaking procedure for a non-controversial rule where the FAA believes that there will be no adverse public comment. This direct final rule advised the public that no adverse comments were anticipated, and that unless a written adverse comment, or a written notice of intent to submit such comment period, the regulation would become effective on December 30, 1999. No adverse comments were received, and thus this notice confirms that this direct final rule will become effective on that date.

Issued in Kansas City, MO on November 18, 1999.

Richard L. Day,

Acting Manager, Air Traffic Division, Central Region.

[FR Doc. 99–31520 Filed 12–3–99; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 71

[Airspace Docket No. 99–ACE–42]

Amendment to Class E Airspace; Malden, MO

AGENCY: Federal Aviation Administration, DOT.

ACTION: Direct final rule; confirmation of effective date.

SUMMARY: This document confirms the effective date of a direct final rule which revises Class E airspace at Malden, MO.

DATES: The direct final rule published at 64 FR 49374 is effective on 0901 UTC, December 30, 1999.

FOR FURTHER INFORMATION CONTACT: Kathy Randolph, Air Traffic Division, Airspace Branch, ACE–520C, DOT Regional Headquarters Building, Federal Aviation Administration, 901 Locust, Kansas City, MO 64106; telephone: (816) 329–2525.

SUPPLEMENTARY INFORMATION: The FAA published this direct final rue with a request for comments in the **Federal Register** on September 13, 1999 (64 FR 49374). The FAA uses the direct final rulemaking procedure for a non-controversial rule where the FAA believes that there will be no adverse public comment. This direct final rule advised the public that no adverse comments were anticipated, and that unless a written adverse comment, or a written notice of intent to submit such an adverse comment, were received within the comment period, the regulation would become effective on December 30, 1999. No adverse comments were received, and thus this notice confirms that this direct final rule will become effective on that date.

Issued in Kansas City, MO on November 18, 1999.

Richard L. Day,

Acting Manager, Air Traffic Division, Central Region.

[FR Doc. 99–31522 Filed 12–3–99; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 71

[Airspace Docket No. 99–ACE–43]

Amendment to Class E Airspace; Sikeston, MO

AGENCY: Federal Aviation Administration, DOT.

ACTION: Direct final rule, confirmation of effective date.

SUMMARY: This document confirms the effective date of a direct final rule which revises Class E airspace at Sikeston, MO.

DATES: The direct final rule published at 64 FR 49373 is effective on 0901 UTC, December 30, 1999.

FOR FURTHER INFORMATION CONTACT: Kathy Randolph, Air Tariff Division,

NRC Waste Confidence Position: 2008 (proposed revision)

displays a currently valid OMB control number.

Regulatory Analysis

A draft regulatory analysis has not been prepared for this proposed regulation because this regulation does not establish any requirements that would place a burden on licensees.

Regulatory Flexibility Certification

Under the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission certifies that this rule, if adopted, would 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 ISFSIs 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 or ISFSIs. Entities seeking or holding Commission licenses for these facilities do not fall within the scope of the definition of ''small entities'' set forth in the Regulatory Flexibility Act or the size standards established by the NRC at 10 CFR 2.810.

Backfit Analysis

The NRC has determined that the backfit rule (§§ 50.109, 70.76, 72.62, or 76.76) does not apply to this proposed rule because this amendment would not involve any provisions that would impose backfits as defined in the backfit rule. Therefore, a backfit analysis is not required.

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, sec. 1701, 106 Stat. 2951, 2952, 2953, (42 U.S.C. 2201, 2297(f)); secs. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842); sec. 1704, 112 Stat. 2750 (44 U.S.C. 3504 note). 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 Public Law 95–604, Title II, 92 Stat. 3033–3041; and sec. 193, Public Law 101–575, 104 Stat. 2835 (42 U.S.C. 2243). Sections 51.20, 51.30, 51.60, 41.80, and 51.97 also issued under secs. 135, 141, Public Law 97–425, 96 Stat. 2232, 2241, and sec. 148, Public Law 100–203, 101 Stat. 1330–223 (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) and under Nuclear Waste Policy Act of 1982, sec. 121, 96 Stat. 2228 (42 U.S.C. 10141). Sections 51.43, 51.67, and 51.109 also under Nuclear Waste Policy Act of 1982, sec 114(f), 96 Stat 2216, as amended (42 U.S.C. 10134 (f)).

2. In § 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 beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations until a disposal facility can reasonably be expected to be available.

* * * * *

Dated at Rockville, Maryland, this 29th day of September 2008.

For the Nuclear Regulatory Commission.

Annette L. Vietti-Cook,

Secretary of the Commission.

[FR Doc. E8–23384 Filed 10–8–08; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

10 CFR Part 51

[Docket ID–2008–0482]

Waste Confidence Decision Update

AGENCY: Nuclear Regulatory Commission.

ACTION: Update and proposed revision of Waste Confidence Decision.

SUMMARY: On September 18, 1990, the Nuclear Regulatory Commission (NRC or Commission) issued a decision reaffirming and revising, in part, the five Waste Confidence findings reached in its 1984 Waste Confidence Decision. The 1984 decision and the 1990 review were products of rulemaking proceedings designed to assess the degree of assurance that radioactive wastes generated by nuclear power plants can be safely disposed of, to determine when such disposal or offsite storage would be available, and to determine whether radioactive wastes can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available. The Commission has decided to again undertake a review of its Waste Confidence findings as part of an effort to enhance the efficiency of combined operating license proceedings for applications for nuclear power plants anticipated in the near future. To assure that its Waste Confidence findings are up-to-date, the Commission has prepared an update of the findings and proposes to revise two of the findings. The purpose of this notice is to seek public comment on the update and the proposed revisions.

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 sufficient mined geologic repository capacity can reasonably be expected to be available within 50–60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) 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 without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations.

The Commission proposes to reaffirm the remaining findings. Each finding, any proposed revisions, and the reasons for revising or reaffirming them are discussed below. In keeping with the proposed revised Findings 2 and 4, the Commission is publishing concurrently

in this issue of the **Federal Register** proposed conforming amendments to its 10 CFR part 51 rule providing its generic determination on the environmental impacts of storage of spent fuel at, or away from, reactor sites after the expiration of reactor operating licenses.

DATES: Submit comments by December 8, 2008. Comments received after this date will be considered if it is practical to do so, but NRC is able to assure consideration only for comments received on or before this date.

ADDRESSES: You may submit comments by any one of the following methods. Comments submitted in writing or in electronic form will be made available for public inspection. Because your comments will not be edited to remove any identifying or contact information, the NRC cautions you against including any information in your submission that you do not want to be publicly disclosed.

Federal e-Rulemaking Portal: Go to *http://www.regulations.gov* and search for documents filed under Docket ID [NRC–2008–0482]. Address questions about NRC dockets to Carol Gallagher 301–415–5905; e-mail *Carol.Gallagher@nrc.gov.*

Mail comments to: Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, ATTN: Rulemakings and Adjudications Staff.

E-mail comments to: *Rulemaking.Comments@nrc.gov.* If you do not receive a reply e-mail confirming that we have received your comments, contact us directly at 301–415–1677.

Hand deliver comments to: 11555 Rockville Pike, Rockville, Maryland 20852, between 7:30 am and 4:15 pm Federal workdays. (Telephone 301–415–1677).

Fax comments to: Secretary, U.S. Nuclear Regulatory Commission at 301–415–1101.

You can access publicly available documents related to this document using the following methods:

NRC's Public Document Room (PDR): The public may examine and have copied for a fee publicly available documents at the NRC's PDR, Public File Area O1 F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland.

NRC's Agencywide Documents Access and Management System (ADAMS): Publicly available documents created or received at the NRC are available electronically at the NRC's Electronic Reading Room at *http://www.nrc.gov/reading-rm/adams.html.* From this page, the public can gain entry into ADAMS, which provides text and image files of NRC's public documents. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's PDR reference staff at 1–800–397–4209, 301–415–4737, or by e-mail to *pdr.resource@nrc.gov.*

FOR FURTHER INFORMATION CONTACT: Neil Jensen, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, telephone 301–415–8480, e-mail, *neil.jensen@nrnc.gov.*

SUPPLEMENTARY INFORMATION:

Background

In October 1979, the NRC initiated a rulemaking proceeding, known as the Waste Confidence proceeding, to assess its degree of assurance that radioactive wastes produced by nuclear power plants can be safely disposed of, to determine when such disposal or offsite storage will be available, and to determine whether radioactive wastes can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available (44 FR 1372; October 25, 1979). The Commission's action responded to a remand from the U.S. Court of Appeals for the District of Columbia Circuit in *State of Minnesota* v. *NRC,* 602 F.2d 412 (1979). That case raised the question whether an offsite storage or disposal solution would be available for the spent nuclear fuel (SNF) produced at the Vermont Yankee and Prairie Island reactors at the expiration of the licenses for those facilities in the 2007–2009 period or, if not, whether the SNF could be stored at those reactor sites until an offsite solution was available. The Waste Confidence proceeding also stemmed from the Commission's statement, in its denial of a petition for rulemaking filed by the Natural Resources Defense Council (NRDC), that it intended to reassess periodically its finding of reasonable assurance that methods of safe permanent disposal of high-level radioactive waste (HLW) would be available when they were needed. Further, the Commission stated that, as a matter of policy, 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.'' (42 FR 34391, 34393; July 5, 1977, *pet. for rev. dismissed sub nom. NRDC* v. *NRC,* 582 F.2d 166 (2d Cir. 1978)).[1]

The Waste Confidence proceeding resulted in five Waste Confidence findings which the Commission issued August 31, 1984; 49 FR 34658:

(1) The Commission finds reasonable assurance that safe disposal of HLW and SNF in a mined geologic repository is technically feasible;

(2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial HLW and SNF will be available by the years 2007–2009, and that sufficient repository capacity will be available within 30 years beyond the expiration of any reactor operating license to dispose of existing commercial HLW and SNF originating in such reactor and generated up to that time;

(3) The Commission finds reasonable assurance that HLW and SNF will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all HLW and SNF;

(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 (ISFSIs);

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

Based on these findings, the Commission amended 10 CFR part 51 of its regulations to provide a generic determination, codified in 10 CFR 51.23(a), that for at least 30 years beyond the expiration of reactor operating licenses, no significant environmental impacts will result from the storage of spent fuel in reactor facility storage pools or ISFSIs located at reactor or away-from-reactor sites.

The Commission conducted a review of its findings in 1989–1990 which resulted in the revision of the second and fourth findings to reflect revised expectations for the date of availability of the first repository, and to clarify that the expiration of a reactor's operating license referred to the full 40 year initial license for operation, as well as any additional term of a revised or renewed license. These findings are:

[1] The NRDC petition asserted that the Atomic Energy Act of 1954, as amended (AEA), required NRC to make a finding, before issuing an operating license for a reactor, that permanent disposal of HLW generated by that reactor can be accomplished safely. The Commission found that the AEA did not require this safety finding to be made in the context of reactor licensing, but rather in the context of the licensing of a geologic disposal facility.

(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 sufficient repository capacity will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial HLW and SNF originating in such reactor and generated up to that time;

(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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite ISFSIs.

The Commission amended the generic determination made in 10 CFR 51.23(a) consistent with these revised findings (55 FR 38472; September 18, 1990):

> 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 (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite [ISFSIs]. 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 [HLW and SNF] originating in such reactor and generated up to that time.

This generic determination is applied in licensing proceedings conducted under 10 CFR Parts 50, 52, 54 and 72. *See* 10 CFR 51.23 (2008).

In 1999, the Commission reviewed its Waste Confidence findings and concluded that experience and developments since 1990 had confirmed the findings and made a comprehensive reevaluation of the findings unnecessary. It also stated that it would consider undertaking such a reevaluation when the impending repository development and regulatory activities run their course or if significant and pertinent unexpected events occur, raising substantial doubt about the continuing validity of the Waste Confidence findings (64 FR 68005; December 6, 1999).

The Commission does not believe that the criteria set in 1999 for reopening the Waste Confidence findings have been met. However, the Commission is now preparing to conduct a significant number of proceedings on combined construction permit and operating license (COL) applications for new reactors. The Commission anticipates that the issue of waste confidence may be raised in those proceedings and desires to take a fresh look at its Waste Confidence findings to take into account developments since 1990. For this purpose, the Commission has prepared this update of the Waste Confidence findings and now proposes the following revisions of Findings 2 and 4:

(2) The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50–60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial HLW and SNF originating in such reactor and generated up to that time.

(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 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite ISFSIs.

The update restates and supplements the bases for the earlier findings. The Commission seeks public comment on the update and on its proposed revisions of Findings 2 and 4.

The Commission is also publishing concurrently in this issue of the **Federal Register** a proposed rule revising 10 CFR 51.23(a) to conform with the proposed revisions of Findings 2 and 4.

I. 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

A. Bases for Finding 1

The Commission reached this finding in 1984 and reaffirmed it in 1990. The focus of this finding is on whether safe disposal of HLW and SNF is technically possible using existing technology and without a need for any fundamental breakthroughs in science and technology. To reach this finding, the Commission considered the basic features of a repository designed for a multi-barrier system for waste isolation and examined the problems the Department of Energy (DOE) would need to resolve in developing a final design for such a repository. The Commission identified three major technical problems: (1) The selection of a suitable geologic setting as host for a technically acceptable repository site; (2) the development of waste packages that will contain the waste until the fission products are greatly reduced; and (3) the development of engineered barriers, such as backfilling and sealing of the drifts and shafts of the repository, that can effectively retard migration of radionuclides out of the repository (49 FR 34667; August 31, 1984).

DOE's selection of a suitable geologic setting has been governed by Congress' passage of the Nuclear Waste Policy Act of 1982, Public Law 97–425, 42 U.S.C. 10101 *et seq.* (NWPA) and by the 1987 amendments to NWPA in the Nuclear Waste Policy Amendments Act, Pub. L. 100–202 (NWPAA). DOE had begun to explore potential repository sites before the NWPA, but that Act set in place a formal process and schedule for the development of two geologic repositories. The following brief summary of key provisions of these Acts may assist readers in understanding the process followed by DOE in locating a suitable geologic setting.

