UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter	:	
of	:	PR-50, 51 (44 F.R. 61372)
Proposed Rulemaking on Storage and Disposal of Nuclear Waste, 10 CFR Parts 50 and 51 (Waste Confidence Rulemaking)	:	

CROSS-STATEMENT OF ROBERT ABRAMS, ATTORNEY GENERAL OF THE STATE OF NEW YORK

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SUMMARY

The representatives of the nuclear industry, not surprisingly, urge the Commission to make a finding of confidence in safe disposal of spent fuel. The principal Statements in support of this position are those of the American Nuclear Society ("ANS"), the Atomic Industrial Forum ("AIF"), and the Utility Nuclear Waste Management Group-Edison Electric Institute ("Utilities" or "UNWMG").

As will be demonstrated below, the industry, like DOE but to a greater extreme, has distorted the issue which the Commission must decide, namely, whether it is now confident, based on existing facts, that nuclear waste will be safely

disposed of by a given date. In our Statement of Position* (pp. 15-16) we divided the confidence issue into its distinct and essential elements, saying that the Commission could make a finding of confidence only if it finds each of the following:

1. that disposal will be accomplished;
2. that disposal will be safe; and
3. that disposal will occur by a given date.

We said that the confidence must exist today, based on facts which exist today, and that the Commission must have the highest degree of confidence.

In this Cross-Statement, we will show that industry defines the issues so as to avoid all of these requirements and thus to frustrate the very purpose of this proceeding (Point I). We will also show that industry has utterly failed to demonstrate the necessary factual basis for confidence in final disposal (Point II) or in indefinite long-term storage (Point III).

One of the most glaring weaknesses of the case presented by industry is its limitation to the technical feasibility of disposal, without any showing that safe disposal will actually be implemented. Industry fails to identify

* Our Statement of Position in this proceeding will be referred to as "SP".

specific repository sites meeting all technical criteria, to show that a sufficient number of such sites will be found, or to offer a credible response to the problems created by State and local opposition to permitting disposal, storage or even transportation of nuclear waste. In addition, industry claims that isolation is necessary for only hundreds of years, thus highlighting the unavailability of methods to assure safety for the million-year period that is really involved. Moreover, industry has no answer to many of the technical data gaps and known technical difficulties, but merely hopes that current research efforts will bring solutions.

I. INDUSTRY DISTORTS THE ISSUE BEFORE THE COMMISSION.

A. Industry Avoids The Question Of Whether Disposal Will Actually Be Accomplished.

As explained in our Statement of Position, the issue before the Commission is whether or not it has confidence "that radioactive wastes produced by nuclear facilities will be safely disposed of." 44 F.R. 61372-3 (emphasis supplied) (SP, pp. 16-19). This means that both technical and institutional problems must be overcome; technical capability, even if it were to be developed, would not be enough. The industry Statements, however, avoid facing honestly the institutional obstacles, although these by themselves could prevent achievement of safe waste disposal. In addition, they fail to demonstrate that all technical problems will truly be overcome.

One of the fundamental weaknesses with the industry Statements is that they discuss primarily the technical feasibility of developing safe repositories. Feasibility -- or theoretical possibility -- is different from the question before the Commission: whether nuclear waste, in fact, will be safely disposed of by a given date. Safe repositories may be feasible in the sense that we do not know of any law of science that would make eventual solution of the technical problems impossible. But feasibility is a long way from

achievement. Even if theoretically feasible, safe disposal will not be accomplished if any of the following occurs: (1) solutions to all the technical problems, while not impossible, are nonetheless not developed; or (2) the necessary number of repository sites meeting all technical requirements are not found; or (3) institutional problems prevent the establishment of the necessary number of repositories.

In particular, technical and institutional obstacles must be overcome not only at one, but at numerous sites around the country. DOE's Statement of Position admits that eight repositories would be needed in salt or granite (p. II-289). And, if the USGS recommendations are adopted, the thermal load of each repository might be reduced to minimize the problems caused by heat -- thus increasing further the number of repositories needed. Further, extra repositories are needed in case a repository site is found to be unsuitable after the site has been selected, or after the repository has been constructed, or even after some or all of the wastes designated for that repository have been emplaced. See SP, p. 18, text and footnote. Finally, in addition to finding all the necessary sites for disposal of all commercial wastes, DOE must also find all the necessary sites for disposal of military wastes. While this rulemaking concerns only commercial waste, the fact remains that DOE will need to find enough sites for both kinds of waste, and if the necessary number for both types

of waste do not exist, the two programs will be in competition with one another for the limited existing sites. There can hardly be confidence that the civilian needs will take precedence over military needs. Indeed, since we cannot be sure that even <u>one</u> site meeting all technical criteria and gaining all necessary approvals will be found, the need to build many repositories is very disturbing, and there can be no confidence that the necessary number will be built.

B. Industry Does Not Show That Disposal Will Be Truly Safe For The Necessary Period.

The Utilities argue that the radioactive waste problem is not unique, and does not deserve the attention it is getting. Doc. 3, p. 1-16. This is incorrect, however, because never before has it been necessary to isolate a toxic substance for the period of time here involved. DOE has called the problem "unique", saying:

> The unique requirements of radioactive waste management have generated the first demands for applying long-term geologic predictions.

DOE Statement of Position, p. II-102. DOE's assessment is consistent with that of the National Academy of Sciences ("NAS"):

> Unlike the disposal of any other type of waste, the hazard related to radioactive waste is so great that no element of doubt should be allowed to exist regarding safety... Safe disposal means that the waste shall not come in contact with any living thing.

