UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

December 10, 1980

Honorable John F. Ahearne
Chairman
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: WASTE CONFIDENCE RULEMAKING - STORAGE AND DISPOSAL OF NUCLEAR WASTE

Dear Dr. Ahearne:

In your letter of January 9, 1980 to the Advisory Committee on Reactor Safeguards, you requested our participation in the proposed rulemaking to reassess the degree of confidence of the Nuclear Regulatory Commission "...that radioactive wastes produced by nuclear facilities will be safely disposed of, to determine when such disposal will be available, and whether such wastes can be safely stored until they are safely disposed of." You proposed that our participation be in the role of commenter and adviser to the Commission after the statements and cross-statements had been filed by the parties to the proceeding. You asked that we give particular consideration to the identification of those issues raised by the parties which we believe need further attention.

In the preparation of our response, we reviewed the statements and cross-statements listed below and had the benefit, during the 248th ACRS meeting on December 4-6, 1980, of discussions with representatives of the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC). We also held Subcommittee meetings in Washington, D. C. on October 3, 1980 and November 13-14, 1980 during which members of the public and representatives of DOE and NRC made presentations.

Because existing directives indefinitely defer the reprocessing of spent commercial nuclear fuel in the U.S., the waste confidence rulemaking was initiated with an arbitrary decision that spent fuel would be the representative nuclear waste to be considered in this proceeding. This decision has been challenged by several participants in the proceeding. However, it has the advantage of forcing consideration of a wider range of waste storage and disposal problems because larger amounts of long-lived heavy elements (actinides) must be assumed present than is the case with waste from reprocessed fuel.

We will address each of the three issues raised in the proposed rulemaking individually. In considering these issues, we believe it is important to note that the U.S. Environmental Protection Agency, which has the responsibility at the Federal level, has not yet published standards for the environmental impact of disposal of nuclear waste. In addition, we believe

that consideration of these issues would benefit from a careful assessment of the relative risks of the various steps within the overall fuel cycle in order to place into perspective the risk from the waste disposal step. Such an assessment should include a comparison of the risks associated with the disposal of spent fuel as contrasted to solidified high level reprocessing wastes.

1. "Reassess Commission confidence that radioactive wastes produced by nuclear facilities will be safely disposed of."

   Whether wastes will be safely disposed of may be said to have two quite different components: the purely technical, which would determine whether safe disposal can be accomplished; and the institutional or political factors which will govern whether, or when, some action -- even if technically feasible -- will be taken. Considering first the technical aspects, we believe that safe disposal of radioactive wastes is reasonably assured by the present state of knowledge. Research in this country and abroad, notably Sweden, has shown that engineered packages for nuclear waste can be expected to remain intact in suitably sited geologic repositories for at least 1000 years.

   We are confident that, in addition to the long containment against radioactive release provided by the engineered waste package, geological isolation can be expected to be effective in the longer time period of tens of thousands of years. Because, after 1000 years, decay of the dominant radioactive constituents represented by the fission products will have occurred, the geological barrier could then be reasonably relied upon for the remaining burden of isolation. In addition, because nuclear wastes lack sufficient concentrated latent energy to produce sudden and damaging effects by accident or malfunction, there should be ample time for measures to mitigate consequences from unexpected events. Therefore, even if the engineered package failed completely after 1000 years, there is still reasonable assurance that radionuclides would not reach the biosphere at unacceptable rates. The present state of knowledge allows the building of a waste repository in one of several known locations which meet the geological isolation requirements to prevent unacceptable rates of radioactive releases to the biosphere.

   In our review of disposal of radioactive waste in geologic repositories we did not find any basic technical issues that, in our opinion, would require further attention prior to a rulemaking finding of confidence. However, we did find that some sociopolitical issues are in need of further attention as discussed below in item 2.

Therefore, we believe that safe disposal of radioactive wastes is reasonably assured from the technical standpoint. We believe that what is needed is an expeditious resolution of legal and political issues concerning site selection and acquisition.

2. "Determine when any such disposal will be available"

We believe that the DOE estimate for completion of a waste repository by 1997-2006 is technically achievable. However, the major problem in forecasting an availability date is sociopolitical. Until the issue of consultation and concurrence among federal, state and local authorities is better resolved and the licensing/litigation process as well as standards setting by EPA and NRC is better defined, we believe that trying to forecast a firm availability date for a repository is futile in the absence of action by Congress.

3. "Whether such wastes can be safely stored until they are safely disposed of"

In our review of whether waste in the form of spent fuel can be safely stored pending its safe disposal, we assume initially a required storage duration of about 30 additional years, that is, until about the year 2010. This is consistent with the date of 1997-2006 when DOE has stated that it will have disposal facilities in operation. As discussed below, we believe that safe interim storage well beyond 30 years can be provided should it be required.

The safety and practicality of interim storage of spent fuel has already been demonstrated for periods of 15-20 years. We believe there is no reasonable doubt that, with continued maintenance and surveillance, safe storage could be continued very much longer barring the occurrence of an unanticipated catastrophic external event. The reason for this confidence is not only the demonstrated performance cited above but the compelling logic that fuel and cladding materials which maintain their integrity under the severe environments of operating reactors will be essentially inert in the relatively benign environment of a storage water basin where the governing corrosion and diffusion rates are at least a few orders of magnitude less. Additionally, a spent fuel storage basin, unlike an operating reactor, has so little latent energy that it is much less subject than an operating reactor to sudden and possibly damaging effects by accident or malfunction. If, in spite of all expectations, an accident should occur, there should be time to deal with it and prevent any serious consequence.

An alternate method of storage, dry storage, has been extensively studied in the U.S., Canada, Europe, and elsewhere with satisfactory results. Although this method lacks the extent of demonstrated use compared to the water basin storage, we believe it warrants serious consideration because with longer aged spent fuel a simpler and more passive design is possible. Therefore, dry storage is even less susceptible to malfunctions.

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.

In conclusion, we believe that the issues and concerns about storage and disposal of nuclear waste have been adequately addressed and that the Commission should have a high degree of confidence that (1) radioactive waste can be safely stored until ultimate disposal is available, (2) disposal facilities can be made available, and (3) a disposal facility availability date by about the year 2000 can be met from the standpoint of technical considerations.

Sincerely,

Milton S. Plesset

Milton S. Plesset
Chairman

References:
1. DOE/NE-0007, "Statement of Position of the USDOE, In the Matter of Proposed Rulemaking on the Storage and Disposal of Nuclear Waste (Waste Confidence Rulemaking)", dated 4/15/80.
2. American Institute of Chemical Engineers Statement dated 6/23/80.
3. Mississippians Against Disposal (M.A.D.) Statement dated 7/1/80.
4. Scientists and Engineers for Secure Energy (SE_2) Statement dated 7/1/80.
5. American Nuclear Society Statement dated 7/3/80.
6. Tennessee Valley Authority Statement dated 7/7/80.
7. State of South Carolina Statement dated 7/7/80.
8. State of Vermont Statement dated 7/7/80.

9. State of Ohio Statement dated 7/7/80.
10. Atomic Industrial Forum Statement dated 7/7/80.
11. Robert Abrams, Attorney General of the State of New York, Statement dated 7/7/80.
12. Edison Electric Institute Statement dated 7/7/80.
13. New England Coalition on Nuclear Pollution dated 7/8/80.
14. William A. Lockstet Statement dated 7/8/80.
15. State of Delaware Statement dated 7/3/80.
16. State of Minnesota Statement dated 7/8/80.
17. Participant Sensible Main Power Statement dated 7/7/80.
18. Bechtel National Inc. Statement dated 7/3/80.
19. Neighbors for the Environment, Eugene Cramer Statement dated 7/4/80.
20. United States Geological Survey Statement dated 7/7/80.
21. Natural Resources Defense Council Statement dated 7/9/80.
22. State of Illinois Statement dated 7/7/80.
23. Wisconsin Geological and Natural History Survey Statement dated 7/10/80.
24. Ocean County and Township of Lower Alloway Creek Statement dated 7/10/80.
25. Marvin I. Lewis Statement dated 7/10/80.
26. California Energy Commission Statement dated 7/7/80.
27. Safe Haven, Ltd. Statement dated 7/11/80.
28. State of Oklahoma Statement dated 7/9/80.
29. James C. Maloro (NRCS) to Samuel J. Chilk (NRC).
30. State of Minnesota Statement Correction dated 7/9/80.
31. Request from Wisconsin's Environmental Decade, Inc dated 7/9/80.
32. California Department of Conservation Statement dated 7/7/80.
33. David Deese, State of Wisconsin's Statement dated 7/8/80.
34. United States Geological Survey Statement Correction dated 7/22/80.
35. Environmental Coalition on Nuclear Power Statement dated 7/22/80.
36. General Electric Company Statement dated 7/7/80.
37. DOE/NE-007, Supp 1, DOE Cross-Statement dated 9/5/80.
38. Attorney General of the State of New York Cross-Statement dated 9/3/80.
39. Atomic Industrial Forum, Inc. Cross-Statement dated 9/5/80.
40. Consumers Power Company Cross-Statement dated 9/5/80.
41. Tennessee Valley Authority Cross-Statement dated 9/5/80.
42. State of Delaware Cross-Statement dated 9/5/80.
43. California Energy Commission Cross-Statement dated 9/5/80.
44. State of Minnesota Cross-Statement dated 9/8/80.
45. State of Ohio Cross-Statement dated 9/8/80.
46. General Electric Company Cross-Statement dated 9/5/80.

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REPORT OF THE WORKING GROUP ON THE PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTES

PART 3

MAJOR ISSUES IN WASTE CONFIDENCE RULEMAKING AND ABSTRACTS OF THE PRINCIPAL POSITIONS ON THESE ISSUES

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TABLE OF CONTENTS

MAJOR ISSUES IN WASTE CONFIDENCE RULEMAKING AND ABSTRACTS OF THE PRINCIPAL POSITIONS ON THESE ISSUES

WASTE CONFIDENCE ISSUES

ABSTRACT OF VIEWS

1. Procedural Issues

1.1 Scope of Proceeding

[Summary: DOE and several participants believe the scope of the waste confidence proceeding should follow closely the Presiding Officer's order of February 1, 1980, while others believe the scope should be enlarged to include such issues as transportation of nuclear waste, low-level waste, and uranium mill tailings disposal.]

Issue:

Should the Waste Confidence Proceeding address waste disposal issues other than storage and disposal of power reactor spent fuel?

1.2 Standard for Finding Confidence

[Summary: DOE and several participants believe the "reasonable assurance" criterion is appropriate to the finding of confidence. DOE notes this criterion is consistent with the relevant court decision and complies with the "substantial evidence" standard of the Administrative Procedure Act. Others believe that the standard should be more restrictive; it should provide, for example, for "assurance beyond a reasonable doubt," "extraordinarily high degree of assurance," and "more than informal (or even documented) optimism."]

Issue:

Is the "reasonable assurance" standard appropriate for finding confidence in this proceeding or should some other standard such as "beyond a reasonable doubt," "more likely than not," "substantial evidence," "extraordinarily high degree of assurance" be applied?

2. Institutional Issues

2.1 Federal Role

[Summary: Some participants suggest that the Federal waste management program cannot ensure policy continuity and financial commitment because the program extends beyond the terms of any one President or Congress. Several note the likelihood of policy disagreements between the Executive and Legislative branches, and among the many different Congressional committees with jurisdiction over the issue. Participants also claim that DOE has not taken into account the roles and authorities of other Federal agencies, such as DOI, EPA, and NRC. Some note that agencies concerned with waste management have often not taken coordinated or timely action in the past.]

Issue

Should the Commission, for the purposes of this proceeding, assume a commitment by the Federal government to provide the policy and budgetary support necessary to carry out whatever measures are required to assure safe waste management and disposal?

2.2 Federal-State Relations

[Summary: Some participants suggest that DOE has not adequately considered the role of the states generally or the precise role of the State Planning Council. They believe that DOE should not assume that States and localities will cooperate with Federal efforts; rather, it should anticipate opposition from host States and develop mechanisms for incorporating State and local views. Additionally, some allege that DOE has offered no means for resolving Federal-State disputes or overcoming State nonconcurrence. Some participants suggest that State and local officials be consulted at an early stage before plans or decisions are made about repository sites and site criteria. They also suggest that DOE address the issue of Federal compensation for host States and localities as a means of mitigating socioeconomic impacts.]

Issue

Will state and local concerns adversely affect the selection of sites or interfere with the development and operation of repositories?

2.3 Public Acceptance

[Summary: Several participants claim that DOE has underestimated the difficulty of creating a positive public atmosphere for waste disposal. They believe that the public's perception of risk from waste disposal is different from the perception of the scientific community and that calculations showing the risk may not affect public acceptance. Moreover, they assert that public distrust of DOE is such that DOE's assessment will not be accepted. In addition, some participants claim that DOE neither adequately considers nor seeks accommodation with groups which have opposed nuclear programs in the past. Also, DOE does not indicate how it will approach and implement contact with hostile officials and citizens or what measures it will undertake to dissipate or dispel public distrust.]

Issue

Will DOE be able to gain public acceptance of its program for waste storage and disposal and, if not, will lack of acceptance significantly handicap the program?

3. The DOE Waste Management Program

3.1 Management Capability, Resources, Schedules, Costs

[Summary: The magnitude and complexity of the proposed waste management program as well as the complex institutional relations focus attention on DOE's organization and management capabilities. Various participants hold that DOE's waste management program is poorly organized, funded, and managed, and is subject to conflicting professional and budgetary incentives. DOE's position is that its recent reorganization provides more centralized direction to the program. The Department now believes that its management structure permits both effective coordination and the flexibility necessary to ensure coordinated action among the different organizations and individual experts involved in the program. Several participants feel that the Federal government (i.e., AEC, ERDA, DOE) has historically failed to solve the problems of waste management or even to make significant progress on them. They believe that this failure suggests that DOE will be unable to solve them in the future. DOE maintains that lessons have been learned from past experience and are reflected in the National Waste Terminal Storage (NWTS) Program. Nevertheless, some participants contend that DOE's schedules and costs are not realistic.]