As initially enacted, NWPA directed DOE to issue guidelines for the recommendation of sites and then to nominate at least 5 sites as being suitable for site characterization for selection as the first repository site and, not later than January 1, 1985, to recommend 3 of those sites to the President for characterization as candidate sites. Section 112 of NWPA, 42 U.S.C. 10132. Not later than July 1, 1989, DOE was to again nominate 5 sites and recommend 3 of them to the President for characterization for selection of the second repository. *Id.* DOE was then to carry out site characterization activities for approved sites. Section 113 of NWPA, 42 U.S.C. 10133. Following site characterization, DOE was then to recommend sites to the President as suitable for development as repositories and the President was to recommend one site to the Congress by March 31, 1987, and another site by March 31, 1989, for development as the first two repositories. Section 114 of NWPA, 42 U.S.C. 10134. States and affected Indian tribes were given the opportunity to object, but if the recommendations were approved by Congress, DOE was then to submit applications for a construction authorization to NRC. *Id.* NRC was given until January 1, 1989, to reach a decision on the first application and until January 1, 1992, on the second. The Commission was directed to prohibit the emplacement in the first repository of more than 70,000 metric tons of heavy metal (MTHM) until a

second repository was in operation. *Id.* The 1987 NWPAA, *inter alia,* restricted site characterization solely to a site at Yucca Mountain, NV (YM) and terminated the program for a second repository. The NWPAA provided that if DOE at any time determines YM to be unsuitable for development as a repository, DOE must report to Congress its recommendations for further action to assure the safe, permanent disposal of SNF and HLW, including the need for new legislation. Section 113 of NWPA, as amended, 42 U.S.C. 10133.

In 1984, the Commission reviewed DOE's site exploration program and concluded that it was 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 would be identified (49 FR 34668; August 31, 1984). In 1990, the Commission noted that the 1987 amendment of NWPA that focused solely on the YM site carried the potential for considerable delay in opening a repository if that site were found to be unlicenseable. However, the possibility of that delay did not undermine the Commission's confidence that a technically acceptable site would be located, either at YM or elsewhere. The Commission observed that the NRC staff had provided extensive comments on DOE's draft environmental assessments of the 9 sites it had identified as being potentially acceptable and on the final environmental assessments for the 5 sites nominated.[2] NRC had not identified any fundamental technical flaw or disqualifying factor which would render any of the sites unsuitable for characterization or potentially unlicenseable, although NRC noted that many issues would need to be resolved during site characterization for YM or any other site (55 FR 38486; September 18, 1990).

With respect to the development of effective waste packages, the Commission, in 1984, reviewed DOE's scientific and engineering program on this subject. The Commission also considered whether the possibility of renewed reprocessing of SNF might alter the technical feasibility of achieving a suitable waste package because of the need to accommodate a waste form other than spent fuel. The Commission concluded that the studies of DOE and others demonstrated that the chemical and physical properties of SNF and HLW can be sufficiently understood to permit the design of a suitable waste package and that the possibility of commercial reprocessing would not substantially affect this conclusion (49 FR 34671; August 31, 1984). In 1990, the Commission reviewed continued research and experimentation on waste packages that were undertaken by DOE in other countries, particularly Sweden and Canada. NRC noted that DOE had narrowed the range of waste package designs to a design tailored for unsaturated tuff at the YM site due to the 1987 redirection of the HLW program. NRC also noted that some reprocessing wastes from the defense program and the West Valley Demonstration Project were now anticipated to be disposed in the repository. However, NRC remained confident that, given a range of waste forms and conservative test conditions, the technology is available to design acceptable waste packages (55 FR 38489; September 18, 1990).

With respect to the development of effective engineered barriers, the Commission's confidence in 1984 rested upon its consideration of DOE's ongoing research and development activities regarding backfill materials and borehole and shaft sealants which led it to the conclusion that these activities provided a basis for reasonable assurance that engineered barriers can be developed to isolate or retard radioactive material released by the waste package (49 FR 34671; August 31, 1984). In 1990, although DOE's research had narrowed to focus on YM, the Commission continued to have confidence that backfill or packing materials can be developed as needed for the underground facility and waste package, and that an acceptable seal can be developed for candidate sites in different geologic media (55 FR 38489–38490; September 18, 1990).

B. Evaluation of Finding 1

There remains high confidence among the scientific and technical community engaged in waste management that safe geologic disposal is achievable with currently available technology. *See, e.g.,* National Research Council, *''Technical Bases for Yucca Mountain Standards,''* 1995. No insurmountable technical or scientific problem has emerged to disturb this confidence that safe disposal of SNF and HLW can be achieved in a mined geologic repository. To the contrary, there has been significant progress in the enhancement of scientific understanding and technological development needed for geologic disposal over the past 18 years. There is now a much deeper understanding of processes that affect the ability of repositories to isolate waste over long periods. *Id.* at 71–72; International Atomic Energy Agency (IAEA), ''Scientific and Technical Basis for the Geologic Disposal of Radioactive Wastes, Technical Reports Series No. 413,'' 2003. The ability to characterize and quantitatively assess the capabilities of geologic and engineered barriers has been repeatedly demonstrated. NRC, ''Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada; Proposed Rule,'' (64 FR 8640, 8649; February 22, 1999); Organization for Economic Cooperation and Development, Nuclear Energy Agency, ''Lessons Learned from Ten Performance Assessment Studies,'' 1997. Specific sites have been investigated and extensive experience has been gained in underground engineering. IAEA, ''Radioactive Waste Management Studies and Trends, IAEA/WMDB/ST/4,'' 2005; IAEA, ''The Use of Scientific and Technical Results from Underground Research Laboratory Investigations for the Geologic Disposal of Radioactive Waste, IAEA–TECDOC–1243,'' 2001. These advances and others throughout the world, in underground research laboratories, continue to confirm the soundness of the basic concept of deep geologic disposal. IAEA, ''Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management, INFCIRC/546,'' 1997.

In the United States, the technical approach for safe HLW disposal has remained unchanged for several decades: Use a deep geologic repository containing natural barriers to hold canisters of HLW with additional engineered barriers to further retard radionuclide release. Although some specifics in this technical approach have changed in response to new knowledge (*e.g.*, engineered backfill was removed as a design concept for YM in the late 1990s in response to enhanced understandings of heat and water transfer processes in the near-field drift environment), safe disposal continues to appear to be a feasible goal with current technology. Assessments for long-term performance of a potential repository at YM were conducted by DOE in 1998 (DOE/RW–0508, Viability Assessment) and 2002 (DOE/RW–0539, Site Recommendation). These assessments used existing technology and available scientific information, and did not identify areas where fundamental

[2] Under the program established by the initial NWPA, DOE had nominated sites at Hanford WA, Yucca Mountain NV, Deaf Smith County TX, Davis Canyon UT, and Richton Dome MS, and had recommended the first 3 sites for site characterization.

breakthroughs in science or technology were needed to support the assessments.

With respect to the issue of identifying a suitable geologic setting as host for a technically acceptable site, DOE made its suitability determination for the YM site in 2002. On June 3, 2008, DOE submitted the application to NRC and on September 08, 2008, NRC Staff notified DOE that it found the application acceptable for docketing (73 FR 53284; September 15, 2008). Whether this particular site will be found to be technically acceptable must await the outcome of an NRC licensing proceeding. The 1987 amendments to NWPA barred DOE from continuing site investigations elsewhere within the U.S. However, Congress' decision to focus solely on YM was not based on any finding that information DOE had obtained on other sites ruled them out for technical reasons; rather, the decision was aimed at controlling the costs of the HLW program (55 FR 38486; September 18, 1990). Repository programs in other countries are actively considering crystalline rock, clay formations, and salt formations as repository host media. IAEA, ''Radioactive Waste Management Status and Trends, IAEA/WMDB/ST/4,'' 2005; IAEA, ''The Use of Scientific and Technical Results from Underground Research Laboratory Investigations for the Geologic Disposal of Radioactive Waste, IAEA–TECDOC–1243,'' 2001. Many of these programs have been conducting research on these geologic media for several decades. Although there are relative strengths to the capabilities of each of these potential host media, no geologic media previously identified as a candidate host has been ruled out based on technical or scientific information. Salt formations currently are being considered as hosts only for reprocessed nuclear materials because heat-generating waste, like spent nuclear fuel, exacerbates a process by which salt can rapidly deform. This process could potentially cause problems for keeping drifts stable and open during the operating period of a repository.

In 2001, NRC amended its regulations to include a new 10 CFR Part 63, ''Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada,'' (66 FR 55732; November 2, 2001), which requires use of both natural and engineered barriers to meet overall total system performance objectives without pre-determined subsystem performance requirements, such as substantially complete containment for a waste package, as is required in 10 CFR Part 60.[3] Accordingly, U.S. research and development activities have focused on understanding the long-term capability of natural and engineered barriers which can prevent or substantially reduce the release rate of radionuclides from a potential repository system. Although the performance of individual barriers may change through time, the overall performance of the total system is required to be acceptable throughout the performance period for the repository. In this context of total system performance, research and development has supported the view that it appears technically possible to design and construct a waste package and an engineered barrier system that, in conjunction with natural barriers, could prevent or substantially reduce the release rate of radionuclides from a potential repository system during the performance period. NRC, ''Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada; Proposed Rule,'' (64 FR 8649; February 22, 1999); IAEA, ''Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management, INFCIRC/546,'' 1997.

Since the Commission last considered Waste Confidence issues, NRC has issued design certifications under its regulations at 10 CFR Part 52, ''Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants,'' and is currently reviewing several plant designs in response to applications for design certifications and for COL applications that reference designs under review or designs previously certified. These facilities would use the same or similar fuel assembly designs as the nuclear power plants currently operating in the United States. A need for possible design changes for repository disposal may be affected by the extent of a licensee's reliance on cladding or fuel type as a barrier to waste isolation. If limited reliance is placed on the barrier capabilities of cladding or fuel type in a demonstration of compliance with repository safety requirements, then minimal design changes may be needed to accommodate new types of SNF or cladding. As such, the new reactor designs and specific license applications currently under review would not raise issues as to the technical feasibility of repository disposal.

NRC is also engaged in preliminary interactions with DOE and possible reactor vendors proposing advanced reactor designs that are different from the currently operating light-water reactors. Some of these advanced reactors use gas-cooled or liquid metal cooled technologies and have fuel and reactor components that might require different transportation and storage containers. Geometric, thermal, and criticality constraints could conceivably require a design modification to disposal containers from that currently proposed for YM. Nevertheless, the technical requirements for disposal of advanced reactor components appear similar to the requirements for disposal of components for current light water reactors. For example, DOE currently plans to dispose of spent fuel at YM from both gas-cooled (Peach Bottom 1) and liquid-metal cooled (Fermi 1) reactors, using the same basic technological approach as for other SNF. Although radionuclide inventory, fuel matrix, and cladding characteristics for advanced fuels might be distinct from current light-water reactors, the safe disposal of advanced fuel appears to involve the same scientific and engineering knowledge as used for fuel from current light-water reactors.

There is currently a high uncertainty regarding the growth of advanced reactors in the U.S. The licensing strategy developed by NRC and DOE for the next generation nuclear plant (NGNP) program found that an aggressive licensing approach may lead to operation of a prototype facility in 2021. Based on comparison with current disposal strategies for fuel from existing gas cooled or liquid-metal cooled reactors, NRC is confident that current technology appears to be adequate to support the safe disposal of spent fuel from a potential prototype facility. In addition to the NGNP activities related to the prototype reactor, various activities, such as DOE's Advanced Fuel Cycle Initiative, are underway to evaluate fuel cycle alternatives that could affect the volume and form of waste from the prototype reactor or other advanced nuclear reactor designs. The need to consider waste disposal as part of the overall research and development activities for advanced reactors is recognized and included in the activities of designers, DOE and NRC. *See, e.g.*, DOE Nuclear Energy Research Advisory Committee and the Generation IV International Forum, ''A Technology Roadmap for Generation IV

[3] NRC's regulations at 10 CFR Part 63 apply only to the proposed repository at YM. NRC's regulations at 10 CFR Part 60, ''Disposal of High-Level Radioactive Wastes in Geologic Repositories,'' govern the licensing of any repository other than one located at YM. However, at the time Part 63 was proposed, the Commission indicated it would consider revising Part 60 if it seemed likely to be used in the future. 64 FR 8640, 8643; February 22, 1999.

Nuclear Energy Systems,'' December 2002.

Based on the information described previously, the Commission proposes to reaffirm Finding 1.

II. Finding 2 (1990): 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 (Which May Include the Term of a Revised or Renewed License) 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

A. Bases for Finding 2

The dual objectives of this finding are to predict when a repository will be available for use and to predict how long spent fuel may need to be stored at a reactor site until repository space is available for the spent fuel generated at that reactor. With respect to the first prediction, the Commission's focus in 1984 was on the years 2007–2009, the years during which the operating licenses for the Vermont Yankee and Prairie Island nuclear power plants would expire.[4] In 1984, DOE anticipated that the first repository would begin operation in 1998 and the second in 2004. However, NRC concluded that technical and institutional uncertainties made it preferable to focus on the 2007–2009 time period. The technical uncertainties involved the questions of how long it would take DOE to locate a suitable geologic setting for a potentially technically acceptable repository and how long it would take to develop an appropriate waste package and engineered barriers. The Commission expressed the view that despite early delays DOE's program was on track and, under the impetus given by the recently-enacted NWPA, would timely resolve the technical problems (49 FR 34674–34675; August 31, 1984).

The Commission also identified institutional uncertainties that needed to be resolved: (1) Measures for dealing with Federal-state disputes; (2) An assured funding mechanism that would be sufficient over time to cover the period for developing a repository; (3) An organizational capability for managing the HLW program; and (4) A firm schedule and establishment of responsibilities. The Commission expressed its confidence in the ability of the provisions of the then recently-passed NWPA to timely resolve these uncertainties (49 FR 34675–34679; August 31, 1984).

With respect to the second prediction, NRC reviewed DOE's estimates of the amount of installed generating capacity of commercial nuclear power plants in the year 2000 and concluded that the total amount of spent fuel that would be produced during the operating lifetimes of these reactors would likely be about 160,000 MTHM. To accommodate this amount, NRC assumed that two repositories would be needed. NRC calculated that if the first repository began to receive SNF in 2005, and the second in 2008, then all the SNF would be emplaced by about 2026. This would mean that sufficient repository capacity would be available within 30 years beyond the expiration of any reactor license for disposal of its SNF (49 FR 34679; August 31, 1984).

