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The Nuclear Regulatory Commission's Proposed Rulemaking on the Storage and Disposal of Nuclear Waste--The Case for Confidence Concerning Spent Fuel Storage

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THE NUCLEAR REGULATORY COMMISSION'S PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE—THE CASE FOR CONFIDENCE CONCERNING SPENT FUEL STORAGE*

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I. INTRODUCTION

The Nuclear Regulatory Commission's (NRC) notice of proposed rulemaking states that the purpose of the Waste Confidence Proceeding is "to reassess . . . the 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 safely disposed."[1] The preceding article discussed the availability of a permanent respository for the disposal of high-level waste. This Article will address spent fuel storage, the other subject of the proceeding. In particular, the Article will briefly develop the factual and legal background for the Commission's consideration of spent fuel storage and will summarize the pertinent presentations made in the proceeding by the Utility Nuclear Waste Management Group—Edison Electric Institute (UNWMG-EEI)[2] and the Department of Energy (DOE), in-

* For a full discussion of the origin, nature, and purposes of the Waste Confidence Proceeding, see Brown & Bergholz, *Nuclear Waste—The Case for Confidence in Disposal,* 32 S.C.L. REV. 851, 851-56 (1981).

** The authors are members of the firm of Lowenstein, Newman, Reis and Axelrad, which is representing the Utility Nuclear Waste Management Group and Edison Electric Institute as joint participants in the Waste Confidence Proceeding.

1. 44 Fed. Reg. 61,372 (1979).

2. The Utility Nuclear Waste Management Group is composed of thirty-nine electric utilities. Its purpose is to encourage and assist governmental agencies in the development of constructive solutions to radioactive waste management problems. The Edison Electric Institute is the association of investor-owned electric utility companies; it serves as the principal forum in which members exchange information on developments in their business and maintains a liaison between the industry and the federal government.

cluding the presentations concerning the technology for and availability of spent fuel storage and conclusions. The Article will also examine the major questions raised by other participants and the remaining phases of the proceeding.[3]

II. Background

A. *Reasons for Storage of Spent Fuel*

The fuel commonly used in commercial nuclear power reactors in the United States today consists of a number of fuel assemblies made up of individual fuel rods, which are filled with uranium dioxide (UO_2) pellets. Under normal reactor refueling conditions, a fraction of the fuel in the core, roughly twenty-five to thirty-three percent, is removed annually and replaced with new fuel because the uranium in the spent fuel has been depleted and no longer contributes efficiently to the operation of the reactor. Each nuclear power station has an area set aside for the handling and storage of spent fuel in water-filled spent fuel storage pools. Underwater storage provides a transparent medium that shields personnel from radiation and also cools spent fuel.[4]

From the early days of the nuclear power industry in the United States, electric utilities planned to reprocess chemically the spent fuel, to recover the residual quantities of useful fuel materials (uranium and plutonium[5]), which would be recycled

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UNWMG-EEI are joint participants in the Waste Confidence Proceeding.

3. To avoid an unduly lengthy article, the authors will discuss only the most significant questions raised by the participants. For the same reason, there is little reference to the numerous presentations in the proceeding that expressed views consistent with those of UNWMG-EEI or the Department of Energy.

4. Reactors produce energy in the form of heat as a result of the splitting, or "fissioning," of uranium atoms contained in the fuel. Even after the reactor has been shut down, however, the fuel continues to produce radiation and heat, primarily because of the radioactive decay of the fission products it contains. For additional discussion of reactor operation and the fission process itself, see 2 U.S. Nuclear Regulatory Comm'n, Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel, NUREG-0575, A-1 to -10 (1979) [hereinafter cited as NRC Spent Fuel GEIS].

5. The standard reactor fuel contains uranium that is about 3% fissionable uranium-235 and 97% uranium-238. Plutonium is formed in this fuel when uranium-238 captures neutrons, resulting in uranium-239, which then decays and eventually becomes plutonium-239, with a half-life of about 24,000 years. For additional discussion, see 2 U.S. Nuclear Regulatory Comm'n, Final Generic Environmental Statement on the Use of Recyled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors II-

into fresh fuel. The radioactive waste that remained would be disposed. The utilities contemplated storing the spent fuel in on-site storage pools for a period of time to facilitate the radioactive decay of short-lived radioisotopes, and then, periodically, to ship the spent fuel off-site for reprocessing. Typically, there would be space in the on-site reactor spent fuel storage pools for about one and one-third full reactor cores. Assuming a reactor fuel reload cycle of three to four years, the on-site storage pools were designed to hold an average of one year's discharge, with sufficient capacity remaining to accommodate a complete core in the event that an unloading of all the fuel from the reactor became either necessary or desirable. In other words, storage pools were designed to hold the amount of spent fuel discharged during four to five years of routine operation.[6]

As the nuclear power industry developed, Nuclear Fuel Services established the first private plant for the reprocessing of spent fuel at West Valley, New York. This was a small facility, which processed only small quantities of spent fuel. During a lengthy shutdown for alterations and expansion, the company decided to withdraw from the nuclear fuel reprocessing business because of increasingly onerous regulatory requirements.[7]

Utility plans for spent fuel management were undermined in 1977, when President Carter announced a policy of deferring reprocessing indefinitely to reduce the risk of nuclear weapons proliferation.[8] To accommodate this new executive policy, the Nuclear Regulatory Commission (NRC) issued an order, which, among other things, terminated its proceedings on all pending and future applications for licenses to recycle commercial plutonium.[9]

Faced with this dramatic turnabout, utilities were confronted with the question of how to manage the spent fuel that

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2 to II-3 (1976).