<u>Issue</u>

Can the DOE waste management program be completed on a schedule consistent with the rate of generation of nuclear waste and the projected storage capacity? Is the DOE program economically feasible?

3.2 Regulatory Framework for DOE Program

[Summary: Several participants express concerns about regulatory uncertainties, including the lack of definitive regulatory criteria, the lack of demonstrated conformance with preliminary criteria, and possible discontinuities in regulatory supervision and authority. It is believed that DOE's waste management program cannot be adequately evaluated until a well-developed regulatory framework for waste disposal or storage has been established. On the other hand, while conceding that definitive criteria are under development, DOE does not believe that they are needed at this time. DOE believes that it has provided a sound basis in the form of seven objectives to judge the adequacy of the proposed waste management program.]

Issue

Can the adequacy of the DOE waste management program be evaluated now, or must evaluation await further development of the regulatory framework?

3.3 Socioeconomic Impacts; Equitable Distribution of Risks and Benefits

[Summary: Several participants express concern about the socioeconomic effects of DOE's waste management program. Similarly, some participants believe that DOE's program will result in an inequitable distribution of risks and benefits. DOE believes its program is adequate to mitigate any adverse socioeconomic impacts. DOE also believes that in an interdependent society practically all citizens are exposed to risks from activities which do not themselves provide exactly offsetting benefits, but the converse is also true.]

Issue

Does the DOE program provide for adequate assessment and mitigation of socioeconomic impacts and adequately address concerns raised regarding the distribution of risks and benefits?

4. Technical Issues for Spent Fuel Storage

4.1 Safe Storage of Spent Fuel for Extended Periods of Time

[DOE believes that spent fuel can be safely stored for extended periods of time at facilities either at reactor (AR) or AFR, with no significant safety hazards or adverse environmental impacts. In support of this belief, DOE cites the more than 20 years of successful experience here and abroad in spent fuel storage, the existence of extensive and relevant basic data that predict the capability of spent fuel to maintain its integrity during storage over a period of 40 years or more, and the successful experience using well-established techniques in examining the condition of spent fuel while in storage. Several participants agree with DOE. Others disagree, citing a number of factors including the possible leakage of fission products as the fuel cladding corrodes, the difficulties of ensuring error-free human performance in a pool facility that requires long-term management, the uncertainties of providing competent management during a period of 40 years or more, and the limitations of DOE's proposed program to evaluate spent fuel integrity during pool storage.]

<u>Issue</u>

Do the properties of spent fuel allow it to be safely stored for extended periods without significant safety, health, and environmental effects?

4.2 Structural and Component Safety for Extended Facilities Operation

[DOE's position is that while reactor storage basins were intended for only temporary cooling and storage of fuel, they were designed to perform this function continuously for a 40-year period. If these facilities were properly maintained, there is no reason why they could not continue to perform this function beyond the 40-year life of the plant. DOE cites the extensive basic data that predict the capability of spent fuel storage basins to function continuously over a period of 40 years or more. DOE also notes successful experience with prompt replacement of pool components and equipment when necessary. Some participants agree with DOE's position. Others cite past unfavorable experience, including the freeze-up of the air cooling system at GE Morris, with subsequent leakage of contaminated water, problems with monitoring and maintaining the necessary pool water chemistry, the possibility of uncontrolled leakage of radioactive materials to the environment, and the long-term degradation of storage pool materials.]

Issue

Can the structure of spent fuel storage basins and associated basin components safely sustain extended periods of operation, perhaps for many decades?

4.3 Risks of Accidents and Sabotage at Spent Fuel Storage Facilities

[Some participants cite accidents which have occurred at spent fuel storage facilities, including leaks and inadvertent releases of contaminated storage pool water. One participant also cites the possibility of terrorist attacks or intentional sabotage of a spent fuel storage facility. These participants conclude that interim storage of spent fuel before geologic disposal will itself be unsafe. DOE and several participants assert that the risk of a major accident with off-site radiological consequences at spent fuel storage facilities is extremely remote. DOE contends that steps have been taken to further tighten security to prevent sabotage at these storage facilities.]

Issue

How important are the risks posed by accidents and acts of sabotage at spent fuel storage facilities?

5. Technical Issues for Waste Disposal Repository Site Selection

5.1 Existence of Technically Acceptable Sites

[Summary: DOE maintains that the site selection process it has adopted will identify acceptable repository sites and that the field operations required to characterize candidate sites will not jeopardize their integrity. Those disagreeing with the DOE position assert that to determine the acceptability of proposed repository sites requires information that will not be available when needed, should it ever become available. Moreover, DOE's past experience shows that apparently acceptable sites are found to have unacceptable geotechnical difficulties upon closer examination. Those participants disagreeing with DOE conclude that there is no basis for a finding of reasonable assurance that DOE will be able to select a site which will be found to be acceptable for a permanent radioactive waste repository.]

Issue

Do potentially acceptable sites exist and can they be identified within the time period at issue?

5.2 Information Required for Site Characterization

[Summary: DOE believes that the technical information now available on the geologic media of potential repository sites is sufficient to support a finding of confidence that a suitable site will be found. Ongoing laboratory and field work will reduce or eliminate existing uncertainties. In most instances where uncertainties remain, it will be possible to bound their effects. Participants disagreeing with the DOE position point to specific and numerous alleged gaps in the current state of knowledge of candidate sites and geologic media. They also believe there will be difficulties in obtaining adequate data and that the existing uncertainties are significant.]

Issue

Can the state of knowledge of candidate geologic media and sites for a repository reasonably be expected to be sufficient when DOE expects to make the key decisions?

5.3 *In Situ* Testing of Geologic Media

[Summary: DOE states that it has incorporated *in situ* testing into its program and that, to date, such testing has aided in significantly improving computational models and supported a finding of confidence in the feasibility of mined geologic disposal. DOE emphasizes that *in situ* testing is but one phase of the site selection process and is one component of the information needed to make the bounding performance assessments required for submittal of a license application for a particular site. Some participants contend that DOE has not conducted sufficient *in situ* experiments and those that have been performed have not yielded definitive and satisfying results relating to repository design and performance; moreover, the fundamental limitations of *in situ* experiments are not recognized and the results have often contradicted *a priori* predications based on laboratory data and modeling.

Issue

To what extent is *in situ* testing necessary prior to developing a radioactive waste disposal facility? Has DOE conducted an adequate amount of *in situ* testing to date?

5.4 Leaching and Sorption

[Summary: It is generally recognized by all participants that an important natural pathway for radionuclide migration to the biosphere is through groundwater. Two factors significantly influencing the rate of radionuclide migration are the leach rate (dissolution of waste by groundwater) and the sorption properties of the host medium (mechanisms that retard the migration of radionuclides). DOE's position is that the uncertainties and gaps in current knowledge of leaching and sorption processes do not prevent making conservative and bounding calculations that provide reliable predictions of mined geologic repository performance. Some participants believe that the current understanding of these processes, as well as available relevant data, does not provide an adequate basis for predicting long-term performance of a mined geologic repository. They also point to fundamental limitations in the experimental data and their applicability to the real geologic environment.]

Issue

Will the state of knowledge of leaching of radioactive waste and the sorption of radionuclides by candidate host media be adequately understood in time to support a valid assessment of the long-term performance of a mined geologic repository?

5.5 Radionuclide Migration from Repository to Biosphere

[Summary: An understanding of the rates of migration of radionuclides from a repository to the biosphere is necessary to evaluate its isolation capability. Some participants point to the large uncertainties and gaps in knowledge of the physical and chemical properties of candidate host media that control underground transport for long flow paths. These uncertainties and gaps, as well as limitations of the transport models themselves, make it impossible to predict with any degree of confidence the performance of a mined geologic repository. DOE maintains that, in spite of lack of knowledge of all details of radionuclide migration, adequate predictions of repository performance can be made by using bounding, conservative assumptions. One participant points out that if containment of radionuclides within the waste package can be ensured for about 500 years, subsequent migration tends to mitigate the hazard to an intruder by decreasing the radionuclide concentration.]

<u>Issue</u>

Will there be adequate information concerning the migration of radionuclides from the repository to the biosphere to support a valid assessment of repository performance?

5.6 Risks from Human Intrusion

[Summary: Several participants state that entry into a waste repository sited in salt, with or without knowledge of the repository's existence, is likely because of the value of salt and other resources often associated with salt deposits (potash, natural gas, oil). Some participants believe that entry, regardless of the geologic medium chosen, is likely because of the value of spent fuel when reprocessed either for fuel or for weapons material. One participant feels that DOE provides detailed answers to the problems posed by the possibility of human intrusion and that the problem of human intrusion has been overstated. DOE feels that it can mimimize the possibility of exploration for resources by analyzing the likelihood and consequences of activities to explore or recover resources and that, because measures to protect against intrusion are available, the use of salt is not invalidated . Natural and engineered barriers would mitigate consequences, and surreptitious entry to recover the spent fuel is unlikely.]

<u>Issue</u>

Does the possibility of accidental or unauthorized intrusion into a waste repository present a significant obstacle to achieving safe waste disposal?

5.7 Engineering Activities for Repository Site Development and Operation Assessment of Spent Fuel as Waste Form

[Summary: If spent fuel from light water reactor (LWR) is to be disposed of in a mined geologic repository, its performance as a waste form must be assessed. DOE believes that the relevant properties of the basic form (irradiated uranium dioxide pellets and zircaloy cladding) are known and that a program in progress will yield sufficent information to define more completely its behavior as a waste package component under repository conditions. A number of participants point to the limits of present knowledge, particularly about the leaching of radioisotopes from spent fuel in a groundwater environment, and conclude that it is not possible to select a waste form which will prevent radioisotopes from migrating to the biosphere.]

Issue

Is spent fuel, as discharged from the reactor, an adequate waste form? Is the information currently available adequate to assess the performance of spent fuel as a waste form?

5.8 Interaction Between Nuclear Waste and Host Medium

[Summary: Several participants maintain that nuclear waste and host rock interactions are not well enough understood to proceed with the development of a geologic repository. Such adverse interactions between the waste package and the host medium could result from the direct or synergistic effects of radiation, heat, and groundwater intrusion. Several state that the heat dissipated from the spent fuel assemblies placed in the repository will increase the temperature of the repository and reduce the structural stability of the repository or the integrity of the host medium. DOE maintains that a considerable amount of relevant research and development on waste-host rock interaction has already been accomplished. DOE believes that the effects of many of the individual processes of waste-host rock interaction can be bounded in its assessments of repository system performance for specific sites.]

Issue

Are waste-host rock interactions sufficiently understood to permit reliable predictions of long-term repository behavior?

5.9 Engineered Barriers

[Summary: Some participants believe that there is inadequate information to permit development of a long-lived, multibarrier waste package, and other engineered barriers that will effectively contain radioactive wastes. They believe that the degradation of canister materials in geologic environments is not sufficiently well understood; also, they point to a lack of data on possible backfill materials. However, DOE, supported by several participants, asserts that it has provided sufficient evidence that long-lived, multibarrier waste packages can be designed and built in a timely manner and that they will perform as required.

Issue

Are engineered barriers (e.g., waste packages and backfill materials) necessary to provide assurance of nuclear waste containment for the desired period of time, and, if so, will DOE develop them when needed?

5.10 Borehole and Shaft Sealing

[Summary: The technology for the sealing of the boreholes and shafts is an area in which the adequacy of the current information base is questioned. The capability of the DOE program to develop sufficient information is also questioned. Some participants maintain that nothing less than permanent and complete sealing is necessary and that seals must perform as well as the host rock in providing a barrier to radionuclide migration. DOE believes that the sealing should provide a barrier with sufficient integrity to ensure acceptable consequences and that sealing adequacy should be determined only on a site-specific basis. DOE believes that a significant body of technical data is available today and that its research program will successfully resolve remaining uncertainties.]

Issue

Will the DOE research program on sealing technology, building on existing information, lead to the development of a capability to seal boreholes and shafts such that radionuclide migration will be limited to acceptable levels?

5.11 Retrievability

[Summary: Retrievability may be necessary if the long-term performance of the repository is found to be unacceptable. DOE believes that its proposed program for development of specific means and procedures for safe retrieval will be successful and that accumulated data and experience support this position. Some participants point to many difficult and basic problems that will not be resolved in time, if ever, to be factored into repository and waste package design. Other participants believe that, since retrievability should be assumed before site selection, DOE's schedule is incompatible with the objective of having a repository in operation by 2006. Participants also differ about whether a method of retrieval has been or needs to be described in sufficient detail at this time to warrant confidence that it is feasible. The possibility and practicality of waste retrieval from a salt repository are particularly questioned.]

Issue

Should waste emplaced in a repository be retrievable and, if so, for how long? Can a system be devised for ensuring retrievability of wastes, if necessary, from geologic repositories, and can this system be implemented in the necessary time frame?

Standards for Acceptable Repository Performance

5.12 Radiological Dosage and Health Effects

[Summary: Several participants have estimated dose rates for workers and for the public during operational or post-closure time periods under both routine and accident conditions. These estimates as well as those of the resulting health effects and risks to the public or workers vary widely because of the use of different assumptions, computational techiques, and standards. Some participants have questioned the adequacy of existing EPA and NRC radiation exposure standards. In the absence of established standards for acceptable releases or doses from a repository, several participants have suggested different standards for use as benchmarks for satisfactory repository performance. On the other hand, DOE maintains that reasonable reductions in present standards would not seriously affect repository design and operation. In addition, DOE and some participants maintain that the risk of nuclear waste will be reduced to minimal levels with properly sited and constructed geologic repositories.]

Issue

What will be the radiological exposure to workers and the public during repository operation and in the long term? What are the appropriate standards for acceptable occupational and public radiological exposure?