In reviewing these predictions in 1990, the Commission faced a considerably changed landscape. First, DOE's schedule for the availability of a repository had slipped several times so that its then-current projection was 2010. Second, Congress' 1987 amendment of NWPA had confined site characterization to the YM site, meaning that there were no ''back-up'' sites being characterized in case the YM site should be found unsuitable or unlicenseable. Finally, site characterization activities at YM had not proceeded without problems, notably in DOE's schedule for sub-surface exploration and in development of its quality assurance program. Given these considerations, the Commission found it would not be prudent to reaffirm its confidence in the availability of a repository in the 2007–2009 period (55 FR 38495; September 18, 1990).

Instead, the Commission found that it would be reasonable to assume that DOE could make its finding whether YM was suitable for development of a repository by the year 2000. The Commission was unwilling to assume that DOE would make a finding of suitability (which would be necessary for a repository to be available by 2010). To establish a new time-frame for repository availability, the Commission made the assumption that DOE would find the YM site unsuitable by the year 2000 and that (as DOE had estimated) it would take 25 years for a repository to become available at a different site.

The Commission then considered whether it had sufficient bases for confidence that a repository would be available by 2025 using the same technical and institutional criteria it had used in 1984. The Commission found no reason to believe that another potentially technically acceptable site could not be located if the YM site were found unsuitable. The development of a waste package and engineered barriers was tied up with the question of the suitability of the YM site but NRC found no reason to believe that a waste package and engineered barriers could not be developed for a different site by 2025, if necessary (55 FR 38495; September 18, 1990). The institutional uncertainties were perhaps more difficult to calculate. The Commission acknowledged that DOE's efforts to address the concerns of States, local governments and Indian tribes had met with mixed results. Nevertheless, the Commission retained its confidence that NWPA, as amended, had 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 (55 FR 38497; September 18, 1990). Similarly, the Commission believed that management and funding issues had been adequately resolved by NWPA, as amended, and would not call into question the availability of a repository by 2025 (55 FR 38497–38498; September 18, 1990). Thus, except for the schedule, the Commission was confident that the HLW program set forth in the amended NWPA would ultimately be successful.

The Commission also considered whether the termination of activities for a second repository, combined with the 70,000 MTHM limit for the first repository, together with its new projection of 2025 as the time for the availability for a repository, undermined its prediction that sufficient repository capacity would be available within 30 years beyond expiration of any reactor operating license to dispose of the SNF originating in such reactor and generated up to that time (55 FR 38501–38504; September 18, 1990). The Commission noted that almost all reactor licenses would not expire until some time in the first three decades of the twenty-first century and license renewal was expected to extend the terms of some of these licenses. Thus, a repository was not needed by 2007–2009 to provide disposal capacity within 30 years beyond expiration of

[4] Under the court remand which precipitated the initial waste confidence review, NRC was required to consider whether there was reasonable assurance that an offsite storage solution would be available by the years 2007–2009 and, if not, whether there was reasonable assurance that the spent fuel could be stored safely at those sites beyond those dates. *See State of Minnesota v. NRC,* 602 F.2d 412, 418 (DCDC Cir. 1979).

most operating licenses.[5] The Commission acknowledged, however, that it appeared likely that two repositories would be needed to dispose of all the SNF and HLW from the current generation of reactors unless Congress provided statutory relief from the 70,000 MTHM limit for the first repository and unless the first repository had adequate capacity to hold all the SNF and HLW generated. This was because DOE's spent fuel projections, in 1990, called for 87,000 MTHM to have been generated by the year 2036. In addition, DOE's projections were based on the assumption of no new reactor orders. The Commission believed that that assumption probably underestimated the total spent fuel discharges to be expected due to the likelihood of reactor license renewals. The Commission expressed the belief that if the need for a second repository was established, Congress would provide the needed institutional support and funding, as it had for the first repository.[6] The Commission reasoned that if work began on the second repository program in 2010, that repository could be available by 2035. 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 operating license expiration for reactors to dispose of the spent fuel generated at their sites up to that time. The Commission concluded that a second repository, or additional capacity at the first repository, would be needed only to accommodate the additional quantity of spent fuel generated during the later years of reactors operating under a renewed license. The Commission stated that the availability of a second repository would permit spent fuel to be shipped offsite well within 30 years after expiration of these reactors' operating licenses and that the same would be true of the spent fuel discharged from any new generation of reactor designs (55 FR 38503–38504; September 18, 1990).

The Commission acknowledged that there were several licenses that had been prematurely terminated where it was possible that SNF would be stored more than 30 years beyond the effective expiration of the license and that there could be more of these premature terminations. However, the Commission remained confident that in these cases, the overall safety and environmental impacts of extended spent fuel storage would be insignificant. The Commission had found that spent fuel could be safely stored for at least 100 years (Finding 4),[7] and that spent fuel in at-reactor storage would be safely maintained until disposal capacity at a repository was available (Finding 3). The Commission emphasized that it had not identified a date by which a repository must be available for health and safety reasons. The Commission found that in effect, under the second part of Finding 2, safe management and safe storage would not need to continue for more than 30 years beyond expiration of any reactor's operating license because sufficient repository capacity was expected to become available within those 30 years (55 FR 38504; September 18, 1990).

B. Evaluation of Finding 2

As explained previously, the Commission based its estimate in 1990 on the premise that at least one geologic repository would be available within the first quarter of the twenty-first century on an assumption that DOE would make its suitability determination under section 114 of NWPA around the year 2000. To avoid being put in the position of assuming the suitability of the YM site, the Commission then assumed that DOE would find that site unsuitable and, as DOE had estimated, that it would take 25 years before a repository could become available at an alternate site.

DOE made its suitability determination in early 2002 and found the YM site suitable for development as a repository.[8] Although DOE's application for a construction authorization for a repository was considerably delayed from the schedule set out in NWPA,[9] on June 3, 2008, DOE submitted the application to NRC and on September 08, 2008, NRC Staff notified DOE that it found the application acceptable for docketing (73 FR 53284; September 15, 2008). DOE's current estimate of the best achievable date for opening of the YM repository, assuming it is licensed, is 2020. At the hearing before the Subcommittee on Energy and Air Quality of the House Committee on Energy and Commerce held on July 15, 2008, Edward F. Sproat III, Director of DOE's Office of Civilian Radioactive Waste Management (OCRWM), informed the Congress that DOE could be ready to begin accepting SNF by 2020, but only if adequate funding is provided.

The NWPA process thus remains on track for making available a geologic repository for the disposal of SNF and HLW. DOE's projection of a date for repository availability has moved from 2010 in 1990 to 2020 today and could slip further. Even with some slippage in DOE's schedule, it remains possible that a repository will be available by 2025. Of course, now the only repository that could become available by 2025 is the proposed repository at YM and it will only become available if the Commission issues a construction authorization and a subsequent authorization to receive and possess HLW. In 2005, the State of Nevada filed a petition for rulemaking with NRC (PRM–51–8) which raised the question whether continued use of the 2025 date, in effect, indicated prejudgment of the outcome of any licensing proceeding that might be held. The Commission rejected this notion in its denial of the petition:

> Even if DOE's estimate as to when it will tender a license application should slip further, the 2025 date would still allow for unforeseen delays in characterization and licensing. It also must be recognized that the Commission remains committed to a fair and comprehensive adjudication and, as a result, there is the potential for the Commission to deny a license for the Yucca Mountain site based on the record established in the adjudicatory proceeding. That commitment is not jeopardized by the 2025 date for repository availability. The Commission did not see any threat to its ability to be an

[5] NRC identified Dresden 1, licensed in 1959, as the earliest licensed power reactor and noted that 30 years beyond its licensed life for operation would be 2029 and that it was possible, if a repository were to become available by 2025, for all the Dresden 1 SNF to be removed from that facility by 2029 (55 FR 38502; September 18, 1991).

[6] DOE is statutorily required to report to the President and to Congress on the need for a second repository between January 1, 2007 and January 1, 2010. Section 161 of NWPA, as amended, 42 U.S.C. 10172a. DOE intends to submit the report in 2008.

[7] The Commission conservatively assumed that licenses would be renewed for 30 year terms (55 FR 38503; September 18, 1990). Thus, the initial 40 year term of the operating license, plus 30 years for the renewed operating license term and 30 years beyond the expiration of the renewed license amounts to storage for at least 100 years.

[8] On February 14, 2002, the Secretary of Energy recommended the YM site for the development of a repository to the President thereby setting in motion the approval process set forth in sections 114 and 115 of the NWPA. *See* 42 U.S.C. 10134(a)(1); 10134(a)(2); 10135(b), 10136(b)(2). On February 15, 2002, the President recommended the site to Congress. On April 8, 2002, the State of Nevada submitted a notice of disapproval of the site recommendation to which Congress responded, on July 9, 2002, by passing a joint resolution approving the development of a repository at YM which the President signed on July 23, 2002. See Pub. L. No. 107–200, 116 Stat. 735 (2002) (codified at 42 U.S.C. 10135 note (Supp. IV 2004)).

[9] Section 114(b) of NWPA directs the Secretary of Energy to submit a construction authorization application to NRC within 90 days of the date the site designation becomes effective. 42 U.S.C. 10134(b).

impartial adjudicator in 1990 when it selected the 2025 date even though then, as now, a repository could only become available if the Commission's decision is favorable. Should the Commission's decision be unfavorable and should DOE abandon the site, the Commission would need to reevaluate the 2025 availability date, as well as other findings made in 1990. *State of Nevada; Denial of a Petition for Rulemaking* (70 FR 48329, 48333; August 17, 2005).

In the absence of an unfavorable NRC decision and DOE's abandonment of the site, the Commission found no reason to reopen its Waste Confidence findings.

However, the Commission has now considered the recommendations of the Combined License Review Task Force Report and, in its June 22, 2007, Staff Requirements Memorandum (SRM) on that report, has approved rulemaking to resolve generic issues associated with combined license applications. SRM—COMDEK–07–0001/COMJSM–07–0001—Report of the Combined License Review Task Force (ML071760109). In a subsequent SRM of September 7, 2007, the Commission expressed the view that a near-term update to the Waste Confidence findings was appropriate. SRM—Periodic Briefing on New Reactor Issues (ML072530192). The staff, in its response to these SRMs, recognized that there would likely be long-term inefficiencies in combined license application proceedings, due to the need to respond to potential questions and petitions directed to the existing Waste Confidence Decision, and committed to evaluate possible updates to the decision.[10] See memorandum from Luis A. Reyes to the Commissioners, ''Rulemakings that Will Provide the Greatest Efficiencies to Complete the Combined License Application Reviews in a Timely Manner,'' December 17, 2007, at 3 (ML073390094). Undertaking a public rulemaking proceeding now to consider revisions to the Waste Confidence findings and rule—rather than waiting until some point closer to the 2025 date—will allow sufficient time to conduct a studied and orderly reassessment and, as appropriate, to revise and update the findings and rule. In particular, it will allow the Commission to consider alternative time-frames which would provide reasonable assurance for the availability of a repository.

One possibility might be to make an assumption that the Commission would ultimately find the YM site unacceptable by a certain date and then set the expected availability of a different repository at a time around 25 years later in accordance with DOE's 1990 estimate of the time it would take to make a repository available at a different site. However, the Commission rejected this route in the denial of the Nevada petition:

> [T]he use of a Commission acceptability finding as the basis for repository availability is impossible to implement because it would require the Commission to prejudge the acceptability of any alternative to Yucca Mountain in order to establish a reasonably supported outer date for the Waste Confidence finding. That is, if the Commission were to assume that a license for the Yucca Mountain site might be denied in 2015 and establish a date 25 years hence for the 'availability' of an alternative repository (*i.e.*, 2040), it would still need to presume the 'acceptability' of the alternate site to meet that date (70 FR 48333; August 17, 2005).

Another approach would be to revise the finding to include a target date or timeframe for which it now seems reasonable to assume that a repository would be available. A target date for when a disposal facility can reasonably be expected to be available would result from an examination of the technical and institutional issues that would need to be resolved before a repository could be available. The target date approach would be consistent with the HLW disposal programs in other countries, as explained further in this document. The target date could be placed in the finding itself, or described in the explanation for the finding. A target date is admittedly not very different from ''the first quarter of the twenty-first century'' as stated in the current finding, but this approach would make it more clear that specification of a particular time for when a repository could be built does not imply that radioactive waste would pose unsafe conditions if a repository were not available at that time. The capability to safely store radioactive waste over long periods is a viable interim alternative not dependent on any one specific year for availability of a repository. The Commission has adopted this approach in updating its finding.

Most countries possessing HLW and SNF eventually plan to confine these wastes using deep geologic disposal. Currently, there are 24 other countries that consider disposal of spent or reprocessed nuclear fuel in deep geologic repositories. From the vantage point of near-term safety, there has been little urgency in these countries for implementing disposal facilities because of the perceived high degree of safety provided by interim storage, either at reactors or at independent storage facilities. Of these 24 countries,10 have established target dates for the availability of a repository. Most of the 14 countries which have not established target dates rely on centralized interim storage, which may include a protracted period of onsite storage before shipment to a centralized facility.[11]

The ''target date'' approach would need to assume a beginning date for a new repository program. NRC believes that it is reasonable to select 2025 as the starting point, the current outer date of the Commission's prediction of repository availability. It is reasonable to assume that it will be known by 2025 whether a repository is available at the YM site. If it is not available, it seems reasonable to assume that a new repository program would get underway around that time. The need for a new repository program would not necessarily be the result of an NRC denial of the license application; it could result from a change in national policy for HLW disposal, a court reversal of a Commission licensing action, or other factors. The assumption of a need for a new repository program would be based on an assumption that the proposed YM repository does not become available, and not on an assumption that NRC determines that facility to be technically unacceptable. In sum, the Commission would be saying that it will remove its expectation that a repository will be available by 2025 but, even in the event that the YM repository does not become available, it retains confidence that spent fuel can be safely stored with no significant environmental impact until a repository can reasonably be expected to be available and that the Commission has a target date for the availability of the repository in that circumstance.