(Ref. 6, p. 3). (first emphasis supplied). Thus, the safety problem is indeed unique, and requires all the thought and care it is receiving from the public.

Industry's approach to assuring protection of the public health and safety can only be termed cynical and irresponsible. The core of its argument is that (1) the period during which the waste is dangerous is only 300 to 1,000 years;

(2) any natural releases within that period will be small, and (3) protection against human intrusion is not required. In addition, industry attempts to buttress its case for confidence in the safety of disposal by reference to (4) allegedly greater dangers from toxic chemicals, (5) the alleged disadvantages of coal power (6) the mine at Oklo, in Africa, and (7) foreign experience. Each of these arguments is without merit.

1. The Period of Danger

ANS argues that because the waste becomes progressively less radioactive, it is dangerous -- and thus needs to be contained -- for "at most 1,000 years." (ANS, p. 14). The Utilities go even further:

> A very high degree of containment... is required for only 300-500 years... For the longer term (after 300-500 years) a geologic repository presents a risk to the general public roughly comparable to that of a high-grade ore body.

UNWMG, Doc. 2, pp. I-8, I-9. This statement is both deceptive and incorrect. It is deceptive because the Utilities admit that "protecting the safety of future generations requires estimation of radionuclide distributions and concentrations for millions of years." Id., Doc. 3, p. 3-2 (emphasis added). Moreover, later in their filing the Utilities reveal that, according to their own hazard index formula, the time at which the hazard from a repository falls below the hazard from an

ore body is 500 years for solidified high-level waste, but more than 10,000 years for spent fuel; indeed, examination of the chart at Doc. 3, p. 2-8 shows that the cross-over time, under the Utilities' formula, would be about 40,000 years. Of course, by order of the Presiding Officer, this proceeding relates only to spent fuel. Order of Feb. 1, 1980, p. 9. Thus, even if the Utilities' comparison to an ore body were relevant and accurate, the period during which spent fuel is more toxic, according to their own filing, is 40,000 years. Repeated reference to a 300-500 year period, therefore, is deceitful.

In addition, the Utilities formula is neither accurate nor relevant. The Utilities' definition of toxicity ignores the fact that spent fuel is highly concentrated -- by their own admission, 2500 times more concentrated than the ore body. Doc. 2, p. I-6. A toxicity index which takes account of this concentration factor by comparing the hazards per unit volume, rather than by total curies, shows that even a high-level waste repository remains more toxic than the ore body for more than a million years. (Ref. 32, Fig. 7B4 at p. S111). And industry admits that the time at which the hazard from a repository falls below that of an ore body is even later for spent fuel than for high-level waste. UNWMG, Doc. 2, pp. I-15 through I-22. Thus, the entire ore body comparison is irrelevant and unreliable, even to show that a spent fuel

repository would become less hazardous than an ore body after 40,000 years.

Significantly, industry points to the proposal by the Swedish KBS group to use "a solid copper canister (15 1/2 tons) with fuel rods embedded in 2 1/2 tons of lead." (UNWMG, Doc. 3, p. 3-21). The Swedish group is said to be willing to expend this much copper and lead in the hope of achieving isolation for hundreds of thousands of years. But why is the Swedish group ready to use so much valuable material to seek long-term isolation if the hazardous period is a mere 500 years? The simple answer, of course, is that the hazard of nuclear waste does last for close to a million years. So says another source relied on by the Utilities:

> Since certain radioactive waste products remain hazardous to some extent for hundreds of thousands or even millions of years, a very long-term perspective is required for addressing geologic isolation.*

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* "Oklo-Geologic Isolation Implications," Ref. 31 to Doc. 3 of the Utilities' filing, at p. 200.

Indeed, that source notes that even after a million years, "certain species such as radium 226 and thorium 229 'grow in' to hazardous levels [and] the fission products technetium 99 and iodine 129 become a more significant component of the generally decreasing radioactivity level for longer isolation periods.*

In the end, it must be recalled that the Department of Energy itself has admitted that the period of hazard is a million years (Ref. 1, p. 1.9). Indeed, as ANS recognizes (ANS Table 5-15 and p. 12), some of the elements of nuclear waste have half-lives of over a million years, and remain radioactive for tens of millions of years. USGS has said:

> Spent fuel assemblies, for example, contain significant quantities of 129 I [Iodine - 129] that has a very long half-life of 1.6×10^7 [16 million] years and that poses a potential hazard at least this long. (Ref. 4, p. 9).

Thus, while the waste will be less dangerous after 1,000 years than it is now, it remains highly toxic for a million years or more -- especially since large quantities of the long-lived elements will exist in concentrated form at each repository.

Moreover, the U.S. Court of Appeals for the D.C. Circuit has concluded that because of its 25,000 year half-life, "plutonium must be isolated from the environment for 250,000 years before it becomes harmless." Natural Resources Defense

* Id. at pp. 200-201.

Council v. U.S. Nuclear Regulatory Commission, 547 F.2d 633, 638-9, rev'd and rem on other grounds sub nom. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978) (emphasis added). That is the Court which directed the Commission to conduct this proceeding, State of Minnesota v. U.S. Nuclear Regulatory Commission, 602 F.2d 412 (1979), and it is also the court which is likely to review any challenges to the ruling which may result from this proceeding. Its finding, therefore, cannot be ignored.

2. The Magnitude of Releases

Like DOE, industry argues that any releases which do flow from any repository will be small. And, like DOE, industry is unable to support this promise.