5.13 Acceptability and Adequacy of Analytical Models

[Summary: The issue of the acceptability of the developed models concerns the validation and verification on a short-term basis of models that describe very long-term processes. The issue of adequacy addresses the question whether the complex phenomena incorporated into these models have been correctly represented, whether the analytical combinations of these phenomena and processes are valid, and whether the event scenarios are realistic and are assigned appropriate probability values. The adequacy of the representations of chemical processes is of particular concern because radionuclide migration during extremely long periods may be critically dependent on small and ill-defined chemical reaction rates.]

Issue

Can analytical models for predicting long-term repository performance properly account for the physical, chemical, and biological phenomena affecting radionuclide release, migration, and effects on biological systems, and yield reasonably accurate calculated consequences? To what extent can they be validated and verified?

5.14 Period of Time Required for Isolation and Containment of Waste

[Summary: Several participants have challenged the time periods proposed by DOE for isolation and containment performance objectives. DOE has established a performance objective of virtually complete containment within the waste package during the period when radiation and thermal output are dominated by fission product decay, i.e., the "first several hundred years" or, quantitatively stated, between 500 and 1,000 years. Several participants felt that DOE should adopt the 1000-year period set forth as a "strawman" technical requirement by the NRC staff.

DOE's performance objective for isolating waste from the accessible environment is 10,000 years, with no prediction of significant decreases in isolation beyond that time. This objective is based on the argument that the residual radiological hazard of spent fuel after 10,000 years is comparable to that of a natural ore body, which constitutes a very small hazard. Other participants suggest that longer periods of isolation are justified because of the residual toxicity, risk integrated over time, and the inevitable action of long-term dispersal.

<u>Issue</u>

Do the time periods set forth in the proposed performance objectives of DOE for containment of waste and isolation of radionuclides from the biosphere provide adequate protection of the health and safety of future generations? Can DOE meet these objectives?

5.15 Monitoring Capability During Repository Operation and After Closure

[Summary: Some participants believe that insufficient attention has been devoted to monitoring and instrumentation for collection of data to determine repository performance. One participant states that both the types of monitoring needed and the time duration of such monitoring have yet to be specified. DOE agrees that monitoring during operation to confirm repository performance will be necessary but claims that the repository will be designed to make environmental monitoring after decommissioning unnecessary. Nonetheless, the adequacy of the capability to effectively monitor a repository, both during the operational phase and after closure, is an issue. Measuring instruments and systems have not generally been employed for monitoring deep geological features over time periods of several decades. Instrument and component reliability and continued accuracy over these long periods are in question. The ability to make such measures without affecting the integrity of the repository is also at issue.]

Issue

Is monitoring a necessary condition for safe waste disposal? What extent of monitoring is technically feasible to monitor repository performance during operation and perhaps for an indeterminate time after closure without jeopardizing the repository's integrity?

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8102020662
69pp

TABLE OF CONTENTS

The Report of the Working Group
on the Proposed Rulemaking on
the Storage and Disposal of Nuclear Wastes

THE REPORT OF THE WORKING GROUP
ON THE PROPOSED RULEMAKING ON
THE STORAGE AND DISPOSAL OF NUCLEAR WASTES

Introductory Statement by the Working Group

This report responds to two of the tasks which the Commission asked the Working Group to complete during the first phase of the waste confidence rulemaking proceeding. These tasks are:

- identify issues in controversy, and
- identify areas in which additional information is needed.

The Working Group notes that identification and summary of issues and identification of gaps in the record were called for by a number of the participants in their suggestions for next steps in this proceeding.

This report does not include proposals for further proceedings in the waste confidence rulemaking, although we hope it will provide a useful basis for the Commission's consideration of next steps. After the participants have commented on the Working Group's identification of issues and summary of the record and the Commission has had an opportunity to review this material, we shall consider the participants' October 5, 1980 filings regarding further proceedings and make recommendations to the Presiding Officer.

In the process of identifying issues and areas in which additional information is needed, we have carefully reviewed the position and cross-statements and prepared a preliminary summary of the record.[1] The summary which accompanies this report is organized as follows:

Part 1.A: Summary of DOE Position Statement

Part 1.B: Summary of Participants' Statements (organized according to DOE subject headings)

Part 2 Major Issues in Waste Confidence Rulemaking (summaries of participants' positions and cross-statements on the major issues identified by the Working Group)

Part 3 Major issues in Waste Confidence Rulemaking and abstracts of the principal positions on these issues.

Our first activity was to review and summarize the salient points in the DOE Position Statement of April 15, 1980. The results of this effort are presented in Part 1.A. Subsequently, with contractor assistance[2], we prepared a summary (Part 1.B) of the participants' position and cross statements organized for

[1]Appendix A lists all documents submitted by participants to the proceeding and used by the Working Group in preparing the summaries and formulating the issues.

[2]Teknekron Incorporated, contract #-19-81-491.

convenient comparison according to the principal subject headings of the DOE Position Statement. We carefully examined the record to identify issues in controversy among the participants. Then after refining and organizing the issues, we considered whether they constituted a comprehensive set of issues for this proceeding. Not all the issues raised by the participants are in our view equally critical to a finding on confidence. Assuming that the Commission does not desire to change the scope of proceeding, we believe that resolution of the issues now identified would enable the Commission to achieve the stated goals of the waste confidence proceeding, including a response to the questions whether safe waste disposal can be accomplished and, if so, when this is likely to be achieved. Whether in our view the record is adequate actually to resolve these issues is a matter we address later in this statement.

We then summarized (Part 2) the positions taken by each participant on each of these issues. As far as practical, the material was segregated according to participants who supported the DOE position and those who were opposed.[2] Lastly, a separate, shorter document (Part 3) was prepared listing the issues and presenting abstracts of the principal positions taken on these issues--in effect, an executive summary of the proceedings to date.

In preparing the summaries, we restricted our work to selecting and organizing the participants' position statements and cross-statements. In the following we present our views on the relative importance of the various issues and an

[2] The Working Group received assistance from Editorial Consultants, Inc., in preparation of the summary by issues.

assessment of the completeness of the record with a view toward identifying gaps.

We emphasize strongly that the summaries are not intended to substitute for the record; rather they are intended to assist the Commission in its decision-making by providing what we believe to be useful guidance to a voluminous record. As a further aid to the Commissioners--and to emphasize the importance of consulting the primary record on the most significant issues -- we have included after each individual summary, page references to identify exactly where the participant's position is set forth in its statements.

The identification and formulation of the major issues in contention have involved judgement on our part. We have placed the issues into five categories (Procedural Issues, Institutional Issues, the DOE Waste Management Program, Spent Fuel Storage Technical Issues, and Waste Disposal Technical Issues) to achieve, we believe, a useful distinction. However, we emphasize that these categories, as well as the individual issues, are not independent of each other. Their interdependence may affect the order in which the Commission may decide to consider the issues in this proceeding. We do not believe each individual issue should be "resolved" by the Commission, dropped from further consideration, and other issues then addressed. Just as in many technical matters, a "systems" approach is required to reach valid conclusions, so in this proceeding all issues should be considered as a whole to assure a valid rulemaking. As an example, it would be illogical to take a position on the issue of the existence of technically acceptable sites without also considering the issue of how technical acceptability is determined.

The fact that we present the issues as separate entities should not obscure their interdependence.

The commentary which follows this introductory statement sets forth our views on the implications of the various issues, their interdependence, and the completeness of the record. We have attempted to be strictly neutral with respect to how each issue should be resolved except in those few instances where we believe the Commission has clearly resolved the issues in the past. We have not been neutral, in view of the Commission's direction to identify "key" issues and indicate how they bear on the Commission's decision, in expressing our views as to the relative significance of the individual issues and how they are interrelated. Moreover, we have exercised our judgment in pointing out where we think the record should be supplemented. We should remark, in this connection, that our views on the adequacy of the record should be considered preliminary at this stage.

DOE and other participants cite numerous references in support of their positions on repository site evaluation and selection. Several references constitute a common pool of information cited by many participants. These common sources reports include the DOE and NRC generic environmental impact statements on waste management and spent fuel storage, the 1978 EPA report of the Ad Hoc Panel of Earth Scientists, the USGS Circular 779, the National Academy of Sciences reports on nuclear waste disposal of 1957, 1966 and 1978 and the IRG report (including its subgroup reports and appendices). We have noted that many of these reports are cited in support of opposing sides on the various

technical issues. (The USGS, author of one core report, points out in its cross statement that some participants have misinterpreted and incorrectly cited material in its report.) The references often lend themselves to different interpretations and the diverse perspectives of the participants lead them to different inferences. This makes it very difficult to judge the technical basis of participants' positions.

Several participants hold the view that waste isolation and containment are scientifically feasible (USGS PS p. 4; NRDC PS, p. 9; UNWMG-EEI PS, p. II-1-7). This view has also been expressed in the Report to the American Physical Society by the Study Group on Nuclear Fuel Cycles and Waste Management (1977) and the Report to the President of the Interagency Review Group on Nuclear Waste Management (1979).[1] In a letter of December 10, 1979, the Advisory Committee on Reactor Safeguards told Chairman Ahearne, "Considering first the technical aspects, we believe that safe disposal of radioactive wastes is reasonably assured by the present state of knowledge. ...We believe that the DOE estimate for completion of a waste repository by 1997-2006 is technically achievable. However, the major problem in forecasting an availability date is sociopolitical. Until the issue of consultation and concurrence among federal, state, and local authorities is better resolved and the licensing/litigation process as well as standards setting by EPA and NRC is better defined, we believe that trying to forecast a firm availability date for a repository is futile in the absence of action by Congress."

[1]We cite these reports because, as noted above, they are core reports cited by many participants.

However, as DOE has acknowledged in its position and cross-statements, additional engineering development work remains to be done before safe waste disposal can actually be achieved. To the extent that technology for safe waste disposal is not "off the shelf" an NRC confidence finding would be largely an expression of confidence that the DOE ongoing waste research and development program will produce the anticipated results in the years ahead.[2] Until the program is completed, there necessarily remains a degree of uncertainty regarding whether DOE will find the answer to questions still open and whether those answers, when found, will turn out as hoped for.

We believe it is unlikely that an intensive review of the data base as it now exists would reduce the uncertainty to an insignificant level. This situation simply reflects the intrinsic difficulty of assessing confidence in the future course and achievements of a developing technology. Thus, a substantial exercise of intuitive judgment may be required in resolving some of the waste disposal technical issues as they bear on this proceeding.

In our view, certain areas have emerged as key to the Commission finding on confidence in safe and timely storage and disposal of spent fuel. These key

[2]The Commission has already relied on the existence of a program as a basis for confidence. 42 Fed. Reg. 34393 (November 5, 1976). Now that the program has been established and has been in operation, the Commission might go further and look for a demonstration of tangible results in order to find confidence. This does not mean that the Commission would have to find the technology fully developed. It simply means that DOE's statement should be evaluated based on the extent to which it has presented information which demonstrates that programs are in operation and are, in fact, achieving relevant results.

areas--which subsume the essential elements of the twenty-six identified issues--are:

- DOE waste management program and its implementation. It is clear that, while significant progress has been made in developing the technology for safe storage and disposal of spent fuel, a great deal of work remains to be done. If waste is to be safely disposed of by around the end of the century, then a sufficient level of technical resources must be committed to the technology development and these resources must be effectively managed. Management will be most effective if DOE is able to cooperate with federal, state, and local governmental bodies and gain public acceptance of its program.

- Existence of technically acceptable sites needed for mined geologic disposal. Obviously, for mined geologic disposal to be successful, there must exist host rock masses suitable for repository siting. Moreover, such host rock masses must be located at a depth and in a geologic environment that permits excavation, mining, repository construction, and closure using available technology.

  Identification of technically acceptable sites will require understanding of the local and regional hydrology and the thermomechanical properties of the rock. The information on hydrology will contribute to understanding of potential leaching and migration of radionuclides. Some of this information can only be obtained from a program of in-situ testing in various

media. Also, evaluation of risks of future human intrusion requires consideration of mineral resources at candidate sites. The record indicates that no site has yet been positively identified as acceptable, and no site under active consideration is free of potential difficulties. Thus, much of this work remains to be accomplished as DOE proceeds with its waste disposal program.

- Spent fuel as a waste form and the associated waste package. A key issue is the ability of spent fuel and the rest of the waste package to contain radioactivity during the period of concern. The decay heat, hydrology, and nuclear radiation could also affect the interaction of waste form and packaging with the host materials.

- Effectiveness of engineered systems in achieving satisfactory repository performance. For example, backfill materials can provide barriers to groundwater movement into the repository, dissipate heat from the spent fuel, buffer chemical reactions, and provide structural stability and radiation shielding. The effectiveness of engineered systems as a defense against migration of radionuclides into the biosphere could be a significant issue.

- Safe storage of spent fuel for extended periods of time. Prior to geologic disposal spent fuel must be stored safely and without serious environmental effects. The associated storage basin components and structures must also safely sustain extended operation.

A special note is necessary concerning the institutional issues. Although they do not appear to affect the ultimate technical feasibility of safe waste disposal, the timely resolution of such issues may be necessary before safe waste disposal can be achieved. Since one of the objectives of this proceeding is to determine whether safe waste disposal will be available by the year 2007, or more generally by the time reactor licenses now being issued are due to expire, the Commission may need to address the relation between institutional issues and the schedule for waste disposal and take a position on when these issues are likely to be resolved.

We have identified several areas in which we believe that supplemental information may be desirable. These areas are:

- Discussion of the historical and projected DOE waste management program expenditures in manpower and monetary commitments and program plans which delineates the linkages between technical projects and technical problems, and shows the timing of expected solutions. (See pages 23 and 24.)

- Relevant information derived from recent power plant siting investigations which present technical subsurface data on basalt at the Hanford site. (See page 50.)

- Additional technical studies on DOE's analysis of retrievability (if they exist). (See page 61.)

Our summaries of the issues and record, together with participants' comments on the accuracy of our representation of their positions, will become a part of the record.