If it is assumed that a new repository program begins around the year 2025, then setting a target date for the

[10] Challenges to 10 CFR 51.23 in individual COL proceedings would likely be addressed through application of 10 CFR 2.335, ''Consideration of Commission rules and regulations in adjudicatory proceedings.'' This rule generally prohibits attacks on NRC rules during adjudicatory proceedings but does allow a party to an adjudicatory proceeding to petition that application of a specified rule be waived or an exception made for the particular proceeding. 10 CFR 2.335(b). The sole ground for such a waiver or exception is that ''special circumstances with respect to the subject matter of the particular proceeding are such that the application of the rule or regulation * * * would not serve the purposes for which the rule or regulation was adopted.'' *Id.* Thus, a review of the Waste Confidence findings and rule now might be expected to obviate such challenges in individual COL proceedings.

[11] The three countries with target dates that plan direct disposal of SNF are: Czech Republic (2050), Finland (2020), and Sweden (2020). The seven countries with target dates that plan disposal of reprocessed SNF/HLW are: Belgium (2035), China (2050), France (2025), Germany (2025), Japan (2030s), Netherlands (2013), Switzerland (2042).

availability of a repository becomes a matter of examining the technical and institutional problems DOE would need to resolve to achieve the target date. The technical problems should be the same as the ones NRC examined in the earlier Waste Confidence reviews, namely, how long it would take DOE to locate a suitable site and how long it would take to develop a waste package and engineered barriers for that site. For the reasons explained in our evaluation of Finding 1, the Commission continues to have reasonable assurance that disposal in a geologic repository is technically feasible. That is the approach being taken in all the countries identified previously which have set target dates for the availability of a repository. It is also the approach of 14 other countries which have HLW disposal programs, but which have not set target dates.[12] In addition when Congress amended NWPA in 1987 to focus exclusively on the YM site, it did so for budgetary reasons and not because the sites DOE was considering at the time were discovered to be technically unacceptable. The research being done nationally and internationally strongly suggests that potentially acceptable sites exist and can be identified.

The amount of time DOE might need to develop an alternative repository site would depend upon the context of any enabling legislation, budgetary constraints, and the degree of similarity between a candidate site and other well-characterized sites with similar HLW disposal concepts. DOE began characterization of the YM site in 1982, made its suitability determination in 2002, and submitted a license application in 2008. However, the history of potential repository development at YM may be a poor indicator of the amount of time needed to develop a new repository. Many problems extraneous to site characterization activities adversely impacted DOE's repository program, such as changes in enabling legislation, public confidence issues, funding in Congressional appropriations, and significant delay in issuing environmental standards. In terms of the technical work alone, a lot would depend on whether Congress established a program involving characterization of many sites preliminary to the recommendation of a single site (similar to the 1982 NWPA) or a program focused on a single site (similar to the amended NWPA). The former would likely take longer but might have a better chance of success if problems developed with the single site. Much would also depend on whether the site(s) chosen for characterization is similar to sites in this or other countries for which much information is available or whether the site(s) would present novel challenges for which much fundamental knowledge would have to be developed. An alternative site with a disposal approach that is similar to that used in other international repository programs could make use of the extensive knowledge from those international programs to gain efficiencies in the alternative repository development program.

In addition, there should be a certain amount of ''lessons learned'' from the YM repository program that could help to shorten the length of a new program. For example, performance assessment techniques have improved significantly over the past 20 years (*e.g.*, the Goldsim software package of DOE's Total System Performance Assessment was not available 20 years ago and represents a significant improvement over the FORTRAN language of years past) such that performance assessment models are easier to develop and more reliable from what was available 20 years ago. Similarly, operational and manufacturing aspects developed during the YM program (*e.g.*, manufacturing of waste packages, excavation of drifts, waste handling), would be applicable to another program. Also, regulatory issues considered during the YM program (*e.g.*, burn-up credit for nuclear fuel and seismic performance analysis) should provide information useful for setting new standards or revising current standards.[13]

Whether waste package and engineered barrier information developed during the YM repository program would be transferable to a new program depends heavily on the degree of similarity between an alternative site and YM. The fundamental physical characteristics of the potential YM repository are significantly different from other potential repository sites that were considered in the U.S. repository program before 1987. If YM does not become available, DOE could select an alternative candidate site that was similar to YM in important physical characteristics (such as oxidizing conditions, drifts above the water table with low amounts of water infiltration, water chemistry buffered by volcanic tuff rocks). In this instance, much of the existing knowledge for engineered barrier performance at YM might be transferable to a different site. Nevertheless, much of DOE's current research on engineered barriers for YM could be inapplicable if an alternative site had significantly different characteristics than the YM site, such as an emplacement horizon in reducing conditions below the water table. In this instance, research from additional programs by DOE, industry, and other countries might provide important information on engineered barriers, provided DOE's alternative was analogous to sites and engineered barriers being considered elsewhere.

It is important to note, however, that broader institutional issues have emerged since 1990 that bear on the time it takes to implement geologic disposal. International developments have made clear that technical experience and confidence in geologic disposal, on their own, have not sufficed to bring about the broader societal and political acceptance needed to realize the authorization of a single national repository.

In the United Kingdom (UK), in 1997, an application for the construction of a rock characterization facility at Sellafield was rejected, leaving the country without a path forward for long-term management or disposal of HLW or SNF. In 1998, an inquiry by the UK House of Lords subsequently endorsed geologic disposal, but specified that public acceptance was required. As a result, the UK Government embraced a repository plan based on the principles of voluntarism and partnership between communities and implementers. This led to the initiation of a national public consultation, and major structural reorganization within the UK program. In 2007, the Scottish Government officially rejected any further consultation with the UK Government on deep geologic disposal of HLW and SNF. Discussions may continue on issues of interim storage only. This action by the Scottish Government effectively ends more than 7 years of consultations with stakeholders from communities near Scottish nuclear installations and represents another major setback for the UK program.

In Germany, a large salt dome at Gorleben has been under study since 1977 as a potential repository for SNF. After decades of intense discussions and protests, an agreement was reached in 2000 between the utilities and the government to suspend exploration of Gorleben for at least three, and at most,

[12] These countries are: Brazil, Canada, Hungary, Lithuania, Romania, South Korea, Slovak Republic, Spain (direct disposal of SNF); Bulgaria, India, Italy, Russia, United Kingdom, Ukraine (disposal of reprocessed SNF/HLW).

[13] Both NRC's Part 63 and EPA's Part 197 are applicable only for a repository at YM. NRC and EPA have in place standards for a repository at a different site, but these standards would likely be revised in a new repository program.

ten years. In 2003, the Federal Ministry for the Environment set up an interdisciplinary expert group to identify, with public participation, criteria for selecting new candidate sites.

After detailed site investigations in several locations in Switzerland, in 1993, the Swiss national cooperative for radioactive waste disposal proposed a deep geologic repository for low- and intermediate-level waste at Wellenberg. Despite a finding by Swiss authorities, in 1998, that technical feasibility of the disposal concept was successfully demonstrated, a public cantonal referendum rejected the proposed repository in 2002. Even after more than 25 years of high quality field and laboratory research, Swiss authorities do not expect a deep geologic repository will be available in their country before 2040.

In 1998, an independent panel reported to the Governments of Canada and Ontario on its review of Atomic Energy of Canada Ltd.'s concept of geologic disposal. Canadian Nuclear Fuel Waste Disposal Concept Environmental Assessment Panel, *Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment* Panel, February 1998. The panel found that from a technical perspective, safety of the concept had been adequately demonstrated, but from a social perspective, it had not. The panel concluded that broad public support is necessary in Canada to ensure the acceptability of a concept for managing nuclear fuel wastes. The panel also found that technical safety is a key part, but only one part of acceptability. To be considered acceptable in Canada, the panel found that a concept for managing nuclear fuel wastes must: (1) Have broad public support; (2) be safe from both a technical and social perspective; (3) have been developed within a sound ethical and social assessment framework; (4) have the support of Aboriginal people; (5) be selected after comparison with the risks, costs and benefits of other options; and (6) be advanced by a stable and trustworthy proponent and overseen by a trustworthy regulator. Resulting legislation mandated a nationwide consultation process and widespread organizational reform. Eight years later, in 2005, a newly-created Nuclear Waste Management Organization (NWMO), recommended an Adaptive Phased Management approach for long-term care of Canada's SNF, based on the outcomes of the public consultation. This approach includes both a technical method and a new management system. According to NWMO, it ''* * * provides for centralized containment and isolation of used nuclear fuel deep underground in suitable rock formations, with continuous monitoring and opportunity for retrievability; and it allows sequential and collaborative decision-making, providing the flexibility to adapt to experience and societal and technological change.'' NWMO, *Choosing a Way Forward: The Future Management of Canada's Used Nuclear Fuel, Final Study Report,* November 2005.

In 2007, the Government of Canada announced its selection of the Adaptive Phased Management approach, and directed NWMO to take at least two years to develop a ''collaborative community-driven site-selection process.'' NWMO must then use this process to open consultations with citizens, communities, Aboriginals, and other interested parties to find a suitable site in a willing host community. The Canadian Government explicitly acknowledges that this approach will ''take time to develop a process that is open, transparent, inclusive, and that is built on a solid foundation of trust, integrity and respect for Canadians and the environment.'' The Honorable Gary Lunn, P.C., M.P., Minister of Natural Resources, Canada, to President of NWMO, July 12, 2007. For financial planning and cost estimation purposes only, NWMO assumes the availability of a deep geological repository in 2035, 27 years after initiating development of new site selection criteria, 30 years after embarking on a national public consultation, and 37 years after rejection of the original geologic disposal concept. NWMO, *Annual Report 2007: Moving Forward Together,* March 2008.

Repository development programs in Finland and Sweden are much further advanced, but have nonetheless taken the time to build support from potential host communities. Preliminary site investigations in Finland began in 1986, and detailed characterizations of four locations were performed between 1993 and 2000. In 2001, the Finnish Parliament ratified the Government's decision to proceed with a repository project at a chosen site only after the municipal council of the host community had approved the siting of the disposal facility in 1999. Finland expects this facility to begin receipt of SNF for disposal in 2020, 34 years after the start of preliminary site investigations.

Between 1993 and 2000, Sweden conducted feasibility studies in eight municipalities. Based on technical considerations, one site was found unsuitable for further study, and two, based on municipal referenda, decided against allowing further investigations. Three of the remaining five sites were selected for detailed site investigations. Municipalities adjacent to two of these sites agreed to be potential hosts and one refused. One of the two volunteer sites will be selected for development as a repository and an application to the Swedish safety authorities is expected in 2009. If construction is authorized, Sweden expects the repository to be available for disposal in 2018, 25 years after starting feasibility studies in 1993.

If YM is not licensed, Congress will need to provide direction to DOE for development of a new site or, potentially, a new management concept, for the long-term management and disposal of SNF and HLW. Whatever approach Congress mandates, international experience since 1990 would appear to suggest that greater attention may need to be paid to developing societal and political acceptance in concert with essential technical, safety and security assurances. While there is no technical basis for making precise estimates of the minimum time needed to accomplish these objectives, examination of the international examples cited previously would support a range of between 25 and 35 years.

Another important institutional issue is whether funding for a new repository program is likely to be available. The provisions of NWPA for funding the repository have proved to be adequate for assuring the timely development of a repository in the sense that there have always been more than sufficient funds available for meeting the level of funding Congress appropriates for the repository program. Section 302(e)(2) of NWPA provides that the Secretary of Energy may make expenditures from the Nuclear Waste Fund (NWF), subject to appropriations by the Congress. At the FY 2009 Appropriations Hearing (April 10, 2008), Edward F. Sproat III, Director of OCRWM, DOE, stated that the NWF has a balance of approximately $21.0 billion. Thus, the NWF has the capacity to ensure timely development of a repository consistent with Congressional funding constraints. Moreover, DOE is in the process of preparing contracts to be signed by utilities planning to build new reactors. Therefore, there will be a source of funding for disposal of the fuel to be generated by these reactors.

Arriving at a target date involves balancing the technical and institutional factors discussed previously. It appears that the technical work needed to make a repository available could probably be done in less time than it took DOE to

submit a license application for the YM site (26 years measured from the beginning of site characterization). However, as discussed previously, the time needed to develop societal and political acceptance of a repository might range between 25 and 35 years. Therefore, if the starting point for a new program were 2025, a reasonable target date would be 2050–2060 for the availability of a repository.

Finding 2 also includes the prediction that sufficient repository capacity will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of HLW and SNF originating in such reactor and generated up to that time. As explained previously, in 1990 DOE projected that 87,000 MTHM would be generated by the year 2036. Given the statutory limit of 70,000 MTHM for the first repository, either statutory relief from that limit or a second repository would be needed. The Commission's continued assurance that sufficient repository capacity would be available within 30 years of license expiration of all reactors rested on an assumption that two repositories would be available in approximately 2025 and 2035, each with acceptance rates of 3400 MTHM/year within several years after commencement of operations. *See* 55 FR 38502; September 18, 1990.

If an assumption is made, for purposes of establishing a target date, that a repository will not become available until approximately 2050–2060, it appears that a finding that sufficient repository space will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) is not supportable.[14] According to the 2007–2008 USNRC Information Digest, NUREG–1350, Vol. 19, Table 11, p.48 (Information Digest), there are 18 reactor operating licenses that will expire between 2009 and 2020. There are an additional 44 licenses that will expire between 2021 and 2030. Many of these licenses may be renewed which would extend their operating lifetimes, but this cannot be assumed.[15] For licenses that are not renewed, some spent fuel will need to be stored for more than 30 years beyond the expiration of the license if a repository is not available until 2050–2060. According to the Information Digest, Appendix B, there are 22 reactors which were formerly licensed to operate, but which have been permanently shut down. Thirty years beyond their licensed life of operation will come as early as 2029 for Dresden 1 and as late as 2056 for Millstone 1, but for most of these plants, 30 years beyond the licensed life for operation will fall in the 2030s and 2040s. Thus, for virtually all of these plants, spent fuel will have to be stored beyond 30 years from the expiration of the license if a repository is not available until 2050–2060.