The precise claim by industry is that "given appropriate site selection and system design, it is highly unlikely (if not impossible) for geohydrologic or geologic processes to result in any releases from a deep-geologic repository during the first several hundred years. Furthermore, the NRC staff is now considering that the waste form/canister/other engineered barriers should be capable of providing a large share (if not all) of the required containment during the first thousand years." (UNWMG, Doc. 2, p. I-5). Even if these statements were true, which they are not, they would fail to provide a basis for confidence that any releases would be small. First, the position assumes both the existence

and selection of satisfactory sites. As explained in our Statement of Position, SP, pp. 56-76, and further at pp. 38-42, below, there is no basis for assuming that any satisfactory site will be found and receive all necessary federal, State and local approvals, let alone a sufficient number of such sites. Second, the position assumes no significant releases resulting from human intrusion. But, as shown below, that assumption is unsupported and unwarranted. Third, the position assumes that the period of hazard is only several hundred to a thousand years. But, as just demonstrated, the true period of required isolation and containment is one million years. Thus, discussion of a period of several hundred to a thousand years is virtually meaningless.

These are the obvious flaws in industry's "small release" position. More fundamental is the fact that no one is in a position to say, with any degree of assurance, that breaches of the repository many hundreds or thousands of years from now will yield only "small" releases of radioactivity. To the contrary, common sense suggests that when the system springs a leak, there is no limit to what can get out.* No amount of calculations, especially based on incomplete models and inadequate data, can change this basic inability to assure long-term containment. Industry's assumption is that "environmental dilution" will assure that "acceptable" levels of releases are not exceeded. UNWMG, Doc. 2, pp. I-21, 29.

* Moreover, even if the releases per year are "small", the effects of radiation are cumulative, so that the total releases over many years would be much greater.

But it is only an assumption. Confidence requires more than pure assumption. It requires fact and sound reasoning. Industry has provided neither.*

Because a release of nuclear waste can be very dangerous to the public, repositories must be designed with multiple, "redundant" systems to assure safety even in the event of multiple failure accidents. After all, during the course of a million years many multiple failure accidents are possible. Each of the safety systems, of course, should be independently sufficient to provide for safety. The Utilities, however, say that under the "systems approach" it is unnecessary for every component in the system to perform well so long as the total system works. UNWMG, Doc. 3, p. 2-51. The fallacy here is that if any component is inadequate to begin with, and if other parts of the system fail, there will be nothing to control or prevent an accident. Redundancy, therefore, is meaningless unless each component meets the highest standards. Similarly, the Utilities say that the "multiple barrier concept" need be designed only so that "no single event could reasonably be expected to breach all of them." Id., p. 3-11. However, Three Mile Island was a multiple failure accident, and demonstrated the need to plan against multiple event accidents. Meeting the single failure standard is simply insufficient to give confidence in safety over a million years.

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* In addition, as we have previously explained, "small" releases are neither accepted by the public nor safe. SP, p. 73, fn.

3. Human Intrusion

The Utilities define "isolation" as "emplacing the waste in a place or manner that humans are not likely to intrude and come in contact with the concentrated waste form". (UWMIG, Doc. 2, p. I-4). They define "the primary goal" of waste disposal as "protection of the general public". (Id., p. I-5). They then take the startling position that fulfillment of this goal "does not require isolation." Id. This contention is absurd, since the public could be very seriously injured if future intrusion causes wastes to escape to the biosphere. The NRC has recognized the seriousness of the human intrusion problem and the impossibility of preventing intrusions (SP 50); industry cannot define the problem out of existence. Indeed, the NRC has accepted an estimate by Battelle Pacific Northwest Laboratories that "the probability of violation of repository integrity as a result of random wildcat drilling" -- which is only one of many possible forms of human intrusion -- is "once in 2500 years." NUREG-0116, Environmental Survey of the Reprocessing And Waste Management Portions of the LWR Fuel Cycle, p. 4-87. Therefore, the NRC expects that there would be 400 "violation[s] of repository integrity" from this one mode alone during the million year period of danger.

The "reason" given by industry for not worrying about human intrusion is apparently that only "a small number of individuals" -- presumably the drillers -- would be exposed

to radiation. Putting aside the legal and ethical question of whether exposure by drillers unaware of the danger can be written off, the fact is that human intrusion could very well lead to contamination of large portions of the general public. The drilling itself would open a new pathway for escape of radioactivity to the public. Moreover, if the intrusion occurred after monitoring equipment were no longer operative (see below, pp. 56-57), a great deal of radioactivity could escape without warning. Through this mechanism, large numbers of people could be exposed to unsafe levels of radioactivity before anyone realized what had happened.

Industry's fall-back position is that "wide archiving of records," societal memory and durable markers "may reasonably extend the period of institutional control" for some centuries. Industry notes "a number of examples" of human activities for which records have survived for much longer periods of time than 300 years. UNWMG, Doc.2, p. III-G-7. This is a classic example of industry's irrationality on the subject of nuclear waste disposal. First, while some records have lasted longer than 300 years, many others have not; there is thus no reason to be confident in advance that the repository records will survive. Second, survival of records is not the same as "institutional control" because the records might not be available to the parties needing them. An excellent example of this was recently experienced by West Germany in its investigation of a salt dome extending under the East German border. In order

to evaluate the dome, geologic records for the entire area were needed, yet these records were held in part by East Germany and were not available. (Ref. 30) And third, as explained above, the period of danger is not 300 years, but a million years.