Edward J. Hanrahan

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Chairman of the Working Group

COMMENTARY ON MAJOR ISSUES

Based on examination of the positions of the various parties, the Working Group has identified 26 major issues in contention. In the Working Group's view, one issue not explicitly in controversy but implicit in the complexity of the record is whether the state of this record can in the end be meaningfully or usefully characterized by a simple finding of "confidence" or "no confidence." As the identification of the issues should indicate, there appear to be a number of contingencies, both technological and institutional, on which the success and timeliness of waste disposal may hinge. If closer study of the record and/or further proceedings leaves significant uncertainty whether these issues will be favorably resolved, the Commission might wish to consider framing the outcome of this proceeding directly in terms of changes in licensing and regulatory policy appropriate for dealing with the uncertainties rather than in terms of a degree of "confidence" which would later have to be translated into policy implications.

Issues raised by the participants have been grouped into five principal categories and subcategories. Table 1 presents the organization of the issues, and identifies each issue by a short title. The following text is a discussion of the issues in each of the five categories, their logical interrelationships, the adequacy of the relevant record, and the principal positions of the participants.

TABLE 1

MAJOR ISSUES IN WASTE CONFIDENCE RULEMAKING

I. Procedural Issues

1.1 Scope of proceeding
1.2 Standard for finding confidence

II. Institutional issues

2.1 Federal role
2.2 Federal-State relations
2.3 Public acceptance

III. The DOE waste management program

3.1 Management capability, resources, schedules, costs
3.2 Regulatory framework for the DOE program
3.3 Socioeconomic impacts; equitable distribution of risks and benefits

IV. Technical issues for spent fuel storage

4.1 Safe storage of spent fuel for extended periods
4.2 Structural and component safety for extended facility operation
4.3 Risks of accidents and sabotage at spent fuel storage facilities

V. Technical issues for waste disposal

Repository site selection
5.1 Existence of technically acceptable sites
5.2 Information required for site characterization
5.3 In-situ testing of geologic media
5.4 Leaching and sorption
5.5 Radionuclide migration from repository to biosphere
5.6 Risks from human intrusion

Engineering activities for repository site development and operation

5.7 Assessment of spent fuel as waste form
5.8 Interaction between nuclear waste and host medium
5.9 Engineered barriers
5.10 Borehole and shaft sealing
5.11 Retrievability

Standards for acceptable repository performance

5.12 Radiological dosage and health effects
5.13 Acceptability and adequacy of analytical models
5.14 Period of time required for isolation and containment of waste
5.15 Monitoring capability during repository operation and after closure

I. Procedural Issues

1. Task: Identify issues in controversy.

1.1 Should the waste confidence proceeding address waste disposal issues other than storage and disposal of power reactor spent fuel?

1.2 Is the "reasonable assurance" standard appropriate for finding confidence in the proceeding or should some other standard such as "beyond a reasonable doubt," "more likely than not," "substantial evidence," "extraordinarily high degree of assurance" be applied?

Although prior statements by the Commission and the Presiding Officer provide guidance concerning the intended scope of the proceeding, the participants have disagreed on the issues to be addressed. A number of participants believe that the proceeding should address such subjects as the disposal of low-level wastes, the safety of transporting radioactive wastes, the management of mill tailings, and international issues related to waste disposal, while others suggest that issues related to reprocessed waste should be considered.

In response to the Presiding Officer's Order, the DOE Position Statement assumes that spent fuel rather than reprocessed high-level radioactive waste will be emplaced in a disposal facility. Opposition in the last Congress to the use of DOE funds for spent fuel disposal makes it uncertain whether DOE's decision to restrict its analysis to the outlook for disposing of spent fuel is realistic.

Despite changing circumstances and the probability that the political situation will remain in flux for some time, the Working Group recommends against altering the scope of the proceeding at this time unless the Commission expects that reprocessed waste or some other waste form will be adopted in place of spent fuel.

With respect to the standard for a finding of confidence that waste can be disposed of safely, participants' positions range from requiring no more than "substantial evidence" to requiring an "extraordinarily high" degree of assurance. For some participants the assurance must be that all problems can be solved while for others it is that all problems have been solved. Many of the states and environmental groups would require a significantly higher standard of sufficiency to demonstrate waste confidence than would DOE, the utilities, and the nuclear industry.

2. Task: Identify areas in which additional information is needed.

The Working Group believes that the Commission's October 18, 1979, Notice of Proposed Rulemaking (44 FR 65372) and the Presiding Officer's First Prehearing Conference Order of February 1, 1980 provide adequate and clear descriptions of the Commission's intended scope for this proceeding. If the Commission is persuaded by the arguments of some participants that the previously stated scope should be revised, then the Working Group urges that any supplementary Commission statement concerning scope provide all participants an opportunity to amend their position or cross statements as necessary.

Regarding the issue of the standard for a finding of confidence, the Working Group notes that the Commission's Notice of Proposed Rulemaking (44 FR 61372) consistently refers to "reasonable assurance," which as the Commission has used the term here might fairly be taken as equivalent to "confidence." Neither "confidence" nor "reasonable assurance" has been precisely defined in the sense that the Commission has not specified the degree of residual uncertainty it would regard as consistent with a finding of confidence or reasonable assurance. If the Commission maintains its intention to express the results of this proceeding in terms of "confidence," clarification of the meaning of the term as perceived by the Commission would be desirable.

Since the issue is largely one of the Commission's choice of meaning, the Working Group does not believe that additional information solicited from the participants would be useful. However, if the Commission wishes to rely on "confidence" expressions from participants, the Commission might request those participants to explain more precisely what they meant.

II. INSTITUTIONAL ISSUES

1. Task: Identify issues in controversy.

Many studies of the nuclear waste disposal problem have indicated that resolution of institutional issues could be as important as, or even more important than, the solution of technical problems. See for example the ACRS statement of December 10, 1980 which calls for an expeditious resolution of legal and political issues concerning site selection and acquisition.* The Working Group has identified three basic institutional issues:

2.1 Should the Commission for purposes of this proceeding assume a commitment by the Federal government to provide the continuing policy and budgetary support necessary to carry out whatever measures are required to assure safe waste management and disposal?

2.2 How will state and local concerns affect the selection of sites or interfere with the development and operation of repositories?

*In addition, the Interagency Review Group on Nuclear Waste Management in its report to the President noted that "the resolution of institutional issues... is equally important as the resolution of outstanding technical issues and problem." (TID-29442, March 1979, page 87.) Similarly, the American Physical Society Study Group on Nuclear Fuel Cycles and Waste Management commented that institutional problems have an effect "often overriding strictly technical considerations." (Rev. Mod. Phys., Vol. 50, No. 1, Pt. II, January 1978, p. S159.)

2.3 Will DOE be able to gain public acceptance of its program for waste storage and disposal, and, if not, will lack of acceptance significantly handicap the program?

Even if technical uncertainties about waste disposal are favorably resolved, timely resolution of the institutional issues may be necessary before safe waste disposal can be implemented. Since one of the objectives of the Waste Confidence Proceeding is to determine whether safe waste diposal will be available by the year 2007, or more generally by the time reactor licenses now being issued are due to expire, the effect that institutional issues have on waste disposal schedules is a matter of potential importance to the proceeding.

Institutional issues generally are subject to actions of political entities whose intentions are uncertain and changeable. For example, action by Congress or the Office of Management and Budget could alter the amount of Federal support for the waste management program as well as the amount of waste requring disposal. DOE, the nuclear industry, and the utilities generally maintain that the Executive Branch and the Congress have taken the steps necessary to ensure a commitment to the Federal waste management program. Several participants, however, believe that DOE cannot ensure continuity because of the long-range nature of the program, policy disagreements between the executive and legislative branches and fragmented decisionmaking throughout the government. Further, they believe that executive or legislative action in response to, or independent of, NRC's decision, might alter the Federal-state relation which affects the outlook for waste disposal.

DOE, the nuclear industry and the utilities generally state that the President and the Congress have recognized the need to involve state and local governments in the decisionmaking process and they are taking steps to establish an institutional framework to accomplish this end. States and environmental groups are skeptical that the mechanisms proposed by DOE for incorporating state and local views (e.g., consultation and concurrence) will work satisfactorily.

The issue of public acceptance involves additional difficulties. It is difficult to obtain an objective measure of the degree of potential public acceptance of any proposed Federal action, and in the present case it appears impossible to fully define future actions which will affect public reaction. Public attitudes may change drastically with time and circumstance. DOE and the utility group believe that an extensive program of public education and communication during all phases of the waste program will facilitate public understanding and acceptance. States and environmental groups generally believe that public distrust is a significant obstacle to DOE's program.

2. Task: Identify areas in which additional information is needed.

The Working Group has reviewed the discussion of these institutional issues in the record of the proceeding and sees no systematic approach to their resolution. The Commission will have to rely on its collective judgment to make findings on the various institutional issues, singly or as a group, to the extent the Commission concludes that this proceeding requires such resolution.

The record relating to the Federal role and Federal-state relations appears to be adequate and the Working Group does not recommend that it be supplemented.

III. THE DOE WASTE MANAGEMENT PROGRAM

1. Task: Identify issues in controversy.

The Working Group has identified the following:

3.1 Can the DOE waste management program be completed on a schedule consistent with the rate of generation of nuclear waste and the projected storage capacity? Is the DOE program economically feasible?

3.2 Can the adequacy of the DOE waste management program be evaluated now, or must evaluation await further development of the regulatory framework?

3.3 Does the DOE program provide for adequate assessment and mitigation of socioeconomic impacts and adequately address concerns raised regarding the distribution of risks and benefits?

As in the case of the institutional issues, resolution of the DOE program issues depends on judgmental factors. Some positions taken by participants are essentially expressions of no confidence in DOE's capabilities. Past events are cited and interpreted as either favorable or unfavorable to the DOE position, depending on the interpreter's particular viewpoint.

With respect to the management of its program, DOE feels that its revised management structure provides the centralized direction, effective coordination, and

flexibility necessary to ensure concerted action. DOE considers its schedule and cost estimates logical, sound and flexible and believes that the time schedule should not be altered. Many industry and utility groups believe that the DOE schedule is too conservative and results in a more protracted timetable than is warranted by technical and institutional concerns. Several states and environmental groups hold that the DOE waste management program is poorly organized, funded, and managed and that DOE's historical failure to solve the problems of waste disposal suggests that DOE will be unable to solve them in the future.

With regard to the regulatory framework, definitive criteria are now being developed. In the interim, DOE believes that its seven basic objectives provide an adequate basis for evaluating the waste management program. (See p. II-7 to p. II-21 of DOE Position Statement) Several states and environmental groups consider the lack of definitive regulatory criteria to be a serious impediment to success of the program and to a finding of confidence.

DOE is structuring its program to take account of socioeconomic impacts on states and local communities and to distribute risks and benefits arising from the repository as equitably as possible. A few participants consider DOE's program seriously deficient in these areas.

2. Task: Identify areas in which additional information is needed.

The record in this area may be deficient in two important respects. First, some participants' arguments may no longer be valid as a result of the recent

(October 1, 1980) changes in the management structure and reorganization of DOE's program. (See DOE Cross Statement, pages II-22 to II-30.) Second, the Working Group's review of DOE's position and cross statement shows that much additional development work remains to be done. To the extent that technology for safe waste disposal is not "off the shelf" an NRC positive finding would be largely an expression of confidence that the DOE ongoing waste research and development program will produce the requisite knowledge in the years ahead.[1] The DOE position and cross statements are weak in that there is not much detailed discussion of the historical and projected expenditures in terms of manpower and monetary commitments to the program. The extent of DOE commitments in manpower and dollars and the effectiveness of DOE's expenditure of resources to date should be a critical factor in determining the level of confidence that radioactive waste will be disposed of in a timely and safe manner.

In addition, the Working Group believes that the description of the DOE program is lacking in regard to an important element: a discussion which clearly delineates the linkages between technical projects and technical problems, the timing of expected solutions, and the integration of the solutions into the decision-making process. As an example. the discussion of in-situ tests

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(pages II-248 and II-268) describes a score of geotechnical tests underway at more than a dozen sites. What is lacking is a discussion of how these investigations are integrated into the logical sequence of site investigation activities and thence into site selection decisions.

IV. TECHNICAL ISSUES FOR SPENT FUEL STORAGE

1. Task: Identify issues in controversy

The Working Group has identified three principal issues:

4.1 Do the properties of spent fuel allow it to be safely stored for extended periods without significant safety, health, and environmental effects?

4.2 Can the structure of spent fuel storage basins and associated basin components safely sustain extended periods of operation, perhaps for many decades?

4.3 How important are the risks posed by accidents and acts of sabotage at spent fuel storage facilities?

DOE cites more than 20 years of successful experience in the U.S. and abroad, as well as extensive relevant basic data, as the basis for its belief that spent fuel can be safely stored for extended periods either at reactors or in away-from-reactor facilities. Also, DOE and other participants maintain that there will be negligible degradation of performance of associated components. DOE and several participants claim that the risks of serious accidents or sabotage with off-site radiological consequences are extremely small. Other participants cite the possibility of leakage of fission products as fuel cladding corrodes and the difficulty of assuring error-free human performance in the long-term

management of storage facilities. They also cite accidents which have occurred as well as other unfavorable experience. These considerations lead them to conclude that interim storage of spent fuel before geologic disposal will itself be unsafe.

The Working Group has considered additional, related issues beyond those arising from disagreements among participants in the area of spent fuel storage. Several potential issues were identified and are discussed below in the Working Group's assessment of the completeness of the information base.

2. Task: Identify areas in which additional information is needed

The participants have introduced a substantial body of information into the record on the three issues. These include the safety analysis reports for the AGNS Barnwell, GE Morris, and NFS West Valley spent fuel storage facilities as well as a number of other technical design studies and evaluations. The record also includes references to relevant foreign fuel storage experience. Also, as stated in the Commission's notice of proposed rulemaking, the record in the waste confidence proceeding will draw upon information set forth in the Commission's recently concluded rulemaking on the environmental impacts of the nuclear fuel cycle (S-3 Table) in which related issues were considered. In addition, the Commission staff recently reported its analysis of extended spent fuel storage in the Final Generic Environmental Impact Statement on the Handling and Storage of Spent LWR Fuel. (NUREG-0575) In view of the information now

on the record in this proceeding as well as on the record in other relevant proceedings, the Working Group believes that the information base is adequate for decision-making on the technical issues discussed above.[1]

Two possible exceptions are noted below:

A. The Commission may wish to reconsider as a policy matter whether the concept of indefinite storage of spent fuel-- either on the surface or in mined, engineered facilities--should be analyzed within the context of this proceeding. DOE maintains that nuclear wastes can be safely disposed of in mined geologic repositories. Thus, DOE gave limited treatment to alternative disposal or indefinite storage concepts.