6. See 1 NRC SPENT FUEL GEIS, *supra* note 4, at 1-1.

7. *See* letter from R.W. Deuster, President, Nuclear Fuel Services, Inc., to K.R. Chapman, Director, Nuclear Regulatory Comm'n Office of Nuclear Material Safety and Safeguards (Sept. 22, 1976) (on file with *South Carolina Law Review*).

8. 13 WEEKLY COMP. OF PRES. DOC. 502 (Apr. 11, 1977). Commercial reprocessing facilities are already operating in a number of countries (including France, India, and Japan) and are being planned in others. ENVIRONMENT AND NATURAL RESOURCES POLICY DIVISION OF LIBRARY OF CONGRESS CONGRESSIONAL RESEARCH SERVICE, 96th Cong., 2d Sess., NUCLEAR PROLIFERATION FACTBOOK 209-10 (Joint Comm. Print 1980).

9. In re Mixed Oxide Fuel, CLI-78-10, 7 N.R.C. 711 (1978).

necessarily was discharged from operating reactors. Although the utilities remained convinced that, ultimately, national policy would permit the reprocessing of spent fuel,[10] they believed that an alternative solution was the direct disposal of spent fuel despite the loss of the residual quantities of useful energy.[11] Without any immediate prospects for either reprocessing or disposal, the need for supplemental action to meet storage needs became readily apparent because most reactors were designed to hold the equivalent of only one and one-third cores of spent fuel in their on-site storage pools.

B. Legal Background

As noted in the previous article,[12] the NRC Waste Confidence Proceeding is a response to two, somewhat independent developments. The primary impetus was the decision of the United States Court of Appeals for the District of Columbia in *Minnesota v. NRC*,[13] remanding two licensing proceedings.[14]

In 1975, the NRC had announced the preparation of a Generic Environmental Impact Statement on spent fuel management[15] and decided that, in the interim, licensing actions for the expansion of spent fuel pools could continue if five factors were considered.[16] In a separate matter, the NRC was requested to

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10. The Presiding Officer of the Waste Confidence Proceeding has ruled that, as a representative case, only the disposal of high-level nuclear waste, like that contained in spent nuclear fuel taken from commercial power reactors, is to be considered. Proposed Rulemaking on the Storage and Disposal of Nuclear Waste, First Prehearing Conference Order, 9-10 (Feb. 1, 1980) [hereinafter cited as First Prehearing Conference Order]. UNWMG-EEI, however, are firmly convinced that because of the high energy resource value of spent fuel it should be reprocessed for reasons of economy and resource conservation.

11. Current plans are to establish an operational repository, capable of receiving *either* high-level radioactive reprocessing waste or spent fuel, sometime between 1997 and 2006. See Brown & Bergholz, *Nuclear Waste—The Case for Confidence in Disposal*, 32 S.C.L. REV. 851 (1981); 1 U.S. DEP'T OF ENERGY, FINAL ENVIRONMENTAL IMPACT STATEMENT ON THE MANAGEMENT OF COMMERCIALLY GENERATED RADIOACTIVE WASTE 1.1-1.34 (1980).

12. See Brown & Bergholz, *supra* note 11, at 852-53.

13. 602 F.2d 412 (D.C. Cir. 1979).

14. The *Minnesota* case arose directly out of NRC proceedings granting two operators of nuclear power plants amendments to their operating licenses to permit expansion of on-site capacity for the storage of spent nuclear fuel.

15. NRC Spent Fuel GEIS, *supra* note 4.

16. 40 Fed. Reg. 42,801 (1975). The five specific factors are

(1) It is likely that each individual licensing action of this type would have

initiate rulemaking to require findings on the safety of waste disposal in proceedings to license reactors. The NRC had decided that, in individual proceedings, storage of spent fuel beyond the expiration of a reactor operating license did not need to be considered because "accumulating evidence . . . support[ed] the Commission's implicit finding of reasonable assurance that methods of safe permanent disposal of high-level wastes can be available when they are needed."[17]

In rulings consistent with these pronouncements, the NRC Licensing Boards authorized expansion of the Vermont Yankee and Prairie Island nuclear plant fuel pools without considering the availability of ultimate disposal facilities or the possibility that the spent fuel pools might become indefinite repositories for their contents. The NRC Appeal Board, in effect, affirmed these decisions.[18] In remanding the proceedings in *Minnesota v. NRC,* the court neither vacated nor stayed the license amendments.[19] The court did, however, contemplate "consideration on remand of the specific problem isolated by petitioners—determining whether there is reasonable assurance that an off-site storage solution will be available by the years 2007-09,

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a utility that is independent of the utility of other licensing actions of this type;

(2) It is not likely that the taking of any particular licensing action of this type during the time frame under consideration would constitute a commitment of resources that would tend to significantly foreclose the alternatives available with respect to any other individual licensing action of this type;

(3) It is likely that any environmental impacts associated with any individual licensing action of this type would be such that they could adequately be addressed within the context of the individual license application without overlooking any cumulative environmental impacts;

(4) It is likely that any technical issues that may arise in the course of a review of an individual license application can be resolved within that context; and

(5) A deferral or severe restriction on licensing actions of this type would result in substantial harm to the public interest. As indicated, such a restriction or deferral could result in reactor shutdowns as existing spent fuel pools become filled.