4. Toxic Chemicals

Industry apparently believes that the Commission should not worry about the hazards of radioactive waste because the public willingly accepts the hazards caused by toxic chemicals, which allegedly present comparable or even greater dangers. But, of course, the fact that the public health is being endangered by toxic chemicals hardly diminishes the need to protect the public from radiation. While the Government was slow to protect the public from toxic chemicals, Congress has now enacted many statutes to improve such protection, including for example:

1) The Resource Conservation and Recovery Act, 42 U.S.C. §§ 6201 et seq;

2) The Toxic Substances Contr l Act, 15 U.S.C. §§ 2601 et seq;

3) The Clean Water Act, 33 U.S.C. § 1317(a);

4) The Safe Drinking Water Act, 42 U.S.C. §§ 300f et seq;

5) The Clean Air Act, 42 U.S.C. §§ 7401 et seq;

6) The Occupational Safety and Health Act, 29 U.S.C. §§ 655(b), 669; and

7) The Federal Food, Drug and Cosmetic Act, 21 U.S.C. §§ 301 et seq.

Relying on these statutes and federal common law, the United States has already initiated 33 hazardous-waste enforcement actions, many of them against major corporations. Criminal fines and jail sentences have been imposed following jury convictions of corporate executives in several cases. For example, a federal court imposed a $50,000 fine and 30 days in jail in U.S. v. Frezzo Bros., 602 F.2d 1123 (3 Cir. 1979); and in Kentucky, another federal court levied a $50,000 fine and two years' imprisonment. See U.S. v. Distler, 9 BNA Env. Rptr. 1649 (W.D. Ky. 1979). A number of the States have also brought similar suits. New York, for example, has filed a $643 million action against the polluters of the Love Canal site. Other States, including California, Michigan, Illinois and New Jersey, have also brought actions against parties charged with unlawful disposal of toxic chemicals.

Meanwhile, it is this Commission that has the Congressional mandate to assure that the public is protected from radiation hazards. The evident enforcement by EPA, the Justice Department , and the States of laws within their respective jurisdictions, if relevant at all, only underscores the duty of the Commission to administer the law under its jurisdiction to protect the public from radiation hazards.

5. Coal

AIF's obvious bias against coal is reflected repeatedly in its Statement. However, whether or not there is confidence today that nuclear waste will be safely disposed

of must be decided on the basis of facts concerning nuclear waste disposal. Alleged operational problems with coal are obviously not a basis for confidence in safe nuclear waste disposal.

6. Oklo

The Utilities rely on the Oklo mine in Gabon, Africa as evidence that the United States will safely dispose of its radioactive waste. This reliance is illogical for many reasons. First, it is impossible to determine exactly what occurred at Oklo almost two billion years ago. Current speculations are of questionable value, and cannot be a basis for confidence today in safe disposal. Second, according to those speculations, "a majority" of the six tons of fission products migrated less than could be expected. Ref. 31 to Doc. 3 of the Utilities' filings, pp. 202-203. This characterization strongly implies that the remainder, perhaps as much as three tons, did migrate. In particular, most of the Cesium migrated. Id. Third, industry fails even to discuss what impact Oklo had on life existing at that time, or what impact it would have on life as it exists today. The species of life inhabiting the earth 1.8 billion years ago may have been much simpler and much less susceptible to radiation damage than those which exist today. Even so, for all we know, Oklo may have brought massive death or even extinction to one or more species living in that part of the world. Certainly, industry has not shown that an Oklo in modern times, allowing

three tons of fission products to escape, would be safe. Fourth, as we have earlier discussed, geology is a retrospective rather than a predictive science. The history of past geologic events -- even if well understood, as Oklo is not -- does not provide a sound basis for predicting events a million years into the future. SP, pp. 43-45. See below, pp. 33-38. Fifth, construction of a repository requires drilling through the host rock. Isolation and containment by the host rock would require satisfactory sealing materials and techniques, which industry concedes are not available (see below, pp. 54-56, and SP, pp. 98-99). By contrast, it would seem safe to assume that no one drilled into Oklo 1.8 billion years ago. Sixth, the necessary drilling just described will fracture the host rock, and could provide escape pathways for groundwater other than the shaft itself (Ref. 7, pp. 3-23; 3-25; DOE Statement of Position, p. II-161; SP, p. 96). This problem, like the need to backfill shafts, was not a factor at Oklo. Seventh, Oklo was evidently not a salt deposit, and thus it cannot be assumed that the degree of containment which allegedly occurred at Oklo would occur in a repository in salt, the favored medium of industry.

Finally, the conclusion of the article on Oklo relied on by industry is that site-specific characteristics were responsible for the alleged limitation of migration there: "geophysical and tectonic conditions of the Francevillien basin were such

that major disruption did not occur...[and] the geochemical conditions at Oklo provided an effective barrier to nuclide dispersal." (Ref. 31 to Utilities' Doc. 3, p. 204). Therefore, even if the Oklo site did perform well almost two billion years ago, that is no basis for concluding that the necessary number of satisfactory sites will be found in the United States, that technical and institutional problems will be overcome, and that repositories will actually be established at those sites.*

7. Foreign Experience

Industry says that other countries too are looking for a solution to the waste problem (AIF pp. 15-20; UNWMG, Doc. 2, p. III-A-16). That is irrelevant, however, for no country has an established solution to the problem, and, of course, experience abroad could hardly prove that technically suitable sites acceptable to the public will be found in the United States.