[1] Of course, this is not to say that all facility-specific issues have been settled today. For instance, the DOE Statement omits mention of potential technical problems for two of the existing storage sites on which they rely to some extent. Specifically, there are expected to be seismic questions raised for the AGNS Barnwell site, and new seismic information has been developed. (This is not a judgement of whether any seismic-related contention would be valid.) Also, a seismic issue exists for the NFS West Valley pool. These issues would be resolved in licensing proceedings if DOE decides to use the facilities and the Working Group does not believe that additional information on these specific topics is critical to the Commission's judgment of confidence. In addition to these technical issues, the provision and timing of spent fuel storage capacity seem to be critically dependent on institutional considerations which are not adequately dealt with in the DOE Statement. Among these are the authorization of funds by Congress, the willingness of present owners of independent spent fuel storage installations to sell them to DOE, and the willingness of the states, which are sensitive to the presence of wastes within their boundaries, and the public to accept a large Federal storage facility. However, the Working Group feels that the Commission has enough information available on the record and from other sources on these issues.

The Working Group points out that, should the Commission decide indefinite surface storage warrants consideration, the record would have to be supplemented.

B. Another potential issue raised by participants and considered by the Working Group is the capability of the DOE waste program to safely store and dispose of damaged spent fuel including that which has been severely damaged in major reactor accidents (e.g., the core from TMI-type accidents). The spectrum of fuel damage analyzed in the DOE Position Statement stops short of considering severely damaged fuel. The Working Group recognizes that management and disposal of severely damaged fuel might present unique problems.

Although it is assumed for purposes of this proceeding that the spent fuel to be stored and disposed of has not been severely damaged in the course of its use in power reactors, i.e., the condition of the spent fuel is essentially the same as all spent fuel presently being stored at reactor sites, DOE states that only spent fuel meeting predetermined acceptance criteria will be accepted in the repository. There is no description of the final disposition of spent fuel which does not meet the criteria.

V. TECHNICAL ISSUES FOR WASTE DISPOSAL

1. Task: Identify issues in controversy

The Working Group has identified fifteen technical issues related to waste disposal which are in controversy among the participants. We have grouped these issues in three principal categories: repository site selection, engineering activities for repository site development and operation; and standards for acceptable repository performance.

Repository Site Selection

Six of the technical issues are germane to the process of repository site selection. The pertinent issues are:

5.1 Do potentially acceptable sites exist and can they be identified within the time period at issue?

5.2 Can the state of knowledge of candidate geologic media and sites for a repository reasonably be expected to be sufficient when DOE expects to make the key decisions?

5.3 What importance should be assigned to *in situ* testing in the evaluation of candidate repository sites? To what extent is *in situ* testing necessary

prior to developing a radioactive waste disposal facility? Is DOE now conducting or will it conduct an adequate amount of in situ testing?

5.4 Will the state of knowledge of leaching of radioactive waste and the sorption of radionuclides by candidate host media be adequate in time to support a valid assessment of the long-term performance of a mined geologic repository?

5.5 Will there be adequate information concerning the migration of radionuclides from the repository to the biosphere to support a valid assessment of repository performance?

5.6 Does the possibility of accidental or unauthorized intrusion into a waste repository present a significant obstacle to achieving safe waste disposal?

Below is a brief discussion of the general positions taken on these issues by the participants.

Issue 5.1

Regarding existence and identification of technically acceptable sites, DOE maintains that the site selection process it has adopted as well as its ongoing exploration program will identify acceptable repository sites and that the field operations required to characterize candidate sites will not jeopardize

their integrity. Those disagreeing with the DOE position assert that determination of the acceptability of proposed repository sites requires information that will not be available when needed.

Issue 5.2:

DOE believes that the technical information now available on the geologic media of potential repository sites is sufficient to support a finding of confidence that a suitable site will be found and that ongoing laboratory and field work will reduce or eliminate existing uncertainties. Participants disagreeing with the DOE position state that there are many specific gaps in the current state of knowledge of candidate sites and geologic media and, that because of this, a finding of confidence is not warranted.

Issue 5.3:

DOE states that *in situ* testing conducted in its program has aided in significantly improving computational models and supported a finding of confidence in the feasibility of mined geologic disposal. Some participants contend that DOE has not conducted sufficient *in situ* experiments and those that have been performed have not yielded definitive and satisfying results relating to repository design and performance; moreover, the fundamental limitations of *in situ* experiments are not recognized and the results have often contradicted *a priori* predictions based on laboratory data and modeling.

Issue 5.4

Regarding leaching and sorption, it is generally recognized by all participants that an important potential pathway for radionuclide migration to the biosphere is through groundwater. DOE's position is that the uncertainties and gaps in current knowledge of leaching and sorption processes do not prevent making conservative and bounding calculations that provide reliable predictions of mined geologic repository performance. Some participants believe that the current understanding of these processes, as well as available relevant data, do not provide an adequate basis for predicting long-term performance of a mined geologic repository.

Issue 5.5:

An understanding of the factors influencing rates of migration of radionuclides from a repository to the biosphere is necessary to evaluate the repository's isolation capability. Some participants contend that large uncertainties and gaps in knowledge of those properties of candidate host media that control underground transport for long flow paths, as well as limitations of the transport models themselves, make it impossible to predict with any degree of confidence the performance of a mined geologic repository. DOE maintains that, in spite of lack of knowledge of all details of radionuclide migration, adequate predictions of repository performance can be made by using bounding, conservative assumptions.

Issue 5.6:

With respect to human intrusion, several participants state that intrusion into a waste repository sited in salt, with or without knowledge of the repository's existence, is likely because of the value of salt and other resources often associated with salt deposits (potash, sulfur, natural gas, oil). Some participants believe that intrusion, regardless of the geologic medium chosen, is likely because of the value of the spent fuel itself or, in some proposed schemes, the value of the waste package materials. On the other hand, DOE feels that it can mimimize the possibility of exploration for resources by taking into account the likelihood and consequences of activities to explore or recover resources in its site selection process. In addition, because measures to protect against intrusion are available, the use of salt is not invalidated. Natural and engineered barriers would mitigate consequences, and surreptitious entry to recover the spent fuel is unlikely.

2. Task: Identify areas in which additional information is needed

In considering whether the record should be supplemented for this section, as well as for the other two sections of the issues in category 5, it is important to distinguish between information which might be available but not on the record and information which has not yet been developed. The Working Group has found that the most significant information gaps are in the latter category.

Additional information regarding in-situ testing, leaching and sorption, radionuclide migration to the biosphere, and intrusion for resource recovery is being developed. While DOE cites five specific geologic environments currently under investigation and numerous references from ongoing exploration efforts, more information would be required to establish definitely that these environments will provide one or more satisfactory sites.

Much of this information remains to be developed. The Working Group believes that the record is essentially complete in its description of current knowledge and would not be improved by additional information. See Appendix B for the Working Group Commentary on the current DOE program.

Engineering Activities for Repository Site Development and Operation

Five of the technical issues are pertinent to engineering activities for repository site development and operation as well as selection of waste form and engineered barriers. These issues are:

5.7 Is spent fuel an adequate waste form? Is the information currently available adequate to assess the performance of spent fuel as a waste form?

5.8 Are waste-rock interactions sufficiently understood to permit reliable predictions of long-term repository integrity?

5.9 Are engineered barriers (e.g., waste packages and backfill materials) necessary to provide assurance of nuclear waste containment for the desired period of time, and, if so, will DOE develop them when needed.

5.10 Will the DOE research program on sealing technology lead to the development of a capability to seal boreholes and shafts such that radionuclide migration will be limited to acceptable levels?

5.11 Should waste emplaced in a repository be retrievable and, if so, for how long? Can a system be devised for ensuring retrievability of wastes, if necessary, from geologic repositories, and can this system be implemented in the necessary time frame?

Below is a brief discussion of the participants' general positions on these issued.

Issue 5.7:

With respect to spent fuel as a waste form, DOE believes that the relevant properties of the basic form (irradiated uranium dioxide pellets and zircaloy cladding) are known and that programs in progress will define more completely its behavior as a waste package component under repository conditions. A number of participants point to the limits of present knowledge, particularly information concerning the leaching of radioisotopes from spent fuel in a

groundwater environment, and conclude that it is not possible to select a waste form which will prevent radioisotopes from migrating to the biosphere.

Issue 5. 8:

Several participants maintain that the interactions of nuclear waste and host rock are not well enough understood to proceed with the development of a geologic repository. Adverse interaction could result from the direct or synergistic effects of radiation, heat, and groundwater intrusion. Examples cited include reduction in the structural stability of the repository or the integrity of the host medium caused by spent fuel heat generation. DOE maintains that a considerable amount of relevant information on waste-host rock interaction is already available and that the effects of many of the individual interaction processes can be bounded and thus permit valid assessments of repository system performance for specific sites.

Issue 5.9:

Some participants believe that there is inadequate information to permit development of a long-lived waste package and other engineered barriers that will effectively contain radioactive wastes. Lack of information on the degradation of canister materials in geologic environments is emphasized as well as a lack of data on potential backfill materials. However, DOE, supported by several participants, asserts that it has provided sufficient

evidence that long-lived waste packages and other engineered barriers can be designed and built in a timely manner and that they will perform as required.

Issue 5.10:

Some participants conclude that current information concerning the technology for the sealing of the boreholes and shafts is inadequate. The capability of the DOE program to develop sufficient information is also questioned. Some participants maintain that seals must perform as well as the host rock in preventing radionuclide migration. DOE believes that the sealing should provide a barrier with sufficient integrity to ensure acceptable consequences and that sealing adequacy should be determined only on a site-specific basis. Moreover, DOE states that a significant body of technical data are available today and that its research program will successfully resolve remaining uncertainties.

Issue 5.11:

Retrieval of waste may be necessary if the long-term performance of the repository is found to be unacceptable. DOE believes that its proposed program for development of specific means and procedures for safe retrieval will be successful and that accumulated data and experience support this position. Some participants believe retrieval presents many difficult and basic problems that will not be resolved in time to be factored into repository and waste package design.

2. Task: Identify areas in which additional information is needed.

Additional data and information on waste form, interaction between nuclear waste and the host medium, performance of engineered barriers and seals, and retrievability would be required to demonstrate the adequacy of these system elements on a site-specific basis. Since this information is being developed, the Working Group believes that the record is essentially complete in its description of current knowledge of these issues and cannot usefully be supplemented at this time. For further discussion see the Working Group's Commentary in Appendix B.

Standards for Acceptable Repository Performance

The last four technical issues are germane to standards for acceptable repository performance and the assessment of performance using models. These issues are:

5.12 What will be the radiological exposure to workers and the public during repository operation and in the long term? What are the appropriate standards for acceptable occupational and public radiological exposure?

5.13 Can analytical models for predicting long-term repository performance realistically account for the physical, chemical, and biological phenomena affecting radionuclide release, migration, and effects on biological

systems and yield reasonably accurate calculated consequences? To what extent can they be validated and verified?

5.14 Do the time periods set forth in DOE's proposed performance objectives for containment of the waste form and isolation from the biosphere provide adequate protection of the health and safety of future generations? Can DOE meet these objectives?

5.15 Is monitoring a necessary condition for safe waste disposal? What extent of monitoring is technically feasible to monitor repository performance during operation and perhaps for an indeterminate time after closure without jeopardizing the repository's integrity?

Below is a brief discussion of the participants' positions on these issues.

Issue 5.12:

Some participants have questioned the adequacy of existing EPA and NRC radiation exposure standards. In the absence of existing standards for acceptable releases or doses from a repository, several participants have suggested that different standards for acceptable releases or doses from a repository be used as benchmarks for satisfactory repository performance. Several participants have estimated dose rates for workers and the public during operational or post-closure periods under both routine and accident conditions. These estimates as well as those of the resulting health risks vary widely because of the use of different

assumptions, computational techniques, and standards. DOE maintains that reasonable reductions in present standards would not seriously affect repository design and operation. In addition, DOE and some participants maintain that the risk of nuclear waste will be reduced to minimal levels with properly sited and constructed geologic repositories.

Issue 5.13:

The issue of the acceptability of models for predicting repository performance concerns the validation and verification on a short-term basis of models that describe very long-term processes. The issue of adequacy of models concerns the question whether the complex phenomena incorporated into the models have been correctly represented, whether the analytical representations of coupled phenomena and processes are valid, and whether the event scenarios are realistic and assigned appropriate probability values. The adequacy of the representations of chemical processes is of particular concern because radionuclide migration during extremely long periods may be dependent on small and ill-defined chemical reaction rates.

Issue 5.14

Several participants have challenged the time periods proposed by DOE for isolation and containment performance objectives. DOE has established a performance objective of virtually complete containment within the waste package during the period when radiation and thermal output are dominated by fission-product

decay, i.e., the "first several hundred years" or, quantitatively stated, between 500 and 1,000 years. DOE's performance objective for isolating waste from the accessible environment is 10,000 years, with no prediction of significant decreases in isolation beyond that time. It is based on DOE's contention that the residual radiological hazard of spent fuel after 10,000 years is comparable to that of a natural ore body, i.e. a very small hazard. Other participants suggest that longer periods of isolation are justified because of the residual toxicity, risk integrated over time, and the inevitable action of long-term dispersal mechanisms.