Id. at 42,802. The NRC recognized that since the five factors might not "fit the factual circumstances of particular licensing actions, . . . [they] will be applied, weighed and balanced within the context of these statements or appraisals in reaching licensing determinations." *Id.*

17. 42 Fed. Reg. 34,391, 34,393 (1977), *pet. for rev. dismissed sub nom.,* Natural Resources Defense Council, Inc. v. NRC, 582 F.2d 166 (2d Cir. 1978).

18. *See* Vermont Yankee Nuclear Power Corp., ALAB-455, 7 NRC 41, 43-51 (1978).

19. 602 F.2d at 418.

the expiration of the plants' operating licenses, and if not, whether there is reasonable assurance that the fuel can be stored safely at the sites beyond those dates."[20]

The NRC was given great flexibility in reviewing the matters remanded.[21] It could have reopened the individual proceedings,[22] merged the subjects into another, on-going proceeding,[23] or undertaken a new generic proceeding.[24] In choosing the last option, the NRC fashioned the Waste Confidence Proceeding to encompass a broad reassessment of its confidence in the ultimate ability to dispose waste safely.

The second stimulus for the NRC Waste Confidence Proceeding was the NRC's decision, in 1977, denying the petition for rulemaking.[25] Although the Commission had found, at that time, that there was reasonable progress in the field of waste disposal, it expressed an intent to reassess this determination periodically.[26] The proceeding would serve that purpose. Determinations on the ability to store fuel for lengthy periods were required by the remand in *Minnesota*.[27] They are also important in the reassessment of confidence concerning disposal since the period for which spent fuel can be stored is obviously important in determining when the disposal of spent fuel would be needed, if reprocessing never commences.

III. The Waste Confidence Proceeding

A. *The First Phase*

The topic of spent fuel storage has received considerable attention in the proceeding because the Waste Confidence Proceeding was initiated largely in response to *Minnesota v. NRC* and because spent fuel storage is a necessary link in any waste management chain. Of the statements of position filed in the rulemaking, those of the UNWMG-EEI and DOE treated the

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20. *Id.*

21. *Id.* at 419.

22. *Id.*

23. *Id.* at 419 n.10. In particular, the court referred to the NRC's Table S-3 proceeding, which concerned the environmental affects of the entire uranium fuel cycle, including waste management. See *id.* at 417-18.

24. *Id.* at 419.

25. 42 Fed. Reg. 34,391, 34,393 (1977). See note 17 and accompanying text *supra*.

26. 42 Fed. Reg. 34,391, 34,393 (1977).

27. 602 F.2d at 418.

topic of spent fuel storage most extensively.[28]

1. UNWMG-EEI Position.—As noted in the UNWMG-EEI statement, spent fuel usually is stored in water basins, that is, in a spent fuel storage pool.[29] The basic technology is the same whether the pool is part of the reactor facility or an independent installation. Generally, a water basin storage system consists of (1) a water-filled reinforced concrete basin, not unlike a swimming pool, typically lined with stainless steel; (2) a rack or rack-and-basket system for supporting the fuel assemblies within the pool; (3) equipment for handling the spent fuel; (4) a heat exchanger for controlling water temperature; and (5) a clean-up system for maintaining water purity.[30]

The basic components of a water basin storage system employ straightforward, well-understood, and well-developed technologies. Spent fuel has been stored in water basins since 1943 when the first nuclear reactors were built by the federal government. Similarly, the first commercial-scale power reactors,[31] and all commercial light-water reactors since then, have utilized water basins.[32] Water basin storage pools also have been designed and constructed as part of reprocessing facilities.[33]

The UNWMG-EEI statement relies, to a considerable extent, on the reported results of the extended storage of spent fuel in water.[34] Some Zircaloy clad fuel, the type used in almost all light-water reactors, has been in water basin storage since 1959. No degradation has been observed in commercial fuel, nor

28. See UTILITY NUCLEAR WASTE MANAGEMENT GROUP - EDISON ELECTRIC INSTITUTE, STATEMENT OF POSITION ON PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE—THE CAPABILITY FOR THE SAFE INTERIM STORAGE OF SPENT FUEL (Document 4) (July 7, 1980) [hereinafter cited as UNWMG-EEI SPENT FUEL STORAGE DOCUMENT]; U.S. DEP'T OF ENERGY, STATEMENT OF POSITION ON PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE (Apr. 15, 1980) [hereinafter cited as DOE STATEMENT OF POSITION].

29. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 2. Dry storage also has been utilized and may be an alternative. For further discussion, see *id.* at 16-17, 31.

30. *Id.* at 2-3.

31. The first commercial-scale power reactors included Shippingport, which began operation in 1957, and Dresden, Unit 1, which went on line in 1960.

32. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 5 (citing address by A.B. Johnson, Jr., American Nuclear Society—Executive Conference on Spent Fuel Policy in Buford, Georgia (April 2-5, 1978)).

33. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 6.