The Swedish KBS-II disposal plan is a plan of action which has yet to be implemented. Whether it will succeed is not known. But it is very different from the plan being pursued by DOE, and therefore is irrelevant to the question of whether waste will be disposed of safely in this country. DOE has announced no plans to use vast amounts of copper and lead as a barrier, as the Swedish plan does. Indeed, USGS, in its

* Ironically, the very discovery of the Oklo reactor -- by an inadvertent penetration in the course of uranium mining-- illustrates that human intrusion can occur.

Statement of Position (p. 11), has said that "a thick copper container, such as proposed by the Swedish plan, might itself be an attraction for future human intrusion" -- which would result in breaches of the repository.

Moreover, a review of KBS-II by the National Academy of Sciences, published this year, reveals that the Swedish plan contains significant weaknesses and fails to answer key technical questions which must be answered if there is to be a potential basis for confidence in waste disposal.

For example, NAS identifies sealing and plugging of tunnels, shafts and boreholes as "an essential feature of all plans for geologic disposal of nuclear waste... one of the most difficult steps in repository construction." (Ref. 30, p. 49). Yet the KBS treatment of this problem is "a notable weakness" of the plan, because "the demonstration of [sealing] procedures under field conditions is inadequate", and the KBS conclusions seem "to rest on inadequate evidence." American engineers were "dubious about the feasibility of the method for filling the tunnels." (Id., pp. 49, 50, 56).

The NAS review of KBS-II also observed that "no agreement has been reached" among technical experts as to the probability that "unacceptable quantities" of radionuclides will migrate through groundwater to the biosphere (Id., p. 46). Measurements of distribution coefficients, on which KBS-II largely relied, were termed "notoriously undependable."

(Id., p. 47). NAS further noted that "the possible effects of glaciation on groundwater movement in a repository are difficult to predict with any assurance," and that the KBS scientists had not considered all relevant circumstances. (Id., p. 29) (emphasis supplied). NAS also confirms that "no adequate model for water flow through fractured crystalline rock is available." Id., p. 18.

Finally, KBS-II assumes a maximum repository temperature of 80°C, which is achieved by cooling all spent fuel rods for 40 years, by limiting the number of rods per canister, and by proper spacing of the canisters. These assumptions, applied to the United States waste disposal problem, would drastically increase both the number of repositories needed (by reducing the volume which each repository could hold) and the total storage capacity needed to store all spent fuel for 40 years. Since we do not know if the necessary number of disposal and storage sites can be found and approved in the United States, the Swedish assumptions could prove troublesome here.

C. Industry Cannot Demonstrate That Safe Disposal Will Be Achieved By A Given Date.

The U. S. Court of Appeals, in the State of Minnesota case, directed the Commission to assess its confidence that safe disposal will be accomplished by a given date, which, as we have argued, should be no later than 1996. SP, pp. 22-24.

The most serious flaw with the AIF and NAS discussions of disposal is that they are theoretical and conceptual, talking about the kinds of sites and conditions that are desirable while ignoring the problem that there are no known sites anywhere in the United States. Until sites meeting all the technical criteria have actually been located, fully tested, and approved, we will not know if they exist. In fact, as of today no suitable medium or site is known to exist. See pp. 38-54 , below and SP, pp. 40 and 65-67. Moreover, many technical gaps and defects are known to exist in the methodology, as acknowledged by DOE, USGS and others. See SP, pp. 43-55, 59-64 and 77-101, and pp. 54-57, below. Until all the gaps and defects are resolved, we will not be sure that they can be.

For this reason, AIF's claim (p. 29) that the first repository could be available a few years earlier than DOE projects is worthless. AIF can work day and night preparing schedules and charts, but they prove nothing until sites meeting all technical criteria and gaining public approval have been found and all technical gaps and problems are resolved. Since nobody knows when, if ever, that will happen, projected dates by both AIF and DOE are sheer fantasy. Indeed, ANS says that the timing is a "political question," and that under certain political assumptions -- such as "reductions in funding, and policy changes" -- the date of implementation would be later than is projected by DOE. (ANS, p. 3, fn).

USGS recognizes that no date can be estimated. In its Statement of Position, as in its Preliminary Statement of April 15, 1980, USGS points to all the research that must still be done in so many areas, and says it is "unable to estimate when [waste] disposal will be available" because such prediction "will be imprecise and premature until many of the key issues identified in this Statement have been addressed" (USGS Statement, pp. 4, 29). "From a technical standpoint," adds USGS, estimating a date for waste disposal is impossible because "new and hitherto untried technology" will be needed, and initial failures are therefore likely. Id. at 5. "How much time should be allowed for such contingencies is not clear." Id. Estimating a date is also impossible because of institutional unknowns, such as the "roles of the States and Indian nations in siting repositories" as well as the Congressional response to President Carter's proposed program. Id.

Of course, it is possible that some day a sufficient number of suitable sites will be found, and all technical and institutional problems will be resolved. At that point, a finding of confidence that disposal will be achieved by a given date might be justified. But to make such a finding today based on hopes for the future would be irresponsible.

D. Industry Has Failed To Establish A Basis For Confidence Today Based On Facts Existing Today.

AMS repeatedly says that disposal is technically "feasible". But that is very different from saying that it

will be implemented. Rather, it means that, in the view of AMS, disposal is being worked on and there are no known insoluble barriers to its becoming available at some time in the future. AMS assumes that all technical gaps now under study will be resolved, whereas in truth we do not know whether the studies will succeed or fail to resolve the problems, or whether new difficulties will arise as work progresses.