Issue 5.15:

Some participants believe that insufficient attention has been devoted to planning, monitoring and instrumentation for collection of data to determine repository performance. Both the types of monitoring needed and the time duration of such monitoring have yet to be specified. DOE agrees that monitoring during operation to confirm repository performance will be necessary but claims that the repository will be designed to make environmental monitoring after decommissioning unnecessary. Nonetheless, the adequacy of the capability to effectively monitor a repository, both during the operational phase and after closure, is an issue. Measuring instruments and system have not generally been employed for monitoring deep geological features over periods of several decades and their reliability and accuracy over these long periods are in question. The ability to make such measurements without affecting the integrity of the repository is also questioned.

2. Task: Identify areas in which additional information is needed.

The Working Group believes that the record is essentially complete in its description of current knowledge of these issues. However, we should emphasize that DOE has acknowledged that a considerable amount of work must be done in order to produce reliable models for bounding the performance of a waste repository. Furthermore, DOE plans to conduct further studies and demonstrations of monitoring techniques. The Working Group has identified some concerns in its Commentary in Appendix B to this report.

APPENDIX A

Documents Submitted by Participants

Statements of Federal Agencies

1. United States Geological Survey
2. Department of Energy
3. Council on Environmental Quality
4. Office of Science and Technology Policy
5. Arms Control and Disarmament Agency

Position Statements of Other Participants

1. American Institute of Chemical Engineers
2. Mississippians Against Disposal
3. Scientists and Engineers for Secure Energy
4. American Nuclear Society
5. Tennessee Valley Authority
6. State of South Carolina (declined comment)
7. State of Vermont
8. State of Ohio
9. Atomic Industrial Forum, Inc.
10. State of New York
11. Utility Nuclear Waste Management Group - Edison Electric Institute (four documents)
12. New England Coalition on Nuclear Pollution
13. William A. Lochstet
14. State of Delaware
15. State of Minnesota
16. Sensible Maine Power
17. Bechtel National, Inc.
18. Neighbors for the Environment
19. U.S. Geological Survey
20. Natural Resources Defense Council
21. State of Illinois
22. Wisconsin
23. Ocean County and Township of Lower Alloway Creek
24. Marvin I. Lewis
25. California Energy Commission
26. Safe Haven, Ltd.
27. Consumers Power Company
28. California Department of Conservation
29. State of Wisconsin
30. Environmental Coalition on Nuclear Power
31. General Electric Company
32. Association of Engineering Geologists

APPENDIX A (continued)

Cross Statements

1. Robert Abrams, Attorney General of the State of New York
2. United States Department of Energy
3. Atomic Industrial Forum, Inc.
4. Position of the American Nuclear Society
5. Consumers Power Company
6. Position of the Tennessee Valley Authority
7. Position of the State of Delaware
8. California Energy Commission, Nuclear Fuel Cycle Committee
9. State of Minnesota
10. State of Ohio
11. Position of the General Electric Company
12. California Department of Conservation
13. Position by the American Institute of Chemical Engineers (AIChE)
14. Niagra Mohawk Power Corporation, Omaha Public Power District, Power Authority of the State of New York, and Public Service Company of Indiana, Inc.
15. United Stated Geological Survey
16. Utility Nuclear Waste Management Group-Edison Electric Institute
17. Environmental Coalition on Nuclear Power
18. Position of the State of Illinois
19. Marvin I. Lewis, Individual Citizen Intervenor
20. Joint Cross-Statement of Position of the New England Coalition on Nuclear Pollution and the Natural Resources Defense Council
21. William A. Lochstet

APPENDIX B

Working Group Commentary on Technical Issues on Waste Disposal

The Working Group notes that it is important to distinguish between information and data which are currently available but not on the record, and information which has not yet been developed. This is particularly germane for the technical issues in waste disposal. The Working Group has found that the significant information gaps belong in the latter category. In addition, the Working Group believes that an intensive review of the data base as it now exists would not eliminate the uncertainty because, for the most part, this information has yet to be developed. Hence, substantial judgment will be required in the resolution of the waste disposal technical issues.

Repository Site Selection (Issues 5.1-5.6)

One of the critical issues is whether repository sites having adequately favorable geologic characteristics will be found to exist. The Working Group notes that the United States Geologic Survey has expressed its confidence that nuclear wastes can be disposed of safely by burial in mined geologic repositories with very low risk to the environment after completion of a program of research and exploration substantially larger than that which was in place in 1978 when the

IRG review took place.[1] In the discussion below, the Working Group briefly summarizes the current state of knowledge regarding existence of sites and highlights areas of significant uncertainty which will need resolution in the course of DOE's on-going program of geologic exploration.

DOE has described the status of its current exploration programs in Appendix B to its Position Statement. There are five specific geologic environments currently under investigation by DOE. These are:

	MEDIA	GEOGRAPHICAL REGION
1.	Domed salt	Gulf Interior
2.	Bedded salt	Paradox Basin Permian Basin Salina Basin
3.	Basalt	DOE's Hanford Site
4.	Volcanic Tuff	DOE's Nevada Test Site
5.	Granite	Location not yet determined

The five programs involve studies of the geologic, hydrologic, tectonic, and resource factors in the various candidate media. In the following paragraphs, the Working Groups presents some preliminary observations concerning these five programs and the extent of information now in the record.

[1]Nonetheless, the United States Geologic Survey position statement did identify a number of areas in which there are significant uncertainties yet to be resolved.

Domed Salt: DOE is examining seven salt domes in the Gulf interior region. Since salt is soluble, any salt dome site must be adequately characterized with respect to rate and direction of ground water flow and amount of total dissolved solids present. Detailed investigations of local and regional hydrology are useful to determine rates of possible dissolution. The local hydrology is complicated because of growth-related faulting which can surround the dome and the gradational lithologic changes. This complexity makes it difficult to obtain reliable estimates of hydraulic parameters for assessing isolation. The dynamics of growth of salt domes are being studied because of their relevance to possible future movement and faulting. An important aspect of the acceptability of salt domes is their attractiveness for resource exploitation--particularly oil, gas, and sulfur. The references cited by DOE and the participants reveal more than twenty technical studies of salt domes. These studies cover salt dome geology, hydrology, screening specifications for Gulf Coast salt domes, as well as mineral resource potential for selected domes.

It should be noted that a massive amount of technical data on Gulf Coast salt domes has been developed primarily by petroleum interests. The particular salt domes selected for investigation by DOE appear to have relatively little potential for economic development, and, accordingly may not have been explored as extensively as other salt domes in the region.

Bedded Salt: DOE is investigating three geologic basins that have extensive bedded salt formations: Permian, Paradox, and Salina. Much of DOE's effort

has focused on the Permian Basin, and specifically the Delaware basin in the Los Medanos area, the site considered for the proposed Waste Isolation Pilot Plant (WIPP). Considerable effort has been devoted to understanding of hydraulic flow paths as well as the effectiveness of the groundwater flow system in retarding radionuclide migration at the Los Medanos site. There are known deposits of potash at the site as well as a potential for oil and gas resources. DOE is also investigating sites at the Palo Duro and Dalhart basins within the Permian basin.

Recently DOE has begun exploration in four areas of the Paradox basin with bedded salt. Considerable additional work will be necessary to evaluate the Paradox basin as a candidate for repository siting. The mineral resource potential of the Paradox sites being studied is not negligible, but may be less than for the Permian basin sites.

Investigations by DOE in the Salina basin (parts of Michigan, Ohio, Pennsylvania, and New York) have been minimal, apparently for reasons other than geologic unsuitability. This basin has been subject to extensive hydrocarbon investigation as well as salt solution mining. The geology of the Salina basin is relatively uncomplicated and the area is considered to be tectonically stable. In addition, the abundance of rainfall coupled with easy access to fresh water lakes reduces the need to utilize groundwater resources--thus reducing the likelihood of future deep drilling for groundwater.

DOE has released a considerable quantity of technical information focused on characterization of the Los Medanos site. The extent of this literature suggests that the state of technical knowledge for waste disposal in bedded salt is more advanced than for other media--perhaps because of the historical focus on salt.

Volcanic Tuff: The Nevada Test Site offers several rock masses which could be suitable candidates for waste repository siting. DOE has limited its investigation to the southwest portion of the site in order to avoid interference with nuclear weapons testing activities. The primary focus in the Nevada Test Site Investigations is welded tuff on Yucca Mountain. DOE has begun a program of drilling and geophysical evaluation. The hydrology may be favorable due to regions of unsaturated tuff and comparatively long flow paths, but additional field work will be required to evaluate the potential. Some paths traverse tuffaceous rocks and alluvium which possess high sorptive capacity. Potential mineral resources have not been subjected to exploration since the withdrawal of the site for weapons testing; an assessment of mineral resources will be needed for future site characterization.

DOE cites over 20 technical studies on the Nevada Test Site evaluating various rock types as repository media. Much of this information is clearly aimed at evaluation of tuff as a host medium. Because of the complex geology of the test site, many additional site-specific studies remain to be done--i.e., analysis and evaluation of groundwater hydrology in the volcanic tuff.

Basalt: Another prime target for site characterization is basalt rock in the Hanford reservation in the center of the Pasco basin (Columbia Plateau, central Washington). The hydraulic characteristics of the geologic formations of interest are complex and may increase the difficulty of evaluating its repository potential. While basalt itself has an extremely low hydraulic conductivity, the presence of fractured zones and of many water-bearing interflow channels--a consequence of a sequence of volcanic events and of the cooling history of the flows--makes it difficult to evaluate its repository potential. In addition, the fact that the formations of interest are deep (several thousand feet) and in a relatively brittle and fractured media may pose some mining engineering problems in repository construction. The potential for recovery of mineral resources appears to be negligible at the Hanford site.

Judging by the technical studies cited, DOE has mounted a considerable effort designed to obtain technical subsurface data on basalt at the Hanford site. Nonetheless, additional data will be required. Recent nuclear power plant siting investigations indicate more extensive and geologically younger near surface faulting then was heretofore thought to be the case. No technical studies were cited by DOE on this particular subject. While a number of studies on groundwater hydrology applicable to the Hanford site are cited, more detailed hydrology characterization of the deeper aquifers may be necessary. Achievement of greater understanding of groundwater flow in a highly fractured media would be necessary.

Granite: Another medium which DOE is currently evaluating is granite. The DOE Statement speaks of granite investigation only at the Nevada Test Site.

In-situ Testing, Leaching and Sorption, Radionuclide Migration to Biosphere. Issues 5.3-5.4

To evaluate a site it is necessary to have adequate data on the properties of the geologic materials associated with the proposed location of the repository. Data are needed to estimate thermal effects on the geologic formations and groundwater in the immediate vicinity of the stored waste. Data on the hydraulic properties (e.g., permeability, porosity, solubilty) of the geologic materials surrounding the waste and between the waste and the biosphere are needed as well as their sorptive and leaching properties with respect to the long-lived radionuclides of concern. A significant fraction of these data must be obtained by experiments performed underground at repository depth--"in situ experiments"--because of the extreme difficulty of simulating the conditions existing in a repository environment. To be able to predict the performance of a specific proposed repository, it is not necessary to secure all such data at the specific site, although this would be desirable. Data obtained from in situ experiments at other locations could be used provided geologic similarities or correlations are established.

At the present time, DOE is supporting a number of programs in the United States involving a variety of host rocks and associated geologic structures. DOE has also established contacts and cooperative arrangements with other countries

(e.g., Sweden, Federal Republic of Germany) to participate in similar experimental programs in these countries.

An indication of the present status of *in situ* testing in the United States and overseas can be obtained by examination of Table 2. *In situ* testing relevant to repository locations in bedded salt and salt domes is apparently now more extensive than that for locations in granite and basalt. Because all participants agree that more data on geologic media are needed to permit choices among media and sites, the need for data is itself not an issue. What is at issue is whether the present data base and data acquisition program are adequate to support a finding of confidence that a sufficient number of sites will be suitable as a waste repository.

The Working Group has only made a preliminary evaluation of the adequacy of the record on *in situ* testing. In addition to the DOE and participants' statements and cross statements, DOE cites about 45 references in this area. On the basis of its preliminary review the Working Group believes the record is adequate for purposes of this proceeding. As Table 2 suggests, investigations to date are more advanced for some media than for others. However, the Working Group believes that a finding of confidence does not require that all media be equally well-understood.

TABLE 2

TYPES OF IN-SITU TESTS

(Data from DOE Position Statement, pp. II-248 to II-268)

Salt

1. Waste handling techniques (a,b)
2. Effect of radiation (a)
3. Production of chlorine (a)
4. Creep at elevated temperature (a,b)
5. Stability of openings (b,c)
6. Brine migration at elevated temperature (b,d)
7. Test of backfill (b,d)
8. Test borehole seals (c)
9. Gas permeability (c)
10. Radar techniques (d)
11. Salt permeability (c,d)
12. Thermal conductivity (a,d)

Sites

a. Lyons, Kansas (bedded salt)
b. Asse, Germany (salt dome)
c. Carlsbad, New Mexico (bedded salt)
d. Avery Island, Louisiana (salt dome)

Granite

1. Thermal conductivity (a)
2. Fracture permeability (a)
3. In-situ stress (a)
4. Thermally-induced stress (a)
5. Nuclide migration (b)
6. Rock response to heat (c)
7. Ventilation (c)
8. Effect of blasting (d)

Sites

a. Stripa, Sweden
b. Studsvik, Sweden
c. Climax, Nevada
d. Idaho Springs, Colorado
e. Cornwall, England (no tests specified)

Shale

1. Thermal models (a,b)
2. Permeabilty due to heat (b)

Sites

a. Oak Ridge, Tennessee
b. Nevada Test Site, Nevada

Basalt

1. Thermally induced deformation (a)
2. Thermal models (a)

Site

a. Hanford, Washington

Tests not identified

Tuff (Nevada Test Site)

Clay (Mol, Belgium)

Engineering Activities for Repository Site Development and Operation (Issues 5.7-5.11)

Assessment of spent fuel as waste form. Waste form is a key factor in waste repository performance if it is intended to function as a barrier to radionuclide release and, thus, to supplement the repository's natural retentive capabilities. DOE's position assumes that the waste form will be spent fuel discharged from LWR's, with aging and mechanical disassembly for volume reduction as the only potential modifications. A number of preliminary studies of fuel leaching--mostly at the Battelle Pacific Northwest Laboratory--have been underway for several years and have yielded some preliminary results. Nonetheless, spent fuel is chemically heterogeneous and, as a result, its complex chemical characteristics must be taken into account when assessing the suitability of a particular candidate host rock for disposal. In current accelerated nuclide release studies, the behavior of simulated spent fuel is being investigated in both deionized water and simulated salt brine under hydrothermal conditions (from 100°C to 300°C) at pressures up to 300 bars. Significant and relevant work has been accomplished since the IRG stated that major gaps exist in current knowledge of the chemical interactions of spent fuel, its cladding and containers with salt or other candidate repository host rock. Although LWR fuel is designed for use under extreme temperature and pressure conditions, its intended period of service is very much shorter than the proposed period of containment in a waste repository. DOE has committed to a engineering plan which will result in the development of additional information in the years ahead.