34. *Id.* at 6-11 and authorities cited therein.

in fuel pellets that had been exposed to pool water as a result of prior fuel assembly damage. Even these have remained inert.[35]

UNWMG-EEI also discussed the durability of spent fuel pool structures. System components, such as the basin structure, building, and radioactive waste treatment system, are derived from standard design methods. None of them are unique, complicated, or exotic. Pool liners and related equipment have produced little evidence of corrosion. Further, if degradation did occur, it could be remedied by repair or replacement. Pipes and pumps can be easily replaced if necessary. And even when a pool liner is damaged, it can be repaired in place; such repairs have been performed in the past.[36]

In summary, spent fuel storage in water-filled basins is a safe, proven technology.[37] It has been examined thoroughly by both the NRC[38] and DOE.[39] It can provide storage for spent fuel for many decades.[40]

The primary location of spent fuel storage has been, and will continue to be, in on-site reactor spent fuel storage pools.[41] The capacity of most pools at reactors that are currently in operation has already been increased, and some reactors are being expanded for a second time. In some pools, there was room to add more racks of the same design as those already installed.[42]

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35. *Id.* at 8 (citing Johnson, *supra* note 32 at 17, 19).

36. UNWMG-EEI Spent Fuel Storage Document, *supra* note 28, at 24-25 (citing Battelle Pacific Northwest Laboratories, Behavior of Spent Nuclear Fuel in Water Pool Storage, BNWL-2256 (UC-70), at 27, 72-74 (A.B. Johnson) (Sept. 1977); 2 NRC Spent Fuel GEIS, *supra* note 4, at B-2).

37. See UNWMG-EEI Spent Fuel Storage Document, *supra* note 28, at 2.

38. See NRC Spent Fuel GEIS, *supra* note 4.

39. See U.S. Dep't of Energy Final Environmental Impact Statement—U.S. Spent Fuel Policy (1980) [hereinafter cited as DOE Spent Fuel EIS].

40. UNWMG-EEI Spent Fuel Storage Document, *supra* note 28, at 2. Similarly, the Commission's statutory Advisory Committee on Reactor Safeguards also has concluded:

> Based on our review of storage of spent fuel for extended periods of time we did not find any important issues that require further attention. We, therefore, conclude that a high degree of confidence is justified that spent fuel can be safely stored until a facility for its safe disposal is available.

Letter from Milton S. Plesset, Chairman, Advisory Committee on Reactor Safeguards, to John F. Ahearne, Chairman, U.S. Nuclear Regulatory Comm'n 4 (Dec. 10, 1980).

41. UNWMG-EEI Spent Fuel Storage Document, *supra* note 28, at 25.

42. In addition to expanding their reactor pools, some utilities could increase their ability to store spent fuel without resorting to independent spent fuel storage pools by transferring fuel from a reactor pool where storage space is limited to another pool where

The most common method to increase capacity, however, is to replace the original racks with racks in which the spent fuel assemblies are stored more closely together. A storage system of this type must assure that the spent fuel remains subcritical by a safe margin, that is, does not result in the type of self-sustaining chain reaction that occurs in a reactor core. The closest spacing, and the greatest storage capacity, is achieved by the use of racks that are constructed with neutron absorbing materials.[43]

An alternative to reracking existing pools to meet expanding storage needs is to utilize separate fuel storage facilities either at the reactor site or away from the reactor locations (AFRs). AFR storage is already available in the water basins constructed in reprocessing facilities. Two of these basins currently are licensed by the NRC to store spent fuel, one at West Valley, New York, and one at Morris, Illinois. A third pool, in Barnwell, South Carolina, is constructed but has not been licensed. All of these facilities appear suitable for expansion beyond their present capacity by reracking.[44]

Another alternative, building a new independent spent fuel pool, either at a reactor site or as an AFR, should not present insurmountable obstacles. From a technical standpoint, the design of such a pool would not differ much from existing pools. Further, specific licensing requirements are included in the NRC's newly issued regulations.[45]

Regarding the cost and availability of these alternatives, the UNWMG-EEI statement noted that the costs of reracking, the method most frequently used by utilities to increase storage ca-

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excess capacity is available. However, the bases upon which the NRC will authorize such transshipment to another pool are unclear in view of a recent decision by an NRC Atomic and Safety Licensing Board, which denied an application for the necessary license amendment. *Duke Power Co.*, (Amendment to Materials License SNM-1773 for Oconee Nuclear Station Spent Fuel Transportation and Storage at McGuire Nuclear Station), LBP-80-____, 12 NRC ____ (October 31, 1980). That decision has been appealed to the Appeal Board of the Commission.

43. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 4-5 (citing NRC SPENT FUEL GEIS, *supra* note 4, at 3-5).

44. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 6, 15. (citing 1 U.S. DEP'T OF ENERGY, STUDY ON SPENT NUCLEAR FUEL STORAGE, DOE/SR-0004 (March, 1980) [hereinafter cited as DOE STORAGE STUDY]. Other possibilities include the removal of fuel rods from assemblies for closer storage within pools and new, dry storage facilities. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 15-17 and authorities cited therein.