The Utilities repeatedly rely on blind technological optimism:

> [The NWTS] Program will corroborate a high level of confidence in repository performance prior to waste emplacement.
>
> * * *
>
> Further, with respect to thermo-mechanical questions, work is well underway, and answers should be available by the time the site selection process is complete.
>
> * * *
>
> ONWI has initiated plans and programs [which] will lead to field testing and demonstration of satisfactory plug designs.
>
> * * *
>
> [B]y the time the facility is closed, there will be a very high degree of confidence in predictions of long-term performances.

UNWMG, Doc. 2, pp. III-D-11, III-D-13, III-F-4, III-E-2. But, of course, neither the Utilities nor anyone else knows or could possibly know whether any of these predictions will materialize. The research might fail to solve the problems.

Evidencing an apparent failure to understand what State of Minnesota v. NRC was all about, ANS says that the Commission's 1977 policy statement announcing confidence, 42 F.R. 34391 at 34393 (July 5, 1977), should remain controlling in the "absence of good cause to change" it. That is not what the D.C. Circuit said in State of Minnesota. The Court there held that the lack of a factual record rendered the 1977 policy statement invalid, and ordered the Commission to reassess its confidence based on a factual record.

AIF relies on portions of the record compiled in the Table S-3 proceeding as supporting the feasibility of storage and disposal. The purpose and focus of the Table S-3 rulemaking were different from those of this proceeding, and the record in Table S-3 is several years old. The Commission is currently conducting this new rulemaking to tackle the waste problem directly, and statements from the prior rulemaking are not binding. Moreover, Commissioners Gilinsky and Bradford both rejected the statements in the final Table S-3 decision which expressed confidence in waste disposal. 44 F.R. 45372-4 (Aug. 2, 1979). In any event, the final Table S-3 ruling has been challenged, and is on review before the U.S. Court of Appeals, D.C. Circuit. State of New York v. Nuclear Regulatory Commission, Docket No. 79-2110, and Natural Resources Defense Council, Inc. v. U.S. Nuclear Regulatory Commission, Docket No. 79-2131. Argument of those cases, together with cases raising challenges to the initial and interim rules, is scheduled for later this month.

E. Industry's Proposed Standard Of Confidence Is Too Weak In View Of The Enormous Risks And Grave Dangers Presented.

To have confidence, the Commission must be highly confident that waste disposal will be truly safe. There should be no expectation of accidents or of releases of radioactivity. The Commission must find that all repositories, even the initial ones, will be accident-free, rather than that accidents will occur initially but will be avoided by the time the tenth repository is being built.

ANS has decided that we need not develop a "perfect" repository, or even "the 'best' site in the 'best' medium" (pp. 6-7). Instead, we should search only for an "acceptable" site for a first repository (p. 7). In effect, ANS is prepared to lower the standard from the very beginning, to accept a site known to fall short of high safety standards and be plagued by many unanswered questions. However, as set forth in our Statement (pp. 21-22 and 43-50), waste disposal presents a unique challenge because it requires society for the first time to try to protect itself against a very dangerous substance for a million years -- a period far beyond our ability to make plans or predictions. We simply do not and cannot know what geologic or human events will occur far in the future. At a minimum, therefore, we must close all data gaps and select repositories having no known defects. If, as ANS suggests, we begin with a mediocre repository known to have flaws, we are inviting disaster, because such a repository is more than likely to fail during the very long period under discussion. As the National

Academy of Sciences has said, "the hazard related to radioactive waste is so great that no element of doubt should be allowed to exist regarding safety." (Ref. 6, p. 3) (emphasis added).

The Utilities say that repository operation "cannot be totally risk free," and that we must therefore determine what level of risk is acceptable. UNWMG, Doc. 3, p. 2-44. To be sure, operation of a repository is inherently fraught with risk, and some risk cannot be avoided. However, that is no excuse for accepting mediocre repositories, or for doing less than whatever is humanly possible to reduce the risk. The repository design and site must be free from all known defects, and there must be no known reason to expect that problems will develop.

USGS has noted that waste disposal "requires new and hitherto untried technology" which "typically" involves "initial failure of some components to perform as originally conceived, discovery of new problems to be resolved, and reconsideration of design concepts." USGS Statement of Position, p. 5. This view is in accord with that taken by the NRC in its draft technical criteria for regulating disposal. The NRC there said that building a repository "is a new human enterprise," and it is therefore "reasonable to expect that, whatever the care exercised and however advanced the techniques, mistakes will occur, improved technologies developed, better designs created, and operational procedures improved." 45 F.R. 31393, col. 2 (May 13, 1980).

Both USGS and the NRC are evidently ready to assume that the inevitable failures or mistakes will not lead to a major accident, but there is no basis for that conclusion. To the contrary, the failures or mistakes will not necessarily occur at a time or place convenient to the repository operator, and could result in an unforeseen accident of major proportions.

In view of the inevitable and uncontrollable risks that flow from the trial-and-error process and the unpredictability of the future, this Commission should not declare confidence if it is not clearly convinced from existing facts that all technological and institutional problems will be favorably resolved, resulting in the selection of a sufficient number of sites meeting the highest standards and having no known defects.

II. INDUSTRY HAS FAILED TO DEMONSTRATE A FACTUAL BASIS FOR CONFIDENCE THAT NUCLEAR WASTE WILL BE SAFELY DISPOSED OF IN REPOSITORIES BY ANY GIVEN DATE.