In 1990, the Commission emphasized that this 30 year period was not a safety finding. It was only an estimate of how long it was likely that SNF would need to be stored, given its confidence that repository disposal would be available by 2025. In fact, the Commission said it was not concerned about the fact that it was already clear in 1990 that a few reactors would need to store spent fuel on-site beyond 30 years after the effective expiration date of their licenses (*i.e.*, the date the license prematurely terminated) due to its confidence in the safety of spent fuel storage (55 FR 38503; September 18, 1990). For the reasons presented in the evaluation of Finding 4, the Commission is now able to say that there is no public health and safety or environmental concern if its target date of 2050–2060 for the availability of a disposal facility results in the need to store fuel at some reactors for a 50–60 year period after expiration of the license or even longer.

Based on the information described previously, the Commission is proposing to revise Finding 2 to eliminate a specific date for the availability of a repository and to state that a repository may reasonably be expected to be available within 50–60 years beyond the licensed life for operation of any reactor.

C. Proposed Finding 2

The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50–60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial HLW and spent fuel originating in such reactor and generated up to that time.

D. Specific Question for Public Comment

An alternative approach would be for the Commission to revise Finding 2 without reference to a timeframe for the availability of a repository. (The proposed revision to simplify 10 CFR § 51.23(a) removes the reference to a repository date although it is based on an expectation of repository availability by 2050–2060 as set forth in the proposed revision to Finding 2). In 2005, in response to PRM–51–8, the Commission had declined to consider such an approach to define ''availability'' based on a presumption that some acceptable disposal site would become available at some undefined time in the future. The Commission concluded then that such an approach would be a departure from the framework it had established in its original 1984 decision to use a specific timeframe as a basis for assessing the degree of assurance that radioactive waste can be disposed of safely and for determining when such disposal will be available (70 FR. 48333; August 17, 2005).

The Commission's proposed revision of Finding 2 is based on its assessment not only of our understanding of the technical issues involved, but also predictions of the time needed to bring about the necessary societal and political acceptance for a repository site. Recognizing the inherent difficulties in making such predictions, the Commission seeks specific comment on whether it should revise its approach to Finding 2 and adopt a more general finding of reasonable assurance that SNF generated in any reactor can be stored safely and without significant environmental impacts until a disposal facility can reasonably be expected to be available. In other words, in response to the court's concerns that precipitated the original Waste Confidence proceeding, the Commission could now say that there is no need to be concerned about the possibility that spent fuel may need to be stored at onsite or offsite storage facilities at the expiration of the license (including a renewed license) until such time as a repository is available because we have reasonable assurance that spent fuel can be so stored for long periods of time, safely and without significant environmental impact. Such a finding would be made on the basis of the Commission's accumulated experience of the safety of long-term spent fuel storage with no significant environmental impact (see Finding 4)

[14] Based on the inventory of SNF in nuclear power plant pools and interim storage facilities, the amount of spent fuel is anticipated to exceed the 70,000 MTHM disposal limit in the NWPA by 2010. *See* Institute of Nuclear Material Management Seminar XXV, January 16, 2008, paper by Bob Quinn of Energy Solutions, *Industry Perspective on the GNEP—Yucca Mountain Relationship.* Therefore, a new repository program would need to remove this limit or provide for more than one repository.

[15] Six of these reactor operating licenses have already been renewed (Dresden 2, Ginna, Nine Mile Point 1, Robinson 2, Point Beach 1, and Monticello). Forty-two other reactor operating licenses have been renewed and the renewed licenses will expire after 2030.

and its accumulated experience of the safe management of spent fuel storage during and after the expiration of the reactor operating license (see Finding 3).

The Commission seeks comment on this alternative revision of Finding 2 and whether additional information is needed for or accompanying changes should be made to its other Findings on the long term storage of spent fuel if such a revision of Finding 2 were to be adopted.

III. Finding 3: The Commission Finds Reasonable Assurance That HLW and Spent Fuel Will Be Managed in a Safe Manner Until Sufficient Repository Capacity Is Available To Assure the Safe Disposal of All HLW and Spent Fuel

A. Bases for Finding 3

The Commission reached this finding in 1984, and reaffirmed it in 1990. The focus of this finding is on whether reactor licensees can be expected to safely store their spent fuel in the period between the cessation of reactor operations and the availability of repository capacity for their fuel. The Commission placed its main reliance that the spent fuel would be managed safely on the fact that, under either a possession-only Part 50 license or a Part 72 license, the utility would remain under NRC's regulatory control and inspections and oversight of storage facilities would continue (49 FR 34679–34680; August 31, 1984; 55 FR 38508; September 18, 1990). In 1990, when extended storage at the reactor site seemed more probable, the Commission pointed out that NRC's regulations provided for license renewals of Part 72 licenses and that NRC was considering issuance of a general Part 72 license under which spent fuel could be stored in NRC-certified casks,[16] (55 FR 38508; September 18, 1990). The Commission reasoned that these regulations would provide further mechanisms for NRC supervision of spent fuel management by licensees. The Commission was not concerned about then-looming contractual disputes between DOE and the utilities regarding DOE's obligation to begin removing spent fuel from reactor sites in 1998 because NRC licensees cannot abandon spent fuel in their possession and would remain responsible for it (55 FR 38508; September 18, 1990).

The Commission also considered the unusual case where a utility was unable to manage its spent fuel. The NWPA had provided an Interim Storage Program (Subtitle B) which enabled a utility to enter into a contract with DOE for temporary storage of its fuel but, by 1990 (the expiration of the program), no utility had sought to take advantage of it (55 FR 38508; September 18, 1990). In a case where a utility became insolvent, NRC believed that the cognizant state public utility commission would be likely to require an orderly transfer to another entity which could be accomplished if the new entity met NRC's regulations (49 FR 34680; August 31, 1984). Further, the Commission expressed the view that, while the possibility of a need for Federal action to take over stored spent fuel from a defunct utility or from a utility that lacked technical competence to assure safe storage was remote, the authority for this type of action exists in sections 186c and 188 of the Atomic Energy Act. *Id.*

B. Evaluation of Finding 3

As explained previously, the focus of Finding 3 is on whether reactor licensees can be expected to safely store their spent fuel in the period between the cessation of reactor operations and the availability of repository capacity for their fuel. In this regard, the NRC is successfully regulating four decommissioned reactor sites that continue to hold Part 50 licenses and consist only of an ISFSI under the Part 72 general license provisions.[17] In addition, the NRC staff has discussed plans to build and operate ISFSIs under the Part 72 general license provisions with the licensees at the La Crosse and Zion plants, which are currently undergoing decommissioning. The NRC is also successfully regulating ISFSIs at two fully decommissioned reactor sites (Trojan and Ft. St. Vrain) under specific Part 72 licenses.[18]

The NRC monitors the performance of ISFSIs at decommissioned reactor sites by conducting periodic inspections that are the same as the inspections performed for ISFSIs at operating reactor sites. When conducting inspections at these ISFSIs, NRC inspectors follow the guidance in NRC Inspection Manual Chapter 2690, ''Inspection Program for Dry Storage of Spent Reactor Fuel at Independent Spent Fuel Storage Installations and for Part 71 Transportation Packages.'' At all six decommissioned reactor sites mentioned previously, all spent fuel on site has been successfully loaded into the ISFSI, so only those inspection procedures applicable to the existing storage configurations are conducted. Also, any generally licensed ISFSI where decommissioning and final survey activities related to reactor operations have been completed is treated as an ''away from reactor'' (AFR) ISFSI for inspection purposes. Therefore, those programs relied upon under the 10 CFR Part 50 license for operation of the generally licensed ISFSI are also subject to inspection.

The NRC has not encountered any management problems associated with the ISFSIs at these six decommissioned reactor sites. Further, NRC's inspection findings do not indicate unique management problems at any currently operating ISFSI. Generally, the types of issues identified through NRC inspections of ISFSIs are similar to issues identified for Part 50 licensees. Most issues are identified early in the operational phase of the dry cask storage process, during loading preparations and actual spent fuel loading activities. Once a loaded storage cask is placed on the storage pad, relatively few inspection issues are identified due to the passive nature of these facilities.

Further, NRC's regulations require that every nuclear power reactor operating license issued under 10 CFR part 50, and every COL issued under 10 CFR part 52 must contain a condition requiring licensees to submit written notification to the Commission of the licensees' plan for managing irradiated fuel between cessation of reactor operation and the time the DOE takes title to and possession of the irradiated fuel for ultimate disposal in a repository. The submittal, required by 10 CFR 50.54(bb), must include information on how the licensee intends to provide funding for the management of its irradiated fuel. Specifically, 10 CFR 50.54(bb) requires the licensee to:

> [W]ithin 2 years following permanent cessation of operation of the reactor or 5 years before expiration of the reactor operating license, whichever occurs first, submit written notification to the Commission for its review and preliminary approval of the program by which the licensee intends to manage and provide funding for the management of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal * * * Final Commission review will be undertaken as part of any proceeding for continued licensing under part 50 or 72 of this chapter. The licensee must demonstrate to NRC that the elected actions will be consistent with NRC requirements for licensed possession of

[16] Part 72 was, in fact, amended to provide for storage of spent fuel in NRC-certified casks pursuant to a general license (55 FR 29191; July 18, 1990).

[17] These reactor sites include Maine Yankee, Yankee Rowe, Connecticut Yankee (also known as Haddam Neck), and Big Rock Point.

[18] There are several additional sites with specific Part 72 ISFSI licenses that are in the process of decommissioning (*e.g.*, Humbolt Bay, Rancho Seco).

irradiated nuclear fuel and that the actions will be implemented on a timely basis. Where implementation of such actions requires NRC authorizations, the licensee shall verify in the notification that submittals for such actions have been or will be made to NRC and shall identify them. A copy of the notification shall be retained by the licensee as a record until expiration of the reactor operating license. The licensee shall notify the NRC of any significant changes in the proposed waste management program as described in the initial notification.

While the interim storage program under Subtitle B of the NWPA expired in 1990, in the past arrangements have been made with DOE to take possession of spent fuel in urgent or unusual circumstances, as was done for the Three Mile Island Unit 2 fuel debris. 10 CFR 50.54(bb) (2008).

To date, the NRC has also renewed three specific Part 72 ISFSI licenses. These renewals include the Part 72 specific licenses for the General Electric Morris Operation (the only wet, or pool-type ISFSI), as well as the Surry and H.B. Robinson ISFSIs. The NRC staff is also currently reviewing an application for renewal of the specific ISFSI license for the Oconee plant (ML081280084) and anticipates a renewal application for the Fort St. Vrain ISFSI sometime in 2009. Specific licenses for six additional ISFSIs will expire between 2012 and 2020. It is expected that license renewal will be requested by these licensees, unless a permanent repository or some other interim storage option is made available. Although the NRC staff's experience with renewal of ISFSI licenses is limited to these three cases, it is noteworthy that both the Surry and H.B. Robinson ISFSI licenses were renewed for a period of 40-years, instead of the 20-year renewal period currently provided for under Part 72. The Commission authorized the staff to grant exemptions to allow the 40-year renewal period after the staff reviewed the applicants' evaluations of aging effects on the structures, systems, and components important to safety. The Commission determined that the evaluations, supplemented by the licensees' aging management programs, provided reasonable assurance of continued safe storage of spent fuel in these ISFSIs. *See* SECY–04–0175, ''Options for Addressing the Surry Independent Spent Fuel Storage Installation License-Renewal Period Exemption Request,'' September 28, 2004 (ML041830697).

With regard to generally licensed ISFSIs, the NRC staff is currently working on a proposed rulemaking to clarify the processes for the renewal of ISFSIs operated under the general license provisions of 10 CFR part 72, and for renewal of the Certificates of Compliance for dry cask storage systems. *See License and Certificate of Compliance Terms* (73 FR 45173; August 4, 2008). There are currently nine sites operating generally licensed ISFSIs that will reach the prescribed 20 year limit on storage between 2013 and 2020.

The Commission concludes that the events that have occurred since the last formal review of the Waste Confidence Decision in 1990 provide support for a continued finding of reasonable assurance that HLW and spent fuel will be managed in a safe manner until sufficient repository capacity is available. Specifically, the NRC has continued its regulatory control and oversight of spent fuel storage at both operating and decommissioned reactor sites, through both specific and general Part 72 licenses. With regard to general Part 72 licenses, the NRC has successfully implemented a general licensing and cask-certification program, as envisioned by the Commission in 1990. There are currently 15 certified spent fuel storage cask designs. 10 CFR 72.214 (2008). In addition, the Commission's reliance on the license renewal process in its 1990 review has proven well placed, with two specific Part 72 ISFSI licenses having been successfully renewed for an extended 40-year renewal period, and a third having been renewed for a period of 20 years. Further, while DOE did not meet its contractual obligation to begin removing spent fuel from reactor sites in 1998, NRC licensees have continued to meet their obligation to safely store spent fuel in accordance with the requirements of 10 CFR Parts 50 and 72.[19]

On the basis of the information described previously, the Commission proposes to reaffirm Finding 3.

IV. Finding 4 (1990): 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 (Which May Include The Term of a Revised or Renewed License) of That Reactor at Its Spent Fuel Storage Basin, or at Either Onsite or Offsite Independent Spent Fuel Storage Installations

A. Bases for Finding 4

The focus of this finding is on the safety and environmental effects of long-term storage of spent fuel. In 1984, the Commission found that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of reactor operating licenses (49 FR 34660; August 31, 1984). In 1990, the Commission determined that if the reactor operating license were renewed for 30 years,[20] storage would be safe and without environmental significance for at least 30 years beyond the term of licensed operation for a total of at least 100 years (55 FR 38513; September 18, 1990). The Commission looked at four broad issues in making this finding: (1) The long-term integrity of spent fuel under water pool storage conditions; (2) the structure and component safety for extended facility operation for storage of spent fuel in water pools; (3) the safety of dry storage; and (d) the potential risks of accidents and acts of sabotage at spent fuel storage facilities (49 FR 34681; August 31, 1984; 55 FR 38509; September 18, 1990).