45. 45 Fed. Reg. 74,693 (1980) (to be codified in 10 C.F.R. 72).

pacity, are low (0.014 to 0.075 mills per kilowatt-hour).[45.1] Generally, reracking takes less than two years.[46] Because a new independent pool (whether at a reactor or an AFR) entails the construction of a new facility, the time for implementation would be significantly longer than for reracking. Perhaps a total lead time of seven years would be required. The costs of a new facility probably would exceed those of reracking, but would tend to decrease, with increasing size, on a per kilowatt-hour basis. In any event, the costs would still be only a small fraction of total fuel cycle costs.[47] The most logical way for the federal government to provide AFR storage capacity for national needs in the short- to mid-term would be to acquire one or more of the three existing facilities. DOE has already issued a notice of its intent to prepare an environmental impact statement concerning such a proposal.

The UNWMG-EEI submittal also considered spent fuel storage in terms of overall management and cost, including interim storage and ultimate disposal system integration. The individual components of an integrated spent fuel management system are interactive, the needed availability and capacity of one component affects the availability and capacity of others. Apparently, an integrated system can be fashioned to accommodate the continuing production of spent nuclear fuel.[48]

If fuel were stored in on-site reactor spent fuel pools through the year 1996, only 13,300 metric tons of uranium (MTU) would require storage at AFR facilities. Assuming that the first repository would receive spent fuel in mid-1997, and that other repositories would begin operation at three-year intervals thereafter, the maximum AFR storage capacity needed would be 20,000 MTU. If this strategy, which would utilize AFRs with 10,000 MTU capacities and ten-year lead times, were

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45.1 UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 33 (citing 2 DOE STORAGE STUDY, *supra* note 44, app. B, tables 3, 4).

46. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 31-34.

47. See *id.* at 34-40 (citing 2 DOE STORAGE STUDY, *supra* note 44, tables 3, 4; TENNESSEE VALLEY AUTHORITY, SPENT FUEL MANAGEMENT PROGRAM STUDY SUMMARY REPORT A-6 (September 1979)).

48. UTILITY NUCLEAR WASTE MANAGEMENT GROUP—EDISON ELECTRIC INSTITUTE, STATEMENT OF POSITION ON PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE—SUMMARY STATEMENT OF POSITION (Document 1) 26-27 (July 7, 1980) [hereinafter cited as UNWMG-EEI SUMMARY STATEMENT OF POSITION]. *See* UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 11-14.

to be implemented, adequate interim storage would present no significant problem.[49]

Because spent fuel must be shipped from reactors, either to interim storage facilities and then to permanent repositories, or directly to the permanent repositories, spent fuel shipping casks must be made available. The precise number of casks needed at a given time is determined by the particular strategy chosen, the timing and loading/unloading capability of the AFRs, and the timing and loading capability of permanent repositories. Transportation requirements can be met with existing casks at least until the late 1980s.[50] A greater capacity for spent fuel transportation will be required when repositories become available, because fuel will arrive from both reactor storage pools and AFRs. One proposal would require about 44 rail casks and 14 truck casks by 1997; these requirements would increase to a peak of 203 rail casks in 2005 and 43 truck casks in 2010.[51] As a general rule, a spent fuel shipping cask will be delivered two years after an order is placed. If casks are ordered on a timely basis, there seems to be no reason why cask requirements cannot be met.[52]

Based on that analysis, UNWMG-EEI concluded the following:

> (1) Spent fuel from licensed facilities can be stored in a safe and environmentally acceptable manner, on-site or off-site, until disposal facilities are available;
> (2) Sufficient additional storage capacity for spent nuclear fuel from licensed facilities can and will be established;
> (3) Interim storage systems for spent nuclear fuel from licensed facilities will be integrated into an acceptable operating system, up to and including disposal, if such disposition becomes the national policy;
> (4) The initial increment of federal off-site spent fuel storage facilities can operate by 1983; and
> (5) No aspect of spent fuel storage would be prohibitively ex-

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49. UNWMG-EEI SUMMARY STATEMENT OF POSITION, *supra* note 48, at 27 (citing UNWMG-EEI Spent Fuel Storage Document, *supra* note 28, § VII B).

50. UNWMG-EEI SUMMARY STATEMENT OF POSITION, *supra* note 48, at 28 (citing DOE STATEMENT OF POSITION, *supra* note 28, at VI-9).

51. UNWMG-EEI SUMMARY STATEMENT OF POSITION, *supra* note 48, at 28 (citing DOE STATEMENT OF POSITION *supra* note 28, at VI 9-11).

52. UNWMG-EEI SUMMARY STATEMENT OF POSITION, *supra* note 48, at 28 (citing DOE STATEMENT OF POSITION, *supra* note 28, at 11); UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 42.

pensive and, thus, unavailable.[53]

In this light, UNWMG urged the NRC to adopt a rule providing that neither the safety nor environmental implications of maintaining spent fuel on-site beyond the anticipated expiration of a nuclear reactor license need be considered in any individual reactor licensing proceeding.[54]

2. DOE Statement of Position.—The relevant portion of the DOE statement[55] discussed the technical basis for the conclusion that spent fuel can be stored safely and in an environmentally acceptable manner. It described the alternative methods and technology for the storage of spent fuel, reviewed the performance requirements of storage facilities, and noted the extensive experience underlying the selection of water basin storage as the currently preferred method.[56]