In our Statement of Position, we enumerated and explained a large number of technical and institutional factors which preclude a finding of confidence. These factors include:

A) the impossibility of predicting geologic or human events far into the future;

B) the fact that satisfactory sites have not been found and no method exists to adequately test candidate sites without ruining them;

C) the likelihood of opposition by State and local government and the affected public to any particular site;

D) our lack of knowledge about rock properties and interactions between the wastes and the repository environment;

E) the known problems with salt and all other candidate media;

F) the lack of technology for sealing repositories; and

G) the lack of technology for monitoring.

In view of this array of unsolved problems, the Court of Appeals, USGS, the IRG and others have acknowledged that the needed technology is not now available. In the words of the Court, "[n]o one disputes that solutions to the commercial

waste dilemma are not currently available." State of Minnesota v. NRC, 602 F.2d 412, 416 (D.C. Cir. 1979). According to USGS, confidence in waste disposal, just from a technical point of view, "depends on favorable outcomes to all of [five] research and exploration efforts" being planned by DOE. USGS Statement of Position dated July 7, 1980, at p. 4. Several of DOE's research efforts, says USGS, "have only recently been expanded in scope so that significant earth-science issues connected with the implementation of waste disposal in mined repositories are now being addressed." Id. Again, since the DOE research has not been completed with favorable results, there is no basis for confidence today.*

Nevertheless, industry blithely declares that the needed technology is "essentially available." (UNWMG, Doc. 2, p. I-30). As this section will demonstrate, industry has failed to show a basis for confidence in the face of the many technical gaps and uncertainties. In addition, industry has not demonstrated that the institutional obstacles to implementing safe disposal will be resolved.

* While the USGS expresses confidence in the technical possibility of geologic disposal, the facts raised by USGS negate a factual basis for confidence, and show that the confidence is based on hope or an optimistic frame of mind rather than fact. USGS also takes no account of the possibility that institutional factors will prevent the accomplishment of waste disposal.

A. Industry Has No Answer To The Impossibility Of Long-Term Prediction.

Industry's claim of a "significant capability" to predict geologic processes over periods of hundreds of thousands to a million years is groundless. (UMTRIG, Doc. 2, pp. III-A-8, III-A-13). DOE and USGS have both acknowledged our utter inability to predict so far into the future. USGS has said:

> [U]se of the geologic record to predict future events is a formidable task.
>
> * * *
>
> The past rates of occurrence of geologic events and processes have varied widely over time and there appears to be no clear philosophical basis for determining rates for these events or processes in the future.

(Ref. 4, p. 11). DOE has acknowledged that "many important aspects of the evolution of the lithosphere ... are difficult, if not impossible to forecast." (Ref. 1, p. 3.1.22). Moreover, according to DOE:

> Much basic knowledge about geologic processes, their interactions and particularly their time of next occurrence is lacking for certain types of events over the time periods being considered. The events are those that would be possibly disruptive to a repository.

(Id., p. 3.1.50).

Industry identifies groundwater movement as "the most probable and most rapid mechanism for potential transport of radionuclides from a repository," and says that "climate is the main natural variable influencing long-term groundwater movement" (id., pp. III-A-8, III-A-10); but understanding groundwater transport is "still in the future," and the effects that changes in climate would bring have been "largely ignored." (SP, pp. 83, 47). Industry's claim that the records of the past provide a basis for predicting climatic changes in the distant future is entirely unsupported, and flies in the face of DOE's admission that "simple projection into the future from local geological history alone is not a satisfactory basis for repository site selection." (Ref. 1, p. 3.1.22; SP, p. 45).

Equally important as geologic uncertainty is the problem of future human intrusion. Industry claims that "potential resources or other factors that would encourage future detrimental activities by man can be determined with reasonable assurance," thus implying that the selection of sites (if they exist) far removed from such resources would prevent human intrusion. (UMWMG, Doc. 2, p. III-A-3).* But NRC staff has acknowledged that "human

* Ironically, industry places great reliance on the Swedish KBS plans, which call for the use of a thick copper container to serve as a barrier against migration. Copper, however, is already a valuable resource and USGS predicts that it will be an attraction for future human intrusion. USGS, p. 11.

intrusion cannot be prevented." 45 F.R. 31398 (May 13, 1980). Moreover, as earlier observed (p. 15), the NRC has accepted an industry estimate that "the probability of violation of repository integrity as a result of random wildcat drilling" is once in 2500 years -- or 400 times during the million year period of danger.

Further, DOE admits that land use cannot be predicted even beyond 100 years, and EPA suggests that existing governments cannot be relied on to last for more than 100 years [SP, pp. 49-50; 43 F.R. 53265 (Nov. 15, 1978)]. We cannot know that a mineral having little value today will not become valuable in future years. As the EPA Panel of Scientists put it, "[m]an's unpredictability far outstrips most of the imagined geologic hazards we can foresee." (Ref. 5, p. 35). Industry also claims that "the hazard due to human intrusion into the waste will have been reduced by a factor of 1,000" in 3 centuries. This reduction, however, is not very comforting: Since the total quantity of radioactivity initially placed in each repository may amount to hundreds of millions of curies (see Ref. 2, p. 10.3.6), even a reduction by a factor of 1000 leaves hundreds of thousands of curies in each repository -- more than enough to cause catastrophic consequences if even a small portion of this radioactivity is released to the biosphere. The fact that existing human institutions may not survive far into the future aggravates the human intrusion

problem, and negates confidence that future generations will take mitigating action to protect themselves from radiation releases caused by intrusion or natural events.