With respect to the safety of water pool storage, the Commission found in 1984 that research and experience in the United States and Canada and other countries confirmed that long-term storage could be safely undertaken, *e.g.*, that the cladding which encases spent fuel is highly resistant to failure (49 FR 34681–34682; August 31, 1984). In 1990, the Commission determined that experience with water storage of

[19] Section 302 of NWPA authorizes the Secretary of Energy to enter into contracts with utilities generating HLW and SNF under which the utilities are to pay statutorily imposed fees into the NWF in return for which the Secretary, ''beginning not later than January 31, 1998, will dispose of the [HLW] or [SNF] involved * * *'' 42 U.S.C. 10222(a)(5)(B). The NWPA also prohibits NRC from issuing or renewing a reactor operating license unless the prospective licensee has entered into a contract with DOE or is engaged in good-faith negotiations for such a contract. 42 U.S.C. 10222(b)(1). When it became evident that a repository would not be available in 1998, DOE took the position that it did not have an unconditional obligation to accept the HLW or SNF in the absence of a repository. *See Final Interpretation of Nuclear Waste Acceptance Issues*, (60 FR 21793; April 28, 1995). The U.S. Court of Appeals for the District of Columbia Circuit, however, held that DOE's statutory and contractual obligation to accept the waste no later than January 31, 1998 was unconditional. *Indiana Michigan Power Co.* v. *DOE*, 88 F.3d 1272 (DCDC Cir. 1996). Subsequently, the utilities have continued to safely manage the storage of SNF in reactor storage pools and in ISFSIs and have received damage awards as determined in lawsuits brought before the U.S. Federal Claims Court, *See, e.g., System Fuels Inc.* v. *U.S.*, 78 Fed. Cl. 769 (October 11, 2007).

NRC has recently become aware that DOE is in the process of developing an amendment to the standard spent fuel contract for new nuclear power plants. This amendment would include a revised commitment for removal of spent fuel from new reactor sites by DOE. *See* discussion of Finding 5, *infra.*

[20] Subsequently, the Commission limited the renewal period for power reactor licenses to 20 years beyond expiration of the operating license or combined license. 10 CFR 54.31 (56 FR 64943, 64964; December, 13, 1991).

spent fuel continued to confirm that pool storage is a benign environment for spent fuel that does not lead to significant degradation of spent fuel integrity and that the water pools in which the assemblies are stored will remain safe for extended periods. Further, degradation mechanisms are well understood and allow time for appropriate remedial action, (55 FR 38510, 38511; September 18, 1990). In sum, wet storage was affirmed as a fully-developed technology with no associated major technical problems, based on both experience and scientific studies.

In 1984, the Commission based its confidence in the safety of dry storage on an understanding of the material degradation processes, derived largely from technical studies, together with the recognition that dry storage systems are simpler and more readily maintained, (49 FR 34683–34684; August 31, 1984). By 1990, NRC and ISFSI operators had gained considerable experience with dry storage. NRC staff safety reviews of topical reports on storage system designs, the licensing and inspection of dry storage at two reactor sites under Part 72, and NRC's promulgation of an amendment to Part 72, incorporating a monitored retrievable storage installation (MRS) (a dry storage facility) into the regulations had confirmed the 1984 conclusions on the safety of dry storage. In fact, under the environmental assessment for the amendment (NUREG–1092), the Commission found confidence in the safety and environmental insignificance of dry storage at an MRS for 70 years following a period of 70 years of storage in spent fuel storage pools (55 FR 38509–38513; September 18, 1990).

The Commission also found that the risks of major accidents at spent fuel storage pools resulting in offsite consequences were remote because of the secure and stable character of the spent fuel in the storage pool environment, and the absence of reactive phenomena—''driving forces''—which might result in dispersal of radioactive material. The Commission noted that storage pools and ISFSIs are designed to safely withstand accidents caused either by natural or man-made phenomena and that human error does not have the capability to create a major radiological hazard to the public due to the absence of high temperature and pressure conditions (49 FR 34684–34685; August 31, 1984). By 1990, the NRC staff had spent several years studying in detail catastrophic loss of reactor spent fuel pool water, possibly resulting in a fuel fire in a dry pool, but concluded that because of the large inherent safety margins in the design and construction of a spent fuel pool no action was justified to further reduce the risk (55 FR 38511; September 18, 1990).

In 1984, the Commission recognized that the intentional sabotage of a storage pool was theoretically possible but found that the consequences would be limited by the realities that, except for some gaseous fission products, the radioactive content of spent fuel is in the form of solid ceramic material encapsulated in high-integrity metal cladding and stored underwater in a reinforced concrete structure (49 FR 34685; August 31, 1984). Under these conditions, the Commission noted that the radioactive content of spent fuel is relatively resistant to dispersal to the environment. Similarly, because of the weight and size of the sealed protective enclosures, dry storage of spent fuel in dry wells, vaults, silos and metal casks is also relatively resistant to sabotage and natural disruptive forces. *Id.* Although the 1990 decision examined several studies of accident risk, no considerations had arisen to affect the Commission's confidence that the possibility of a major accident or sabotage with offsite radiological impacts at a spent fuel storage facility is extremely remote (55 FR 38512; September 18, 1990).

Finally, the Commission noted that the generation and onsite storage of a greater amount of spent fuel as a result of reactor license renewals would not affect the Commission's findings on environmental impact. Finding 4 is not based on a determination of a specific number of reactors and amount of spent fuel generated. Finding 4 evaluates the safety of spent fuel storage and lack of environmental impacts overall, noting that individual license renewal actions would be subject to safety and environmental reviews (55 FR 38512; September 18, 1990).

B. Evaluation of Finding 4

As explained previously, the focus of Finding 4 is on the safety and environmental significance of long-term storage of spent fuel. Specifically, the Commission examined four broad issues in making this finding: (1) The long-term integrity of spent fuel under water pool storage conditions; (2) the structure and component safety for extended facility operation for storage of spent fuel in water pools; (3) the safety of dry storage; and (4) the potential risks of accidents and acts of sabotage at spent fuel storage facilities.

1. Storage in Spent Fuel Pools

Since 1990, the NRC has continued its periodic examination of spent fuel pool storage to assure adequate safety is maintained and that there are no adverse environmental effects of storage of spent fuel in pools. The Office of Nuclear Reactor Regulation (NRR) and the former Office for Analysis and Evaluation of Operational Data (AEOD) independently evaluated the safety of spent fuel pool storage, and the results of these evaluations were documented in a memo to the Commission dated July 26, 1996, entitled ''Resolution of Spent Fuel Storage Pool Action Plan Issues,'' (ML003706364) and a separate memo to the Commission dated October 3, 1996), entitled, ''Assessment of Spent Fuel Pool Cooling,'' (ML003706381) (later published as NUREG–1275, Vol. 12, ''Operating Experience Feedback Report: Assessment of Spent Fuel Cooling,'' February 1997), respectively. As a result of these studies, potential follow-up activities were identified. The NRR staff described NRC follow-up activities and associated industry actions in a memo to the Commission dated September 30, 1997, entitled ''Followup Activities on the Spent Fuel Pool Action Plan,'' (ML003706412). These evaluations became part of the investigation of Generic Safety Issue 173, ''Spent Fuel Pool Storage Safety,'' which found that the relative risk posed by loss of spent fuel cooling is low when compared with the risk of events not involving the SFP.

The safety and environmental effects of spent fuel pool storage were also addressed in conjunction with regulatory assessments on permanently shutdown nuclear plants and decommissioning nuclear power plants. NUREG/CR–6451, ''A Safety and Regulatory Assessment of Generic BWR and PWR Permanently Shutdown Nuclear Power Plants,'' (August 1997) addressed the appropriateness of regulations (*e.g.*, requirements for emergency planning and insurance) associated with spent fuel pool storage. The study identified a number of regulations that were pertinent only to an operating reactor and not to spent fuel storage. Those regulations were not needed to ensure the safe maintenance of a permanently shutdown plant. This study also provided what are now known to be conservative bounding estimates of fuel coolability, and provided a number of conservative bounding estimates of offsite consequences for the most severe accidents that involve draining of the spent fuel pool.

More recently, the NRC issued NUREG–1738, ''Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants,'' (February 2001). This study

provided the results of the NRC staff's latest evaluation of the potential accident risk in a spent fuel pool at decommissioning plants. The report contained a discussion of fuel coolability for various types of accidents and included potential offsite consequences based on assumed radiation releases. The study demonstrated that using conservative and bounding assumptions regarding the postulated accidents, the predicted risk estimates were below that associated with reactor accidents and well below the Commission's safety goal. There was even some concern within the NRC that the level of conservatism in the analysis accompanying NUREG–1738 overstated the likelihood and severity of the more extreme spent fuel pool accidents. These concerns have proven valid, as subsequent studies (described in the following paragraph) have conclusively and consistently shown that the safety margins are much larger than indicated by previous studies, such as NUREG–1738. *See The Attorney General of Commonwealth of Massachusetts, The Attorney General of California; Denial of Petitions for Rulemaking* (73 FR 46204; August 8, 2008).

Following the terrorist attacks of September 11, 2001, the NRC undertook a complete reexamination of spent fuel pool safety and security issues. This reexamination included a significantly improved methodology, based on detailed state-of-the-art analytical modeling, for assessing the response of spent fuel assemblies during security events including those which might result in draining of the spent fuel pool. This more detailed and realistic analytical modeling was also supported by extensive testing of zirconium oxidation kinetics in an air environment and full scale coolability and ''zirc fire'' testing of spent fuel assemblies. This extensive effort resulted in both the confirmation of the conservatism of past analyses and improved, more realistic analyses of fuel coolability and potential responses during accident or security event conditions. Importantly, the new more detailed and realistic modeling led to the development of improvements in spent fuel safety, which were required to be implemented at spent fuel pools by the Commission for all operating reactor sites. *See id.*

In 2003, the U.S. Congress asked the National Academies to provide independent scientific and technical advice on the safety and security of commercial SNF storage including the potential safety and security risks of SNF presently stored in cooling pools and dry casks at commercial nuclear reactor sites. A classified report was issued by the National Academy of Sciences (NAS) in July 2004, and an unclassified summary for public distribution was issued in 2005. As part of the information gathering for the study, the NRC and Sandia National Laboratories briefed the NAS authoring committee on the ongoing work to reassess spent fuel pool safety and security issues. The NAS report contains findings and recommendations for reducing the risk of events involving spent fuel pools as well as dry casks. The NRC provided its response to the NAS in a letter to Senator Pete V. Domenici from NRC Chairman Nils J. Diaz, dated March 14, 2005 (ML050280428). In essence, the NRC concluded, as a result of its own study and subsequent regulatory actions, that it had adopted the important recommendations of the NAS report relevant to spent fuel pools. As a result of the improvements to spent fuel pool safety and security, together with the inherent safety and robustness of spent fuel pool designs, the NRC concluded that the risk associated with security events at spent fuel pools is acceptably low. Because those safety improvements to spent fuel pool storage are applicable to non-security events (randomly initiated accidents), accident risk will also have been further reduced.

While the Commission continues to have reasonable assurance that storage in spent fuel pools provides adequate protection of public health and safety and the common defense and security, and will not result in significant impacts on the environment, NRC acknowledges several incidents of groundwater contamination originating from leakage in reactor spent fuel pools and associated structures. In 1990, the Commission specifically acknowledged two incidents where radioactive water leaked from spent fuel pools, one case resulting in contamination outside of the owner controlled area. (*See* 55 FR. 38511; September 18, 1990). The Commission addressed these events stating, ''[t]he occurrence of operational events like these have been addressed by NRC staff at the plants listed. The staff has taken inspection and enforcement actions to reduce the potential for such operational occurrences in the future.'' *Id.*

On March 10, 2006, the Liquid Radioactive Release Lessons Learned Task Force was established by the NRC Executive Director for Operations in response to incidents at several plants involving unplanned, unmonitored releases of radioactive liquids into the environment. Liquid Radioactive Release Lessons Learned Task Force Final Report, September 1, 2006 (Task Force Report) (ML062650312). One of the incidents that prompted formation of the Task Force involved leakage from the Unit 1 and 2 spent fuel pools at Indian Point.[21] Task Force Report, at 1, 5–6, 11. The Task Force reviewed historical data on inadvertent releases of radioactive liquids, including four additional incidents involving leakage from spent fuel pools (Seabrook, Salem, Watts Bar, and Palo Verde). As a result of its review, the Task Force concluded that ''[b]ased on bounding dose calculations and/or actual measurements, the near-term public health impacts have been negligible for the events at NRC-licensed operating power facilities discussed in this report.'' Task Force Report, at 15. While concluding that near-term public health impacts were negligible, the Task Force made 26 specific recommendations for improvements to NRC's regulatory programs with regard to unplanned or unmonitored releases of radioactive liquids from nuclear power reactors.

The NRC staff has addressed, or is in the process of addressing, the Task Force recommendations. *See* ''Liquid Release Task Force Recommendations Implementation Status as of February 26, 2008'' (ML073230982) (Implementation Status). Actions taken in response to Task Force recommendations have included revisions to several guidance documents, development of draft regulatory guidance on implementation of the requirements of 10 CFR 20.1406 (*i.e.* DG–4012),[22] revisions to Inspection Procedure 71122.01, and an evaluation of whether further action was required to enhance the performance of SFP tell-tale drains.[23] For example, Regulatory

[21] The NRC staff recently completed an inspection at Indian Point Units 1 and 2. NRC Inspection Report Nos. 05000003/2007010 and 05000247/2007010, May 13, 2008 (ML0813404250). The purpose of the inspection was to assess Entergy's site groundwater characterization conclusions and the radiological significance of Entergy's discovery of a spent fuel pool leakage at Units 1 and 2. The NRC staff concluded that Entergy's response to the spent fuel pool leakage was reasonable and technically sound. The NRC staff stated that ''[t]he existence of on-site groundwater contamination, as well as the circumstances surrounding the causes of leakage and previous opportunities for identification and intervention, have been reviewed in detail. Our inspection determined that public health and safety has not been, nor is likely to be, adversely affected, and the dose consequence to the public that can be attributed to current on-site conditions associated with groundwater contamination is negligible.'' *Id.*

[22] DG–4012 was formally issued as Regulatory Guide 4.21, ''Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning'' in June 2008.