The DOE statement also discussed the reasons justifying the extended pool storage of spent fuel at reactor sites or AFRs. The need for AFR storage capacity was also considered, along with relevant program plans and schedules.[57] Finally, the DOE presentation considered integration of the mined geologic repository program with the interim spent fuel pool storage program. It presented and discussed a combined system to provide the necessary flexibility to balance technical conservatism, regional needs, reactor operating requirements, and cost and logistical considerations.[58] Like UNWMG-EEI, DOE recommended that the NRC promulgate a rule that, in individual licensing cases, the agency need not consider safety and environmental concerns arising from spent fuel remaining on site after the expiration of facility licenses.[59]

B. Issues in Dispute

As the Waste Confidence Proceeding has evolved, a number of disputed issues have been identified. Technical issues and in-

53. UNWMG-EEI SUMMARY STATEMENT OF POSITION, *supra* note 48, at 3-4.
54. *Id.* at 4.
55. DOE STATEMENT OF POSITION, *supra* note 28. For a full summary of the DOE position, see Brown & Bergholz, *supra* note 11, at 862-66.
56. See DOE STATEMENT OF POSITION, *supra* note 28, at IV-1 to -22.
57. *Id.* at IV-22 to V-28.
58. *Id.* at VI-1 to -15.
59. *Id.* at VII-1.

stitutional issues constitute the principal areas of contention concerning spent fuel.[59.1]

1. Technical Issues.—A number of participants have claimed that the safety of long-term fuel storage has not been established adequately, and that there is a lack of experience with the storage and handling of "high burnup" fuel.[60] These critics, however, have not cited any technical basis for the claims that experience is an inadequate basis for establishing the safety of long-term storage. They merely have noted that no spent fuel has been stored for periods significantly beyond twenty years and that high burnup fuels generally have been stored for shorter periods. There has been no challenge to the technical bases underlying the acceptability of long-term storage including the stability of the system itself, the high corrosion resistance of fuel cladding, the resistance of fuel pellets to leaching, and even the ability to encapsulate and reencapsulate spent fuel. Because of the lack of degradation of fuel, including some high burnup fuel, and spent fuel pool systems over the years, and the ability to take remedial action if problems do develop, there is no reason to suspect the suitability of long-term water basin storage.[61]

The risk that is posed to the public health and safety by spent fuel storage accidents must be considered. As noted in the *UNWMG-EEI Cross-Statement*, the benign environment, the low level of stored energy within the fuel, and the simple, stable

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59.1 These issues are discussed in U.S. Nuclear Regulatory Comm'n, Report of the Working Group of the Proposed Rulemaking on the Storage and Disposal of Nuclear Waste 25-28 (Jan. 29, 1981) [hereinafter cited as NRC Working Group Report].

60. D. Abrahamson, Comments on Proposed Rulemaking on the Storage and Disposal of Nuclear Waste 33 (July 2, 1980) (attached to State of Minnesota, Statement of Position on Proposed Rulemaking on the Storage and Disposal of Nuclear Waste (July 3, 1980)); New England Coalition on Nuclear Power, Statement of Position on Proposed Rulemaking on the Storage and Disposal of Nuclear Waste 56, 62, 103 (July 7, 1980). "High burnup" fuel has an extended reactor residence time, generally experiencing a burnup in excess of current design levels of around 30,000 Mw-days/MTU. See Utility Nuclear Waste Management Group—Edison Electric Institute, Cross-Statement on Proposed Rulemaking on the Storage and Disposal of Nuclear Waste, at III-11 (Sept. 5, 1980) [hereinafter cited as UNWMG-EEI Cross-Statement].

61. See the discussion in UNWMG-EEI Cross-Statement, *supra* note 60, at III-1 to -6, III-11 to -13 and authorities cited therein. See Letter from Milton S. Plesset, Chairman, Advisory Committee on Reactor Safeguards, to John F. Ahearne, Chairman, U.S. Nuclear Regulatory Comm'n (Dec. 10, 1980) (on file with *South Carolina Law Review*).

nature of the storage system itself indicate that the hazard of credible accidents is low, even in the event of a spent fuel pool cooling system failure.[62] There is ample time for necessary remedial action because of the absence of any reasonable mechanism for rapid change in the storage system.[63] The UNWMG-EEI position on the safety of spent fuel storage is supported by the *NRC Generic Environmental Impact Statement on Handling and Storage of Spent Fuel* and the *DOE Final Environmental Impact Statement—U.S. Spent Fuel Policy*. Both state that the risk of a major accident involving a spent fuel pool is very remote.[64]

The risk of accidents from handling shipping casks is another specific concern. UNWMG-EEI have noted that the risk has been reduced in individual instances by the installation of cask handling equipment designed to avoid mishaps in case of equipment failure, and by technical specifications that limit the movement of heavy objects over the spent fuel pool.[65] Additionally, the NRC has completed a generic study of the cask drop issue, which specifies the ultimate criteria to be met and the interim protective measures to be implemented until there is full compliance with those criteria.[66]

One participant argued that there has been inadequate consideration of a possible emergency need to unload a reactor core or spent fuel pool in the event of a reactor accident or a fuel pool malfunction.[67] The need to rapidly unload an entire core, however, would be very unusual. Further, as noted by UNWMG-EEI, the NRC consistently has taken the position that the capability to off-load a full core, is not a safety requirement.[68] This is

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62. UNWMG-EEI CROSS-STATEMENT, *supra* note 60, at III-7 (citing UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 17-22, 24-28 and authorities cited therein).