Interaction between nuclear waste and host medium: Interaction between the waste package and the host rock could result from the direct or synergistic effects of radiation, heat, and groundwater intrusion. DOE asserts that a considerable amount of relevant research and development on waste-host rock interaction has already been accomplished. In addition, where there is substantial uncertainty, DOE believes that the effects of many of the individual interaction processes can be bounded in assessment of repository system performance.

The Working Group notes that a principal factor in design of a repository is limitation of the impact from heat generated by the nuclear waste. This is because the temperature increase in the repository may affect the structural stability and integrity of the host rock. In addition, a temperature rise increases corrosion rates and other chemical reactions between the waste packaging and fluids contained in the host rocks. Heat can also affect the processes which govern the rate of nuclide migration from the repository.

The Working Group notes that DOE has cited a considerable body of technical literature. The cited work reports on analyses and experiments on thermally-induced rock stresses for repositories sited in basalt, bedded and domed salt, as well as hard crystalline rock. DOE proposes to control thermal effects by limiting the heat loading in a repository (restricting the number of waste canisters per area or volume), but DOE does not establish quantitative limits for heat loading.

There appears to be a consensus that radiation effects on the host rock are of secondary importance in repository design and performance. These effects should be more or less restricted to the first meter of the host rock surrounding a canister. One possible concern is radiolytic products of fluids which could come in contact with the waste canister and could affect canister longevity.

DOE cites a significant body of technical literature on the effects of radiation damage in rocks. Much of this effort has been conducted on salt as a host medium. Additional information on radiation and thermomechanical effects will result as DOE proceeds with programs in this area.

Engineered barriers. The Working Group notes that in DOE's conceptual design, engineered barriers, consisting of long-lived nuclear waste packages and backfill materials, would retard radionuclide migration. The key is to design and test barriers which will be effective for extended periods of time. The waste package consists of spent fuel, stabilizer (or filler), waste canister, overpack, and emplacement hole sleeve. In addition, the emplacement hole backfill materials (to fill voids between canister, overpack, sleeve and host rock) also retard nuclide migration. Other materials might be used to backfill drifts and shafts within the repository. The stabilizer can improve heat transfer from the spent fuel while minimizing adverse chemical or mechanical effect on the spent fuel and cladding assembly. It may also provide mechanical resistance to canister collapse caused by lithostatic pressure and may act as a corrosion-resistant barrier between the spent fuel and canister. Canister and overpack materials will have to be selected based upon corrosion tests at various temperatures

and levels of radiation. Groundwater chemistry will also be a factor in choice of materials. The canister, overpack, and sleeve should constitute a relatively impermeable element of the waste package. DOE is currently considering a wide variety of metals, ceramics, carbides, carbon forms, glasses, and cements as candidate materials. Based upon the references cited by DOE, technical work has been accomplished or is underway including the following:

- corrosion resistance of metallic canisters (including titanium and iron-based alloys, glass-ceramics, glass forms and others)

- permeability measurements on cementatious materials,

- leaching characteristics and radiation effects on waste package materials and components.

Logically, testing programs involving the components of the waste package system would be developed in a manner which would provide for testing under anticipated repository conditions. For example, corrosion studies could be conducted with chemical properties of water similar to those found in potential repository sites. In addition, the use of higher temperatures might be considered to obtain data to determine whether overdrive tests can be justifiably used to predict material behavior. Testing pressures might be elevated to a level which simulates repository conditions.

DOE is considering a large variety of emplacement hole backfill materials--including borates, zeolites, sand, crushed host rock, anhydrite, and bentonite. DOE cites a substantial number of supporting technical references on both emplacement hole backfill and drift backfill barriers. Some recent studies have focused on the testing and development of smectite clay and sand barriers in the presence of brine for use in a salt repository. In addition, there have been backfill studies in Sweden on bentonite clay, clay-sand mixtures, and barriers of zeolite.

Backfill materials can provide a barrier to groundwater movement into the repository and seals to reduce and control groundwater movement and absorption of radionuclides. However, the choice of backfill material to achieve the proper characteristics (see page III-186 of the DOE Statement) is of substantial importance. The DOE Position Statement does not (and, indeed, at this early stage, cannot) indicate which backfill material will be used; it does not preclude use of the material excavated from the repository. Also, the DOE Position Statement indicates that backfilling of excavated areas to achieve long-term stability is a common practice. While such practices are common to control subsidence in mining operations, conventional procedures may not be entirely satisfactory as applied to meet repository needs. Backfilling techniques and materials to meet repository conditions could be different and more work may have to be done in this area. More data and technical studies on the various engineered barriers will provide additional information as DOE proceeds with its program in the years ahead.

Borehole and shaft sealing. The Working Group notes that a major factor in repository performance is proper sealing. Boreholes and shafts must be adequately sealed before repository decommissioning. All penetrations provide potential pathways for radionuclides to reach the biosphere or for groundwater to enter the repository. The penetrations must be sealed adequately for an extended period of time. Understanding of the geology and hydrogeology at a particular site is needed in order to make a proper choice of the design of borehole and shaft seals. Expected temperature and pressure conditions may also influence the sealing design.

DOE cites a substantial quantity of technical reference material in support of its position. DOE has been studying cement-based borehole plugging and has examined use of grout materials for application to the WIPP and other potential repository sites. DOE is also examining use of earth melting technology for plugging in bedded salt domes and use of compacted natural earth materials. The feasibility of borehole plugging by hydrothermal transport is also being evaluated.

While, as the DOE Position Statement indicates, there is a considerable body of experience in sealing from the oil, gas, and other mineral extraction industries, there are two significant differences between related industrial experience and sealing penetrations for a repository: (1) seal performance and (2) long-term durability. The seals for a repository will need to be emplaced in a manner that will ensure negligible water intrusion, while typical industrial mining applications are significantly less stringent regarding water

intrusion (or fluid leakage). Also repository seals may need to last for many centuries.

Work on effective borehole and shaft sealing is still in progress. Future DOE effort will be needed to verify borehole seal performance for each candidate medium and will generate additional technical studies and information. In this regard, an important aspect is seal performance as a function of time (e.g., do they fail catastrophically or gradually). DOE intends to determine seal performance specifications as the result of consequence assessment (calculated predictions of radionuclide release and transport to the accessible environment) for a particular site.

Retrievability. The Working Group notes that DOE has said that retrieval would be necessary only if the long-term performance of the repository is found to be unacceptable. DOE has said that during waste emplacement, instrumentation and monitoring devices will be installed. The repository design will include features to allow for the retrieval of emplaced canisters throughout the operating phase. Retrieval from the repository could involve the following: (a) re-excavation of the backfill; (b) removal of waste packages from the disposal holes to the surface (c) repackaging damaged canisters (if needed); and (d) placement of the wastes into alternate storage.

The DOE Position Statement indicates that design features of the repository will be provided to allow for the retrieval of emplaced canisters throughout the operating phase. If spent fuel emplaced in a repository were required to

be retrievable for an indefinite period as was proposed by several bills in the last session of Congress, then additional analysis and discussion on this subject by DOE would be appropriate. DOE's discussion on retrievability does not include consideration of the ability to retrieve canisters after closure of the repository.

There are only three technical references cited by DOE in its position statement: experience with retrieval at Lyons, Kansas (Project Salt Vault), analysis of retrieval at the WIPP site, and a safety assessment for spent fuel storage in the Climax Granite Stock at NTS.* It would appear that the DOE effort so far has been limited to preliminary design studies of retrieval concepts and a few experiments at Lyons, Kansas (bedded salt).

The Working Group notes that the DOE Position Statement is weak in its discussion of the feasibility and the operational exposure impacts of retrievability. In particular, the DOE statement does not discuss methods for locating canisters and extracting them from their emplacement locations and of methods for controlling or dissipating heat buildup in the medium surrounding the canisters prior to their removal. Additional information provided by DOE on its plans for retrieval would be useful. To the extent that additional technical studies exist on DOE's analysis of retrievability, the Working Group believes that it would be useful for the record to be supplemented in this area.

*Nevada Test Site, Nevada

Standards for Acceptable Repository Performance (Issues 5.12-5.15)

5.12 Radiological dosage and health effects. The Working Group notes that DOE has estimated on a generic basis the radiation dose commitment during routine operations for repositories sited in different media types. The estimates were originally prepared by DOE for their draft Environmental Impact Statement for Management of Commercially Generated Radioactive Waste. For repositories sited in granite and shale, DOE estimates that routine repository operation may result in a regional population dose commitment (70-year, total body) of 4,000 man-rem, compared to 3,000 man-rem for repositories sited in salt and basalt.[1] The estimate of work-force radiation dose commitment (70-years, total body) is 80,000 man-rem which does not depend upon media type. DOE's estimate of worldwide population dose commitment is 200 man-rem, which also does not depend upon the type of host rock. Comparison of these dose commitment estimates for routine operations with doses attributable to naturally occurring sources shows that the regional population dose from the repository is less than 0.1% of that due to natural sources; worldwide population dose is less than one- millionth of one percent of the dose due to natural sources. No health effects would be expected in the regional population due to repository operation (since the average

[1]Estimate assumes two million people in region, six billion world wide population, an LWR scenario that generates 10,000 GWe/yr through year 2040, repository availability in year 2000, worldwide exposure limited to noble gases, carbon-14 and tritium.

individual 70-year total body dose would be a few millirems). Because of the high degree of containment and isolation, DOE maintains that reasonable reductions in the radiation levels permitted under present standards would not seriously affect repository design and operation.

DOE's definition of isolation (in its proposed performance objectives) makes reference to meeting an ALARA standard. The ALARA standard has only been applied to reducing actual emissions at reactors and fuel cycle facilities during their terms of operation. These reductions in releases can be quantified to estimate the benefit. Because there is no experience in repositories and because of inherent difficulties of long-term analytical prediction, the use of an ALARA analysis may be quite difficult to apply to a repository with the same precision. Also, DOE's definition of isolation indicates that wastes will be considered to be isolated if releases are "predicted to be within the range of variations experienced with natural background radiation." DOE has not explained why the range in values in natural background levels in different areas provides an appropriate criterion for determining permissible levels of public exposure.

Due to the uncertainties in design parameters for a geologic repository which could substantially alter the calculated radiological releases, any repository design which indicated that consequences of only a "few millirem" would result in the initial years after repository closure, would not be consistent with Objective 5 to provide for conservatism in the repository design. The Working Group notes that it also appears to be inconsistent

with Objective 2. Objective 3 would restrict the repository operational risks to a level not greater than that allowed for other nuclear fuel cycle facilities. The repository operational phase includes the period when wastes are being received, handled, packaged and placed into the disposal system. DOE's intent appears to be application of NRC's existing regulatory framework to the waste disposal operation.

While there is disagreement among the participants on this issue, the Working Group feels that the record is sufficiently complete in that the participants have expressed their views clearly. Therefore the Working Group sees no need to supplement the record on this issue.

5.13 Acceptability and adequacy of analytical models An assessment of long-term performance is important for design of the waste package and the repository as well as for overall judgment of the repository performance. The Working Group notes that DOE intends to rely heavily on models--mathematical descriptions of phenomena--for assessing the overall adequacy of the containment and isolation capabilities of a geologic repository. These models are usually embodied in computer codes. Although the Working Group considers models an important element in evaluating repositories, it recognizes that such models are not without their intrinsic shortcomings and, as noted below, DOE has a considerable amount of work to accomplish in order to produce reliable models. Furthermore, the Working Group believes that the use of models requires the application of expert judgment regarding the capabilities and limitations of models. DOE states that models are

ready for application to actual and hypothetical waste disposal systems, though improvements in the models will continue (page II-224 of DOE Position Statement).

It should also be recognized that some systems are more amenable to precise modeling than others (e.g., heat transfer aspects of repository can be modeled accurately while water flow through a fractured media has proven difficult to model). These models, even if coupled with more accurate models for other systems, would add to the uncertainty levels of the overall performance assessment to such a degree that the results could be meaningless. As many as possible of the models used in assessing repository performance should have the capability of producing accurate results with an acceptable level of uncertainty over extended time periods.

A key factor is the extent to which one may have confidence in predictions, derived from models or expert judgment, of groundwater flow and/or radionuclide transport over thousands of years.

The Working Group emphasizes that in applying models to repository performance, it is essential to account for significant uncertainties associated with the analytical methodology and the input data (descriptions of system geometry, lithology, structure, hydraulic properties, mechanical and thermal properties, transport properties, initial conditions, and boundary conditions).

5.14 Period of time required for isolation and containment of waste. DOE's generic performance objective 2 indicates that disposal systems should provide reasonable assurance that wastes will be isolated from the accessible environment for at least 10,000 years. The 10,000 year period referred to in Objective 2 is derived from a comparison of the radiotoxicity of the spent fuel and naturally occurring uranium ore bodies from which the fuel originally was extracted and manufactured. The methodology used to arrive at 10,000 years appears not to consider the inherent differences between the ore body and the spent fuel (i.e., the radioactivity in the spent fuel waste is highly concentrated and is in a chemical form different from that in the original ore body).