[23] In addition to the NRC's efforts, the nuclear industry collectively responded to these incidents

Continued

Guide 4.1 is being revised to provide guidance to industry for detecting, evaluating, and monitoring releases from operating facilities via unmonitored pathways; to ensure consistency with current industry standards and commercially available radiation detection methodology; to clarify when a licensee's radiological effluent and environmental monitoring programs should be expanded based on data or environmental conditions; and to ensure that leaks and spills will be detected before radionuclides migrate offsite via an unmonitored pathway. Also, Regulatory Guide 1.21 is being revised to provide a definition of ''significant contamination'' that should be documented in a licensee's decommissioning records under to 10 CFR 50.75(g); to clarify how to report summaries of spills and leaks in a licensee's Annual Radioactive Effluent Release Report; to provide guidance on remediation of onsite contamination; and to upgrade the capability and scope of the in-plant radiation monitoring system to include additional monitoring locations and the capability to detect lower risk radionuclides. Further, Inspection Procedure 71122.01 has been revised to provide for review of onsite contamination events, including events involving groundwater; evaluation of effluent pathways so that new pathways are identified and placed in the licensee's Offsite Dose Calculation Manual, as applicable; and inclusion of limited, defined documentation of significant radioactive releases to the environment in inspection reports for those cases where such events would not normally be documented under current inspection guidance. *See* Implementation Status (ML073230982).

In addition, on January 22, 2008; 73 FR 3812, the NRC published a proposed rule that would, in part, amend 10 CFR part 20 to clarify existing requirements by explicitly requiring licensees to conduct their operations to minimize the introduction of residual radioactivity into the site, including subsurface soil and groundwater. This proposed rule also would include a requirement that licensees perform surveys to evaluate the concentrations and quantities of residual radioactivity and the potential radiological hazards of residual radioactivity detected. *Id.* While unmonitored, unplanned releases continue to require the NRC's and licensees' attention, the NRC staff is confident that this issue will be adequately addressed through continued regulatory oversight of operating and new nuclear reactors and enhanced through the NRC's continued implementation of the Task Force recommendations. Therefore, the NRC staff continues to have assurance that no significant environmental impacts or safety concerns will result from extended storage in spent fuel pools.

2. Storage in Dry Casks

With regard to dry cask storage, studies of the accident risk of dry storage since 1990 have focused on specific dry cask storage systems located at either a generic Pressurized Water Reactor (PWR) site or a specific Boiling Water Reactor (BWR) site. In 2004, the Electric Power Research Institute (EPRI) performed a Probabilistic Risk Assessment (PRA) of a bolted dry spent fuel storage cask at a generic PWR site. K. Canavan, ''Probabilistic Risk Assessment (PRA) of Bolted Storage Casks Updated Quantification and Analysis Report,'' Electric Power Research Institute, Palo Alto, California; EPRI Doc. No. 1009691, December 2004. In 2007, the NRC published a pilot PRA methodology that assessed the risk to the public and identified the dominant contributors to risk associated with a welded canister dry spent fuel storage system at a specific BWR site. NUREG–1864, ''A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant,'' March 2007. Both studies calculated the annual individual radiological risk and consequences associated with a single cask lifecycle where the lifecycle is divided into three phases: loading, onsite transfer, and onsite storage. The results of the EPRI study showed that risk is extremely low with no calculated early fatalities, a first year risk of latent cancer fatality of 5.6E–13 per cask, and subsequent year cancer risk of 1.7E–13 per cask. The NRC study also showed that risk is extremely low with no prompt fatalities expected, a first year risk of latent cancer fatality of 1.8E–12 per cask and subsequent year cancer risk of 3.2E–14 per cask. The major contributors to the low risk associated with dry cask storage are that they are passive systems, relying on natural air circulation for cooling, and are inherently robust massive structures that are highly damage resistant.

NRC and licensee experience to date with ISFSIs and with certification of casks has indicated that interim storage of spent fuel at reactor sites can be safely and effectively conducted using passive dry storage technology. There have not been any safety problems during dry storage. The problems that have been encountered primarily occur during cask preparation activities, after initial loading of spent fuel, but before placement on the storage pad. One issue involved the unanticipated collection and ignition of combustible gas during cask welding activities. The NRC issued generic communications in 1996 addressing the problem and providing direction for preventing its recurrence. NRC Bulletin 96–04, ''Chemical, Galvanic, or Other Reactions in Spent Fuel Storage and Transportation Casks,'' and NRC Information Notice 96–34: ''Hydrogen Gas Ignition During Closure Welding of a VSC–24 Multi-Assembly Sealed Basket.'' NRC inspection and review guidance was also revised to ensure that appropriate measures are in place to preclude these events. *See* NRC Inspection Manual, Inspection Procedure 60854 Item 60854–02 and 02.03.a.6 and SFPO Interim Staff Guidance No. 15, dated January 10, 2001.

In addition, issuance of Materials License No. SNM–2513 for the Private Fuel Storage, LLC (PFS) facility has confirmed the feasibility of licensing an AFR ISFSI under 10 CFR Part 72. While there are several issues that would have to be resolved before the PFS AFR ISFSI could be built and operated,[24] the extensive review of safety and environmental issues associated with licensing the PFS facility provides additional confidence that spent fuel may be safely stored at an AFR ISFSI for long periods, after storage at a reactor site. The PFS facility was licensed for a

of unplanned, unmonitored releases of radioactive liquids through the Industry Initiative on Groundwater Protection (Industry Initiative). The Industry Initiative has resulted in publication of voluntary industry guidance on the implementation of groundwater protection programs at nuclear power plants. *See* ''Industry Ground Water Protection Initiative-Final Guidance Document,'' NEI–07–07, August 2007 (ML072610036); ''Groundwater Protection Guidelines for Nuclear Power Plants: Public Edition, EPRI, Palo Alto, CA: EPRI Doc. No. 1016099, 2008.

[24] For example, on September 7, 2006, two separate Interior Department agencies refused PFS a lease to use tribal lands to store spent fuel and refused to grant a right-of-way to access the land. On July 17, 2007, PFS filed a complaint against the Interior Department challenging its decisions. The case has not yet been resolved. Another issue is associated with the February 2006 (NAS) Report on the transport of SNF in the United States, which concluded that while safe transport is technically viable, ''the societal risks and related institutional challenges may impinge on the successful implementation of large-quantity shipping programs.'' National Research Council 2006, ''Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States,'' Washington, DC: National Academy Press, TIC: 217588, at pp. 214. The NAS committee found that ''malevolent acts against spent fuel and high-level waste shipment are a major technical and societal concern,'' and recommended that ''an independent examination of security of spent fuel and high-level waste transportation be carried out prior to the commencement of large-quantity shipments to a federal repository or to interim storage.'' *Id.*

period of 20 years with the potential for license renewal.

In addition, as noted in its 1990 Waste Confidence Decision, the Commission has confidence in the safety and environmental insignificance of dry storage at an MRS for 70 years following a period of 70 years of storage in spent fuel storage pools (55 FR 38509–38513; September 18, 1990). Specifically, the Commission stated:

> Under the environmental assessment for the MRS rule [NUREG–1092], 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.

Further, a commenter on the 1990 Waste Confidence Decision asserted that there was reasonable assurance that spent fuel could be stored safely and without significant environmental risk in dry casks at reactor sites for up to 100 years. The Commission responded (55 FR 38482; September 18, 1990):

> The Commission does not dispute a conclusion that dry spent fuel storage is safe and environmentally acceptable for a period of 100 years. Evidence supports safe storage for this period. A European study published in 1988 states, ''in conclusion, present-day technology allows wet or dry storage over very long periods, and up to 100 years without undue danger to workers and population (See Fettel, W., Kaspar, G., and Guntehr, H., ''Long-Term Storage of Spent Fuel from Light-Water Reactors'' (EUR 11866 EN), Executive Summary, p.v., 1988).
>
> Although spent fuel can probably be safely stored without significant environmental impact for longer periods, the Commission does not find it necessary to make a specific conclusion regarding dry cask storage in this proceeding, as suggested by the commenter, in part because the Commission's Proposed Fourth Finding states that the period of safe storage is ''at least'' 30 years after expiration of a reactor's operating license. The Commission supports timely disposal of spent fuel and high-level waste in a geologic repository, and by this decision does not intend to support storage of spent fuel for an indefinitely long period.

The Commission also explained the nature of its finding that spent fuel could be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation, stating (55 FR 38509; September 18, 1990):

> [I]n using the words ''at least'' in its revised Finding Four, the Commission is not suggesting 30 years beyond the licensed life for operation * * * represents any technical limitation for safe and environmentally benign storage. Degradation rates of spent fuel in storage, for example, 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.

As explained previously in this document under the discussion of Finding 3, the NRC has renewed two specific ISFSI licenses for an extended 40-year period under exemptions granted from 10 CFR part 72, which provides for 20-year renewals. In addition, NRC is considering a rulemaking which would provide a 40-year license term for an ISFSI with the possibility of renewal. *See License and Certificate of Compliance Terms,* 73 FR 45173; August 4, 2008. Continued suitability of materials is a prime consideration for ISFSI license renewals. As discussed under Finding 3 in this document, the applicants' evaluation of aging effects on the structures, systems and components important to safety, supplemented by the licensees' aging management programs, provided reasonable assurance of continued safe storage of spent fuel in these ISFSIs. Thus, these cases reaffirm the Commission's confidence in the safety of interim dry storage for an extended period. While these license renewal cases only address storage for a period of up to 60 years (20-year initial license, plus 40-year renewal), studies performed to date indicate no major issues with dry storage for up to 100 years. *See, e.g.*, NUREG/CR–6831, ''Examination of Spent PWR Fuel rods after 15 Years in Dry Storage,'' (September 2003); J. Kessler, ''Technical Bases for Extended Dry Storage of Spent Nuclear Fuel,'' Electric Power Research Institute, Palo Alto, California; EPRI Doc. No. 1003416, December 2002. (55 FR 38509; September 18, 1990).

3. Terrorism and Spent Fuel Management

The NRC has, since the 1970s, regarded spent fuel in storage as a potential terrorist target and provided for appropriate security measures. Before the tragic events of September 11, 2001, spent fuel was well protected by physical barriers, armed guards, intrusion detection systems, area surveillance systems, access controls, and access authorization requirements for persons working inside nuclear power plants and spent fuel storage facilities. Since September 11, 2001, the NRC has significantly modified its requirements, and licensees have significantly increased their resources to further enhance and improve security at spent fuel storage facilities and nuclear power plants. *See* Letter to Senator Pete V. Domenici from NRC Chairman Nils J. Diaz, dated March 14, 2005 (ML050280428) (Diaz Letter), at 20.

Consistent with the approach taken at other categories of nuclear facilities, the NRC responded to the terrorist attacks of September 11, 2001 by promptly developing and requiring security enhancements for spent fuel storage both in spent fuel pools and dry casks. In February 2002, the NRC required power reactor licensees to enhance security and improve their capabilities to respond to terrorist attack. The NRC's orders included requirements for spent fuel pool cooling to deal with the consequences of potential terrorist attacks. These enhancements to security included increased security patrols, augmented security forces, additional security posts, increased vehicle standoff distances, and improved coordination with law enforcement and intelligence communities, as well as strengthened safety-related mitigation procedures and strategies. The February 2002 orders required licensees to develop specific guidance and strategies to maintain or restore spent fuel pool cooling capabilities using existing or readily available resources (equipment and personnel) that can be effectively implemented under the circumstances associated with the loss of large areas of the plant due to large fires and explosions. The NRC issued additional orders on security, including security for spent fuel storage in January and April of 2003. The NRC subsequently inspected each facility to verify the licensee's implementation, evaluated inspection findings and, as necessary, required actions to address any noted deficiencies. The NRC's inspection activities in this area are ongoing. In 2004, the NRC reviewed and approved revised security plans submitted by licensees to reflect the implementation of new security requirements. The enhanced security at licensee facilities is routinely inspected using a revised baseline inspection program, and power reactor licensees' capabilities (including spent fuel pools) are tested in periodic (every 3 years) force-on-force exercises. Diaz Letter, at iii, 7, 9.

In 2002, the NRC required power reactors in decommissioning, wet ISFSIs and dry storage ISFSIs to enhance security and improve their capabilities to respond to, and mitigate the consequences of, a terrorist attack. In the same year, the NRC required licensees transporting more than a specified amount of spent fuel to

enhance security during transport. Diaz Letter, at 7, 8.

In 2002, the NRC also initiated a classified program on the capability of nuclear facilities to withstand a terrorist attack. The early focus of the program was on power reactors, including spent fuel pools, and on dry cask storage and transportation. As the results of that classified program became available, NRC provided licensees additional guidance on the Commission's expectations regarding the implementation of the orders on the spent fuel mitigation measures. Diaz Letter, at iv.

More recently, on October 26, 2006; 71 FR 62664, the NRC issued a proposed rule to improve security measures at nuclear power reactors. The Commission is currently considering a draft final rule. In addition, in 2007 the NRC issued a final rule revising the Design Basis Threat, which also increased the security requirements for power reactors and their spent fuel pools (72 FR 12705; March 19, 2007).

i. Spent Fuel Pools

SFPs are extremely robust structures that are designed to safely contain spent fuel under a variety of normal, off-normal, and hypothetical accident conditions (*e.g.*, loss of electrical power, floods, earthquakes, tornadoes). SFPs are massive structures made of reinforced concrete with walls typically over six feet thick, lined with welded stainless steel plates to form a generally leak-tight barrier, fitted with racks to store the fuel assemblies in a controlled configuration and provided with redundant monitoring, cooling and make-up water systems. Spent fuel stored in SFPs is typically covered by about 25 feet of water that serves as both shielding and an effective protective cover against impacts directly on the stored fuel. Diaz Letter, at 2; *The Attorney General of Commonwealth of Massachusetts, The Attorney General of California; Denial of Petitions for Rulemaking,* 73 FR 46206; August 8, 2008 (*Denial of PRMs*).