63. UNWMG-EEI CROSS-STATEMENT, *supra* note 60, at III-7 (citing UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 18-19).

64. *E.g.*, 1 NRC SPENT FUEL GEIS, *supra* note 4, at 4-16 to -22; 2 DOE SPENT FUEL EIS, *supra* note 39, at B-1, -59.

65. UNWMG-EEI CROSS-STATEMENT, *supra* note 60, at III-7 to -8 and authorities cited therein.

66. NRC Control of Heavy Loads at Nuclear Power Plants—Resolution of Task A-36, 45 Fed. Reg. 55,552 (1980).

67. NEW ENGLAND COALITION OF NUCLEAR POWER, STATEMENT OF POSITION ON PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE 55, 62, 103 (July 7, 1980).

68. 3 NRC SPENT FUEL GEIS, *supra* note 4, at 2-43 to -44.

also the view of Congress' Office of Technology Assessment.[69] It is possible that malfunctions, such as leaks, will occur in the spent fuel pool itself; however, even leaks in the pool can be repaired without fuel removal, and make-up water can be added in the interim.[70]

Finally, there is concern over the possibility of sabotage in the spent fuel storage facility. UNWMG-EEI observed that extensive physical protection requirements have been established, which the NRC deems adequate to protect public health and safety.[71] Both NRC and DOE evaluated the risk of sabotage and found that it was low.[72] Finally, an analysis was performed for the spent fuel storage operation in Morris, Illinois, which concluded that there was no risk of a credible sabotage event that would release radioactivity and endanger the public health and safety.[73]

2. *Institutional Issues.*—These issues, for the most part, have pertained to federal and state action, or inaction, toward the establishment of an overall spent fuel storage system. Several participants noted that, in the absence of congressional authorization of an AFR program, there is no assurance that spent fuel storage will be available.[74] Although a legislative program for AFR capacity was not completed during the last session of Congress, extensive attention has been given to the problem.

In response to the executive policy established in October of 1977,[75] DOE announced a spent fuel policy that would enable utilities to deliver spent fuel to the federal government in ex-

69. Letter from John H. Gibbons, Director, Office of Technology Assessment, to Senator Gary Hart, p. 3 (July 21, 1980) (on file with *South Carolina Law Review*).

70. Commonwealth Edison Co. (Zion Station, Units 1 and 2), LBP 80-7, 11 NRC 245, 258 (1980).

71. 10 C.F.R. § 73.55 (1980).

72. *See, e.g.*, 1 NRC SPENT FUEL GEIS, *supra* note 4, 5-1 to -7, 5-10 to -11; 2 DOE SPENT FUEL EIS, *supra* note 39, IV-1 to -4, IV-5 to -7.

73. Voiland, Sabotage Analysis for Fuel Storage at Morris, NEDM-20682 (Jan. 1980). With respect to possible risks caused by acts of war, UNWMG-EEI concluded that both NRC regulations, *see* 10 C.F.R. § 50.13 (1980), and judicial precedent, *see* Siegel v. AEC, 400 F.2d 778 (D.C. Cir. 1968), place such concerns beyond the scope of the proceeding.

74. UNWMG-EEI CROSS-STATEMENT, *supra* note 60, at III-14 and authorities cited therein.

75. 13 WEEKLY COMP. OF PRES. DOC. 502 (Apr. 11, 1977). *See generally* note 8 and accompanying text *supra*.

change for a fee.[76] DOE called for prompt action, and appropriate legislation was submitted.[77]

On July 30, 1980, the Senate passed a comprehensive waste policy bill, the Nuclear Waste Policy Act.[78] Title III of the legislation proposed an AFR program that required DOE to construct or acquire AFR capacity sufficient to meet the needs of civilian American nuclear power plants.[79] Further, section 309 of the Act established a mechanism for federal-state interaction, including the resolution of any conflicts.[80] Although the Senate and the House of Representatives did not reach agreement on comprehensive waste management legislation in the late stages of the 96th Congress, the proposed legislation indicates that a definitive national policy could be adopted in the near future.[81]

The second institutional issue concerns transportation logistics. A specific concern is the perceived difficulty of establishing a basic transportation system sufficient to meet anticipated needs. UNWMG-EEI noted that, like the need for AFR storage, the demand for spent fuel transportation services will continue at a low level for some time, and then increase gradually. This period will provide adequate time to fabricate casks and to develop transportation service.[82]

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76. See 1 DOE SPENT FUEL EIS, *supra* note 39.

77. *Id.*

78. S.2189, 96th Cong., 2d Sess., 126 CONG. REC. S10266 (daily ed. July 30, 1980).

79. *Id.*

80. *Id.* at S10267-68 (noted in UNWMG-EEI CROSS-STATEMENT, *supra* note 60, at III-14 to -15.). The federal-state mechanism of § 309 was sponsored by Senator Ernest F. Hollings and Senator Strom Thurmond, both of South Carolina, where there is a completed (but unlicensed) AFR facility. It is, in the words of Senator Thurmond, "a prime candidate to serve as one of the Nation's first AFR facilities." 126 CONG. REC. S10061 (daily ed. July 29, 1980) (remarks of Senator Thurmond).