5.15 Monitoring capability during repository operation and after closure. Radiological monitoring during repository operation is necessary to assure the safety of the workers and the neighboring public as well as to evaluate repository performance. Nonradiological monitoring during operation--including surveillance of temperatures, pressures, dimensional stability of critical repository components and structures, environmental parameters--is needed primarily to assess repository performance. Although DOE believes that the repository can be designed so that monitoring after decommissioning is not necessary, it is supporting work on techniques for data transmission from subsurface sensor locations to surface monitoring stations. DOE also cites a few studies concerned with the development of "installed instrumentation to detect and quantify a problem under emergency conditions in reactors" and states that similar studies will be undertaken

for repositories and the results used in selecting monitoring instrumentation for a repository. The Working Group considers that the record, although it is minimal, is adequate for considering this issue. The Working Group considers monitoring to be a secondary issue.

Department of Energy
Washington, D.C. 20585

March 27, 1981

Marshall E. Miller, Esq.
Administrative Judge
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Proposed Rulemaking on the Storage and Disposal of Nuclear Waste (Waste Confidence Rulemaking), NRC Docket No. PR-50, 51 (44 FR 61372)

Dear Mr. Miller:

Events recently have occurred relating to the information previously submitted in the above-entitled proceeding by the United States Department of Energy (DOE). Particularly important has been a change in DOE's projections of the quantity of spent nuclear fuel that may require interim storage prior to the availability of a disposal facility. This change makes more feasible various actions that utilities could take to meet spent fuel storage needs prior to the availability of a disposal facility and has contributed to a decision by DOE to discontinue its efforts to provide Federal government-owned or -controlled away-from-reactor (AFR) storage facilities. DOE is providing herewith information concerning these events so that the record in this rulemaking may be more complete. That this new information does not change DOE's previous statements that there exists an overall waste management program capable of handling, storing and disposing of spent nuclear fuel from commercial power reactors. The existing record herein is more than adequate for the Commission to determine that questions of the disposition of spent nuclear fuel need not be addressed in individual NRC licensing proceedings.

I. Spent Nuclear Fuel Storage Projections

DOE recently has completed its annual update of projections of spent fuel discharges and storage requirements. These data reflect changes in utility plans for reactor operation and modifications to utility storage capabilities. The projected nuclear capacity has dropped from 276 GWe to 180 GWe in the year 2000, and the resulting cumulative spent fuel discharges have dropped from 100,000 MTU to 72,100 through the year 2000. In addition, utilities have continued to expand their at-reactor storage capabilities. These actions have reduced substantially the projected additional storage requirements upon which DOE's earlier statements were based. Cf. DOE PS, Tables V-1 and V-3. As shown in the attached Table 1, projected requirements for additional storage capacity now begin in 1986 (instead of 1981) and grow to about 9,500 tonnes prior to the availability of full-scale, licensed disposal facilities in 1997.

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As DOE showed in Part IV of its April 15, 1980 Statement of Position and Chapter II.C of its September 5, 1980 Cross-Statement, the storage of spent fuel is a safe, well developed technology. */ The new projections do not change this basic technical conclusion. What has changed is the amount of spent fuel that will require storage services and the time frame in which additional storage will be needed. This allows for consideration of additional options, discussed below, by which utilities can provide any required additional storage. If spent fuel were to be reprocessed in the future, the spent fuel storage requirements would be reduced even further.

II. Redirection of the DOE Spent Nuclear Fuel Storage Policy

DOE previously has stated that spent fuel storage is primarily the responsibility of the electric utilities. See, e.g., DOE PS at I-11. The Department's offer to accept limited quantities of spent fuel for storage was made in October 1977 as a result of President Carter's earlier indefinite deferral of reprocessing and nonproliferation policies. However, Congressional authority to fully implement the policy never was obtained and utilities have continued to rerack their at-reactor fuel storage basins to increase their storage capacities. This also has contributed to the decision to discontinue efforts to provide Federal government-owned or -controlled away-from-reactor spent fuel storage. Spent fuel storage program activities to support acquisition of interim storage facilities will be redirected to concentrate on the development of alternative technology to further increase utility storage capabilities. The activities of DOE will be directed toward developing technologies, such as dry storage and rod storage (including fuel disassembly). Both of these technologies are technically feasible as DOE previously has demonstrated in this proceeding. See, e.g., DOE PS at IV-12 to IV-19 and IV-63; DOE CS at II-147 (and cited references). There are no reasons why they could not be tested on a full scale and promptly implemented to provide additional storage capacity beyond the planned capabilities of reactor basins, if needed.

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*/ In its Statement of Position, DOE noted that spent fuel will be stored at reactor facilities and, to the extent necessary, at away-from-reactor storage facilities. DOE PS at IV-1. The storage of fuel in water basins at reactor sites is a well established and demonstrated technology as described in Chapters IV.B, IV.C, IV.D and IV.E of the DOE Statement of Position. See also DOE CS, Chap. II.C. There is no evidence of degradation as the result of storage. See DOE CS at II-151 to II-154. In fact, no degradation mechanisms have been identified which could be expected to cause failures in fuel cladding in the time frame of 50 years or longer. DOE PS at IV-73; DOE CS at II-153. Therefore, the efforts of utilities to provide additional water basin storage represent a safe step in the management of spent fuel.

As discussed below, the absence of a federal government-owned or -controlled away-from-reactor storage only means that one of several possible approaches to addressing storage needs will not be available. There remain a number of safe, acceptable methods to meet storage demands (now reduced) until the availability of disposal facilities.

III. Impact of New Spent Fuel Projections and Redirection in DOE Spent Fuel Storage Policy

DOE previously has analyzed the integration of spent fuel storage and the availability of disposal facilities. See, e.g., DOE PS, Part VI; and DOE CS, Sec. III.A.3. The results indicated that some additional storage capacity, such as at away-from-reactor storage facilities, was required. Attached Figure 1 shows the new projected storage requirements and the capabilities of disposal facilities. Curve I in Figure 1 represents the base planning case for DOE's projections and assumes maximum basin reracking, no transshipment of fuel between reactors, and the maintenance of full-core reserve in the reactor basin. Curves II and III show how intra-utility transshipment and reactor operations without full core reserve can reduce the requirements for additional storage. There have been no technical or safety problems identified with transshipment. Also, full-core reserve is not required by the Commission. The maintenance of full-core reserve is a prudent operational procedure, but is not necessary for safe reactor operations. The use of transshipment and operations without full-core reserve are safe and should in no way adversely affect the Commission's findings in this proceeding. The shaded area of Figure 1 represents additional storage that may be required prior to the availability of disposal facilities.

The Commission should assume that any additional storage requirements will be satisfied in any one or more of the following ways:

A. The use of private existing away-from-reactor storage facilities, such as the General Electric Company facility at Morris, Illinois; the Allied General Nuclear Services facility at Barnwell, South Carolina; or the Nuclear Fuel Services, Inc. facility at West Valley, New York. The absence of a Federal program to acquire and use these facilities does not preclude their use by private industry.

B. The construction of new water basins, either at the reactors or away from the reactors by private industry or the utilities. These facilities could be brought on line in about 8 years. See DOE PS at V-21. This means such facilities could be operational by 1990, which is the initial year of additional storage requirements included in the shaded area of Figure 1.

C. The transshipment of spent fuel between reactors of different utilities. There is currently and there will continue to be more total storage space available in basins of power reactors than there will be discharged spent fuel. The storage requirements discussed above and in

earlier statements by DOE have assumed that each utility would manage its own fuel exclusively. While interutility transshipments could face institutional obstacles, there are no obstacles that are safety related.

D. The disassembly of spent fuel assemblies and the storage of spent fuel rods in canisters. This technology has the potential for increasing the capacity of some existing reactor basins by a factor of two.

E. The use of dry storage at the reactor sites. Although there is significantly more experience with water storage, there are no known technical problems that prevent the use of dry storage. See DOE PS at IV-12 to IV-19 and IV-63.

While it is impossible to predict just what combination of these methods ultimately will meet actual storage needs, it is clear that a number of approaches exist that will safely provide any necessary spent fuel storage. DOE, therefore, submits that its previous conclusions that spent nuclear fuel can and will be stored in a safe and environmentally acceptable manner until disposal facilities are available are still valid. The information provided herein should not serve as a basis for delaying this important NRC proceeding.

Very truly yours,

Omer F. Brown II

Omer F. Brown, II
Attorney
Office of the General Counsel

Enclosures

cc: As indicated on attached service list

TABLE 1

COMPARISON OF DATA IN PART V OF DOE STATEMENT

OF POSITION OF APRIL 15, 1980 AND RECENT SPENT FUEL PROJECTIONS

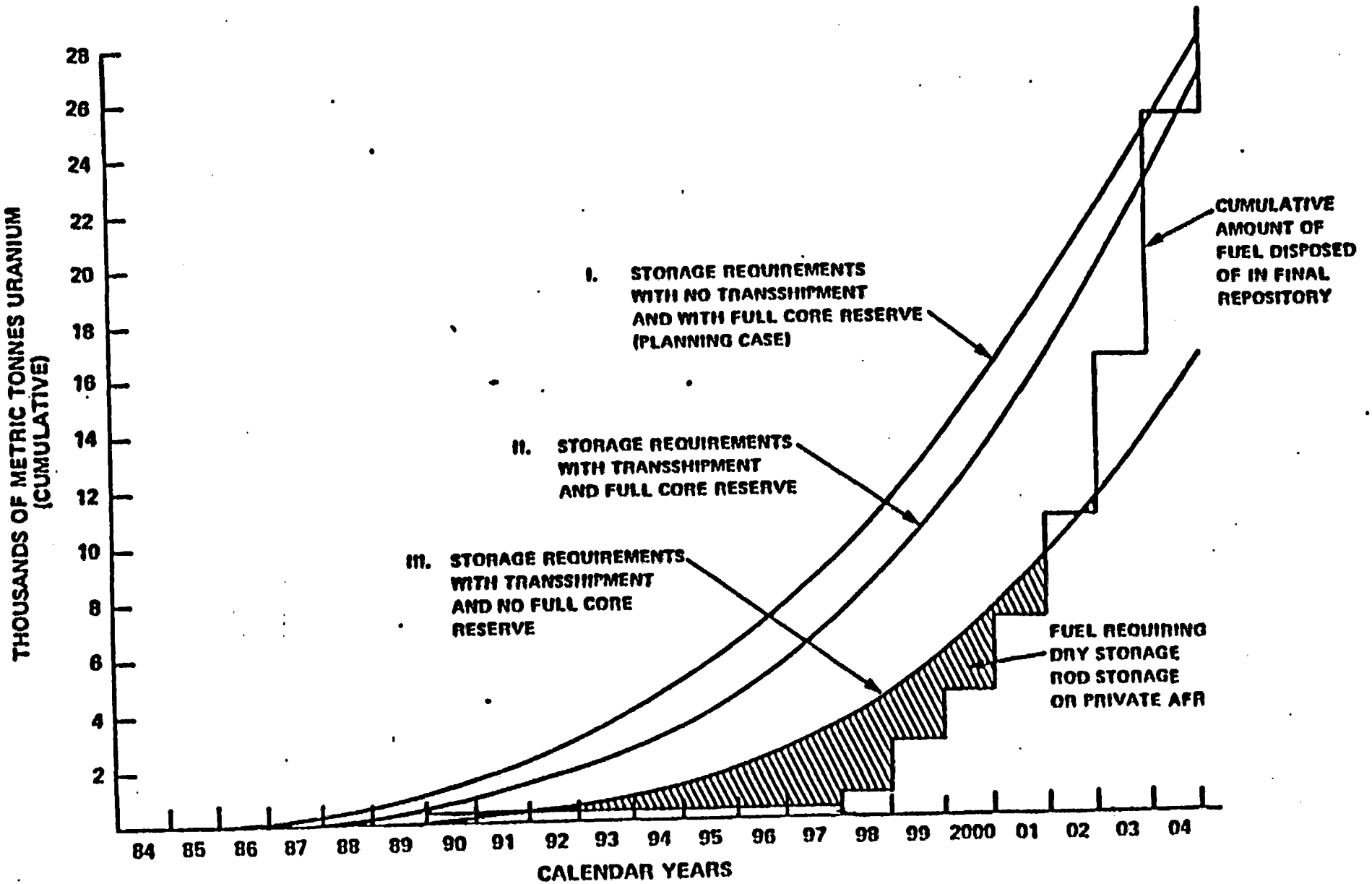
(Cumulative MTU)

	DOE PS Data[1]		Recent Utility Data[2]	
Year	Spent Fuel Discharges	Additional Storage Requirements[3]	Spent Fuel Discharges	Additional Storage Requirements[3]
1981	9,100	200	8,300	0
1982	10,900	300	9,600	0
1983	13,100	400	11,500	0
1984	15,700	500	13,700	0
1985	18,700	800	16,100	0
1986	22,300	1,000	18,700	120
1987	26,200	1,500	21,800	390
1988	30,400	2,000	24,800	620
1989	34,800	2,500	28,500	1,240
1990	39,400	3,300	32,000	1,800
1991	44,100	4,300	35,400	2,300
1992	49,000	5,500	39,300	3,180
1993	53,800	7,000	43,200	4,110
1994	60,500	8,800	46,700	5,060
1995	66,300	10,900	50,900	6,480
1996	72,500	13,300	55,000	8,000
1997	78,800	16,100	58,900	9,540
1998	85,500	19,200	63,200	11,490
1999	92,500	22,700	67,600	13,810
2000	99,700	26,300	72,100	16,010

[1]Projected nuclear capacity of 276 GWe in 2000
[2]Projected nuclear capacity of 180 GWe in 2000
[3]Planning base case (assumes maximum basin reracking at reactors, no transshipment of fuel between reactors, and the maintenance of full-core reserve in the reactor basin).

Figure 1

ADDITIONAL SPENT FUEL STORAGE REQUIREMENTS



UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF	)	
	)	
PROPOSED RULEMAKING ON THE STORAGE AND DISPOSAL OF NUCLEAR WASTE	)	PR-50, 51 (44 FR 61372)
	)	
(Waste Confidence Rulemaking)	)	
	)	

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