The post September 11, 2001 studies noted previously confirm the effectiveness of additional mitigation strategies to maintain spent fuel cooling in the event the pool is drained and its initial water inventory is reduced or lost entirely. Based on this recent information and the implementation of additional strategies following September 11, 2001, the probability, and, accordingly, the risk of an SFP zirconium fire initiation will be less than reported in NUREG–1738 and previous studies. Given the physical robustness of SFPs, the physical security measures, and the SFP mitigation measures, and based upon NRC site evaluations of every SFP in the United States, the NRC has determined that the risk of an SFP zirconium fire, whether caused by an accident or a terrorist attack, is very low. In addition, the NRC has approved license amendments and issued safety evaluations to incorporate mitigation measures into the plant licensing bases of all operating nuclear power plants in the United States. (*See Denial of PRMs,* 73 FR 46207–08; August 8, 2008).

ii. Dry Storage Casks

Dry storage casks are massive canisters, either all metal or a combination of concrete and metal, and are inherently robust (*e.g.*, some casks weigh over 100 tons). Storage casks contain spent fuel in a sealed and chemically-inert environment. Diaz Letter, at 3.

The NRC has evaluated the results of security assessments involving large commercial aircraft attacks, which were performed on four prototypical spent fuel cask designs, and concluded that the likelihood is very low that a radioactive release from a spent fuel storage cask would be significant enough to cause adverse health consequences to nearby members of the public. While differences exist with storage cask designs, the results of the security assessments indicate that any potential radioactive releases were consistently very low.

The NRC also evaluated the results of security assessments involving vehicle bomb and ground assault attacks against these same four cask designs. The NRC concluded that while a potential radiological release was possible, the size and nature of the release did not require the Commission to immediately implement additional security compensatory measures. Accordingly, the NRC staff has recommended, and the Commission has approved, development of risk-informed, performance-based security requirements and associated guidance applicable to all ISFSI licensees (general and specific), which would enhance existing security requirements. This proposed ISFSI security rulemaking would apply to all existing and future licensees. *See* SECY–07–0148, ''Independent Spent Fuel Storage Installation Security Requirements for Radiological Sabotage,'' (August 28, 2007) (ML080250294); Staff Requirements—SECY–07–0148–Independent Spent Fuel Storage Installation Security Requirements for Radiological Sabotage, (December 18, 2007) (ML073530119). In addition, the NRC has noted that distributing spent fuel over many discrete storage casks (*e.g.*, in an ISFSI) limits the total quantity of spent fuel that could potentially be attacked at any one time, due to limits on the number of adversaries and the amount of equipment they can reasonably bring with them. Diaz Letter, at 17, 18, 22.

iii. Conclusion-Security

Today, spent fuel is better protected than ever. The results of security assessments, existing security regulations, and the additional protective and mitigative measures imposed since September 11, 2001, provide high assurance that the spent fuel in both spent fuel pools and in dry storage casks will be adequately protected. The ongoing efforts to update the ISFSI security requirements to address the current threat environment will integrate the additional protective measures imposed since September 11, 2001, into a formalized regulatory framework in a transparent manner that balances public participation against protection of exploitable information.

4. Conclusion

The Commission concludes that the events that have occurred since the last formal review of its Waste Confidence Decision in 1990 provide support for a continued finding of 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. Specifically, NRC finds continued support for this finding in the extensive study of spent fuel pool storage that has occurred since 1990, and the continued regulatory oversight of operating plants, which has been enhanced by the recommendations of the Liquid Release Task Force.

Further, the Commission is proposing to revise Finding 2 to reflect its expectation that repository capacity will be available within 50–60 years of the licensed life for operation of any reactor. Consistent with this, the Commission is proposing to revise Finding 4 to reflect that spent fuel can be safely stored in dry casks for a period of at least 60 years without significant environmental impacts. Specifically, the inherent robustness and passive nature of dry cask storage—coupled with the operating experience and research accumulated to date, the 70 year finding in the Environmental Assessment for the MRS rule, and the renewal of two specific Part 72 licenses for an extended 40 year period (for a total ISFSI

operating life of at least 60 years)—support this finding. Further, this finding is consistent with the Commission's statements in 1990 that it did not dispute that dry spent fuel storage is safe and environmentally acceptable for a period of 100 years (55 FR 38482; September 18, 1990); that spent fuel could probably be safely stored without significant environmental impact for periods longer than 30 years (55 FR 38482; September 18, 1990); and that the 30 year finding did not represent a technical limitation for safe and environmentally benign storage (55 FR 38509; September 18, 1990).

C. 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 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations.

V. 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

A. Bases for Finding 5

The focus of this finding is on the timeliness of the availability of facilities for storage of spent fuel when the fuel can no longer be stored in the reactor's spent fuel storage pool. At the outset of the Waste Confidence proceeding there was uncertainty as to who had the responsibility for providing this storage, with the expectation that the Federal government would provide away-from-reactor facilities for this purpose. However, in 1981 DOE announced its decision to discontinue the AFR program. The Commission found that the industry's response to this change was a general commitment to do whatever was necessary to avoid shutting down reactors. The NWPA provided Federal policy on this issue by defining public and private responsibilities for spent fuel storage and by providing for an MRS program, an interim storage program at a Federal facility for utilities for whom there was no other solution, and a research, development, and demonstration program for dry storage designed to assist utilities in using dry storage methods. These NWPA provisions, together with the availability of ISFSI technology and the fact that the Part 72 regulations and licensing procedures were in place gave the Commission assurance that safe independent onsite or offsite spent fuel storage would be available when needed (49 FR 34686–34687; August 31, 1984).

In 1990, the Commission saw no need to revise this finding. It recognized that the NWPAA had undermined the ability of an MRS to provide for timely storage by linking the MRS to the siting and schedule for a repository (*e.g.*, DOE was not permitted to select an MRS site until it had recommended a site for development as a repository). However, it found that whatever the uncertainty introduced by these NWPAA provisions, it was more than compensated for by operational and planned spent fuel pool expansions and dry storage investments by the utilities themselves. The Commission also considered the fact that it seemed probable that DOE would not meet the 1998 deadline for beginning to remove spent fuel from the utilities. This did not undermine the Commission's confidence that storage capacity would be made available as needed because NRC licensees cannot abrogate their safety responsibilities and would remain responsible for the stored fuel despite any possible contractual disputes with DOE. The Commission noted that DOE's research program had successfully demonstrated the viability of dry storage technology and that the utilities had continued to add dry storage capacity at their sites. Further, the Commission believed that there would be sufficient time for construction and licensing of any additional storage capacity that might be needed due to operating license renewals (55 FR 38513–38514; September 18, 1990).

B. Evaluation of Finding 5

In 1990 the Commission reaffirmed Finding 5 despite significant uncertainties regarding DOE's MRS and repository programs, and the potential for the renewal of reactor operating licenses. Specifically, in reaffirming Finding 5 the Commission stated:

> In summary, the Commission finds no basis to change the Fifth Finding in its Waste Confidence Decision. Changes by the NWPAA, which may 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 * * * 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.'' (55 FR 38514; September 18, 1990).

In reaching this conclusion, the Commission stressed that—regardless of the outcome of possible contractual disputes between DOE and utilities—the utilities possessing spent fuel could not abrogate their safety responsibilities. In addition, the Commission cited to three situations where dry storage had been licensed at specific reactor sites (Surry, H.B. Robinson, and Oconee), and to several additional applications for licenses permitting dry cask storage at reactor sites. *Id.*

1. Operating and Decommissioned Reactors

As in 1990, the NRC staff is not aware of any current operating reactor that has an insurmountable problem with safe storage of SNF. The options successfully being used to increase onsite storage capacity are spent fuel pool re-racking and fuel-pin consolidation, as well as onsite dry cask storage. While there are cases where a licensee's ability to use an onsite dry cask storage option may be limited by State or Public Utility Commission authorities, the NRC is successfully regulating six fully decommissioned reactor sites that contain ISFSIs licensed under either the general or specific license provisions of Part 72. The NRC has not encountered any management problems associated with the ISFSIs at these six decommissioned reactor sites and has discussed plans to build generally licensed ISFSI's with two additional licensees that are in the process of decommissioning.

In addition, since 1990, the NRC has renewed the specific Part 72 ISFSI licenses for both the Surry and H.B. Robinson plants for an extended 40-year period, instead of the 20-year renewal period currently provided for under Part 72. As discussed previously under Finding 3, the Commission authorized the staff to grant exemptions to allow the 40-year renewal period after the staff reviewed the applicants' evaluations of aging effects on the structures, systems, and components important to safety, and determined that the evaluations, supplemented by the licensees' aging management programs, provided reasonable assurance of continued safe storage of spent fuel in these ISFSIs. *See* SECY–04–0175, ''Options for Addressing the Surry Independent Spent Fuel Storage Installation License-Renewal Period Exemption Request,'' September 28, 2004 (ML041830697).

With regard to the uncertainty surrounding the contractual disputes

between DOE and the utilities referenced by the Commission in 1990, the U.S. Court of Appeals for the District of Columbia Circuit has since held that DOE's statutory and contractual obligation to accept the waste no later than January 31, 1998, was unconditional. *Indiana Michigan Power Co.* v. *DOE*, 88 F.3d 1272 (DC Cir. 1996). Subsequently, the utilities have continued to manage spent fuel safely in spent fuel pools and ISFSIs and have received damage awards as determined in lawsuits brought before the U.S. Federal Claims Court, *see, e.g., System Fuels Inc.* v. *U.S.*, 78 Fed. Cl. 769 (October 11, 2007).

In total, there are currently 51 licensed ISFSIs being managed at 47 sites across the country, under either specific or general Part 72 NRC licenses. As explained in the discussion of Finding 3, NRC's inspection findings do not indicate unique management problems at any currently operating ISFSI regulated by the NRC. Generally, the types of issues identified through NRC inspections of ISFSIs are similar to issues identified for Part 50 licensees. Most issues are identified early in the operational phase of the dry cask storage process, during loading preparations and actual spent fuel loading activities. Once an ISFSI is fully loaded with spent fuel, relatively few inspection issues are identified due to the passive nature of these facilities.

Finally, on June 3, 2008, the DOE submitted its license application for the proposed Yucca Mountain HLW repository, and on September 8, 2008, NRC Staff notified DOE that it found the application acceptable for docketing (73 FR 53284; September 15, 2008). While the Commission can express no view on the quality or acceptability of the application in this evaluation of waste confidence, its submittal is evidence of a continued Federal commitment to providing for ultimate disposal of spent fuel.

2. New Reactors

With regard to the status of contracts requiring DOE to take title to and possession of the irradiated fuel generated by utilities, the NRC staff understands that DOE has drafted language for a new amendment to the standard DOE-utility contracts. According to reports in the trade press, the revised contract will require DOE to accept spent fuel from any new nuclear power plants ten years after expiration of the operating license or any extension of the operating license. The utilities have not publicly expressed an opinion on the revised contracts to date. *See* Energy Daily, ED Vol. 36 No. 107, Thursday, June 5, 2008. In addition, before licensing a new reactor the NRC must find that the applicant has entered into a contract with DOE for removal of spent fuel from the reactor site, or receive written affirmation from DOE that the applicant is actively and in good faith negotiating with the DOE for such a contract. NWPA, Sec.302(b). This finding will be documented in the Safety Evaluation Report produced by the NRC staff in response to specific license applications for new reactors.

The near-term design certifications and existing or planned combined license applications do not undermine the Commission's confidence that spent fuel storage will become available when such storage is needed. These facilities will use the same or similar fuel assembly designs as the nuclear power plants currently operating in the United States and the spent fuel will be accommodated using existing or similar transportation and storage containers. As discussed under Finding 1, the NRC is also engaged in preliminary interactions with DOE on ''advanced reactors'' (*e.g.*, gas-cooled or liquid-metal cooled technologies). The fuel and reactor components associated with some of these advanced reactor designs would likely require different storage, transportation and disposal packages than those currently used for spent fuel from light-water reactors. The possible need for further assessment of performance and storage capability for new and different fuels would depend on the number and types of reactors actually licensed and operated. There is currently a high uncertainty regarding the growth of advanced reactors in the U.S. In addition, the need to consider waste disposal as part of the overall research and development activities for advanced reactors is recognized and included in the activities of DOE, designers, and the NRC (see, for example, ''A Technology Roadmap for Generation IV Nuclear Energy Systems,'' issued by the U.S. DOE Nuclear Energy Research Advisory Committee and the Generation IV International Forum, December 2002).

Nonetheless, the addition of new plants will undoubtedly add to the amount of spent fuel requiring disposal. This fact does not affect the Commission's confidence that safe storage options will be available when needed because, as the Commission stated in 1990—utilities have sought to meet storage capacity needs at their respective reactor sites (55 FR 38514; September 18, 1990). Specifically, as discussed under Finding 3, NRC licensees have successfully and safely used onsite storage capacity in spent fuel pools and, more recently, in onsite ISFSIs licensed under 10 CFR part 72. In addition, while construction and operation of an MRS facility by DOE is uncertain, the NRC has promulgated regulations that provide a framework for licensing such a facility. *See* 10 CFR part 72 (53 FR 31651; August 19, 1988). Further, while there are unresolved issues that prevent construction and operation of the PFS facility, the extensive safety and environmental reviews that supported issuance of an NRC license for PFS provide added confidence that licensing of a private AFR facility is technically feasible.

The Commission concludes that the events that have occurred since the last formal review of the Waste Confidence Decision in 1990, provide support for a continued finding of reasonable assurance that safe independent onsite spent fuel storage or offsite spent fuel storage will be made available if such storage capacity is needed. Specifically, since 1990, NRC licensees have continued to develop and successfully use onsite storage capacity in the form of pool and dry cask storage in a safe and environmentally sound fashion. With regard to offsite storage, the Commission licensed the PFS facility after an extensive safety and environmental review process, and a protracted adjudicatory hearing that resulted in over 70 ASLB and Commission decisions. The Commission also has a regulatory framework in place for licensing an MRS facility, should the need arise. In addition, based on discussions with the DOE and recent reports in the trade press, the NRC understands that a new standard contract providing for disposal of spent fuel by DOE is currently being prepared. This, coupled with the recent submission of a license application for the proposed Yucca Mountain repository, provides the NRC with continued confidence in the Federal commitment to providing for the ultimate disposal of spent fuel.

For all the above reasons, the Commission proposes to reaffirm Finding 5.

Dated at Rockville, Maryland, this 29th day of September 2008.

For the Nuclear Regulatory Commission.

Annette Vietti-Cook,

Secretary of the Commission.

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