81. Subsequent to passage of S.2189, the House of Representatives passed H.R. 8378, its own version of comprehensive waste management legislation. *See* 126 CONG. REC. H11,747-69 (daily ed. Dec. 3, 1980). H.R. 8378 did not contain an AFR provision. Efforts to reach a compromise failed because the House and Senate differed over the congressional procedures to be employed when a state petitions to disapprove a site selected for the permanent disposal of defense-generated waste. *See generally*, Letter from Representatives John D. Dingell and Morris K. Udall to Senator Henry M. Jackson (Dec. 8, 1980) (on file with *South Carolina Law Review).* S.2189 was amended, then, to encompass only low-level waste and was passed by both the Senate and House.

The position of the Reagan administration on spent fuel reprocessing and on the establishment of repositories is likely to be affected by the need for action to further the viability of nuclear power.

82. UNWMG-EEI SPENT FUEL STORAGE DOCUMENT, *supra* note 28, at 40-42 and authorities cited therein. DOE discussed the adequacy of the transportation system in con-

Several participants also noted that state and local laws and ordinances that prohibit or regulate the transportation of spent fuel or other nuclear materials may represent a restriction, or even an impasse, to the establishment of an AFR program.[83] The extent to which state and local ordinances may raise a transportation safety issue may well be beyond the scope of the proceeding.[84] In addition, as UNWMG-EEI have pointed out, "proposed Department of Transportation (DOT) rules will preempt state and local prohibitions on the transportation of radioactive materials, while permitting state agencies with state-wide enforcement authority to establish alternate routes."[85] The final DOT regulations have been adopted and should, for all practical purposes, remove the potential for significant state and local impediments to the transportation of spent fuel shipments.[86]

C. *Recommendation Phase of NRC Proceeding*

After filing Statements of Position and Cross-Statements, all participants were required to file suggestions for procedures for the remainder of the proceeding.[87] UNWMG-EEI stated that, in its view, all the issues pertinent to the proceeding had

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siderable detail in its Cross-Statement. See U.S. DEP'T OF ENERGY, CROSS-STATEMENT ON PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE, at II-159 to -170 (Sept. 5, 1980). To place the logistics of the transportation system in perspective, DOE noted that a typical 1,000 Mwe coal-fired generating station annually receives 30,000 railroad carloads of coal, containing 100 tons each, compared with the 7 cask shipments of about the same size, which would transport the annual spent fuel discharge from a nuclear generating station of the same capacity. *Id.* at III-163.

83. UNWMG-EEI CROSS-STATEMENT, *supra* note 60, at III-17 (citing various position statements of the State of New York, the State of California, and the New England Coalition on Nuclear Power). For a full discussion of this issue, see Jaksetic, *Constitutional Dimensions of State Efforts to Regulate Nuclear Waste,* 32 S.C.L. REV. 789, 843-47 (1981).

84. As a general matter, the Presiding Officer ruled that issues related to the safety of spent fuel transportation were beyond the scope of the Waste Confidence Rulemaking because waste *management* is the sole focus of the proceeding and transportation has been and is being extensively considered elsewhere. *See First Prehearing Conference Order,* 10-11.

85. UNWMG-EEI CROSS-STATEMENT, *supra* note 60, III-17 (citing Highway Routing of Radioactive Materials, Proposed Amendments to 49 C.F.R. Parts 173 & 177, 45 Fed. Reg. 7140 (1980).

86. *Id.* The DOT regulations can be found at 45 Fed. Reg. 5298 (1981).

87. *In the Matter of Proposed Rulemaking on the Storage and Disposal of Nuclear Waste, Order Extending Time to File Statements and Cross-Statements of Position* 4-5 (May 29, 1980).

been identified and that the participants had provided sufficient factual information to enable the NRC to make a determination. Thus, UNWMG-EEI maintained that no further proceedings, additional areas of inquiry, or further data or studies were required and that the Commission should proceed to complete its generic assessment.[88] In general, other participants also concluded that the factual record is sufficiently complete, particularly with respect to spent fuel storage, to proceed to a decision.[89] However, no decisions have been made regarding the conduct of future proceedings.

D. *Future Proceedings*

The NRC had established a special working group to summarize the record and to identify the issues in controversy and any additional information that may have been required. The working group did identify the need for more information on some subjects; the subject of spent fuel, however, was not one of them.[90]

The Presiding Officer now will make recommendations to the NRC concerning further proceedings and will include the participant's comments on the report of the working group.[91] It is possible that there will be additional proceedings before the NRC, and the filing of the equivalent of proposed findings and conclusions. As a result, it is unlikely that the NRC will complete the proceeding before the end of 1981.

88. *See* UTILITY NUCLEAR WASTE MANAGEMENT GROUP—EDISON ELECTRIC INSTITUTE, SUGGESTIONS RE PROCEDURES FOR THE REMAINDER OF THE PROCEEDINGS ON PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE 1-2 (Oct. 6, 1980).

89. This is not to say that all the participants agree with the conclusions of UNWMG-EEI. As noted earlier in this Article, some participants have raised a number of technical or institutional issues. These disputes, however, are concerned primarily with the conclusions to be reached, not with the adequacy of the record.

90. NRC WORKING GROUP REPORT, *supra* note 59.1, at 10.

91. NRC, MEMORANDUM AND ORDER ON THE PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE 2-3 (Jan. 16, 1981).