Finally, industry, like DOE, seeks to rely on "modelling" and "risk assessment" to compensate for our inability to predict the future. (UNWMG, Doc. 2, p. III-G-8; AIF, pp. 22-25). In particular, AIF's discussion entitled "Perspectives on Actual Risks" (pp. 22-25) is meaningless. It purports to project the number of fatalities from waste disposal on the incorrect assumptions that ideal sites exist and that all technical problems have been solved. The discussion takes no account of accidents or human intrusion into the repositories, or breaches caused by severe earthquakes or other disruptive natural events, which could cause very large releases of radiation killing many people and rendering large areas uninhabitable. Also ignored are the numbers of illnesses or genetic injuries that would not result in early deaths.

Moreover, since basic data needed for risk assessment are unavailable (SP, pp. 50-54), AIF's discussion is an exercise in futility. In its Statement of Position dated July 7, 1980, the USGS again emphasizes the need for <u>in situ</u> tests "to generate the data needed to perform risk assessment for the actual sites." USGS, p. 6. Since selection of sites is at least several years away, data needed for risk assessments

will not even be available for some time, and the results will not be known until sometime thereafter. In addition, the models still need considerable generic data "pertinent to the phenomena being modelled and a better understanding of the processes and events involved to assure that the models are an adequate representation of reality." Id., p. 15.

Beyond that, however, risk assessment models are plagued by uncertainties because of the difficulty, or even impossibility, of assigning mathematical probability figures to "rare geologic events," human intrusion, and other variables. Id., p. 16. The Utilities' filing acknowledges the large uncertainties "inherent in the immeasurable data" -- including future human behavior, future geologic events such as earthquakes and glaciation, and the repositories' ability to contain wastes in the future. UNWMG, Doc. 3, p. 2-24. "The least certain of all the risk assessment elements are the scenarios for loss of containment and isolation and the immeasurable data, both of which depend on the ability of the analyst to account for future events of a disruptive nature in his risk assessments. There always remains doubt whether all important disruptive events are included." Id., p. 2-26 (emphasis in original). Also, the Utilities concede that the underlying scientific principles relating to "transport of dissolved contaminants in dispersive media and the mechanical properties of rock around mine openings" are uncertain. Id., p. 2-19. They concede uncertainty with respect to "sorption, or chemical interactions between radio-

nuclides and geologic media, groundwater flow in fractured media, and leaching of solid waste forms." Id., p. 2-20 (emphasis in original).

The Utilities insist that models for risk assessment should be used despite the uncertainties regarding the underlying scientific principles, the scientific data, and the numerical approximations used. See UNWMG, Doc. 3, pp. 2-19 to 2-25. The Utilities would have us believe that no matter how unreliable the data fed into the computer, accurate risk assessments will result. This, however, is untenable. Computer results can be no better than the data provided. If the data are unreliable, so inevitably are the resulting assessments. The models, therefore, are of almost no value for making confident predictions.

B. Industry Has Not Shown That Technical Problems Of Site Suitability Will Be Overcome And That A Sufficient Number Of Satisfactory Sites Will Be Found.

Industry's response to the fact that no suitable site has been identified to date is to pretend that there is no problem. AIF and ANS simply assume in their discussion that suitable sites will be found.

The Utilities admit that "exceptionally high rock quality" is required, and that site suitability depends on "tectonic and mechanical stability, related hydrology and

geochemistry, physical extent of host formation, and homogeneity and characteristics of surrounding geologic, hydrologic and geochemical conditions." UNWMG, Doc. 2, pp. III-A-7, II-7. They also admit that "long-term geologic stability" should be assessed "on a site-specific basis," and that "there is no amount of generic information that could greatly reduce the need for detailed studies at specific sites." Id., p. III-A-13.

The necessity of in situ testing for site selection has been acknowledged by DOE, IRG, USGS, and others. (SP, pp. 59-64). Failure to recognize its importance was mentioned by the National Academy of Sciences as a weakness of the Swedish KBS-II Plan:

> [G]eologic exploration from the surface and from drillholes can never provide all the needed information about a site, and ... actual underground exploration will almost certainly reveal a number of unanticipated geologic irregularities.
>
> * * *
>
> Predictions [from surface measurements and a few boreholes] would have to be verified, of course, by in situ measurements in exploratory tunnels.

(Ref. 31., pp. 16, 20; see also id. at 48). There cannot be confidence that nuclear waste will be safely disposed of until the necessary number of sites meeting all technical criteria and gaining public approval have been found. They will not be

identified, however, until after many years of in situ testing. Indeed, the American Institute of Chemical Engineers says, in its Statement of Position (p. 6), that "assurance that a site is suitable will not be established until the underground portion of that site is virtually fully developed." Therefore, many years of in situ testing, and later construction, will be necessary before suitability of the site can be fully assessed.

Notwithstanding all this, and prior to in situ testing, the Utilities simply conclude that the "feasibility of candidate sites can be evaluated by established techniques of field exploration and laboratory testing," and that the federal government is "highly likely to identify candidate sites." (Id., pp. III-A-3, III-A-19). There is no admission of the fact that non-destructive testing technology has not been developed (see SP, p. 63); and the answer given to the lack of non-destructive excavation technology is merely that the federal government is studying the problem. (Id., p. III-A-14) (see SP, p. 96).

The Utilities' position is somewhat ambiguous. If, as appears to be the case, "candidate sites" means only potential sites which must then undergo in situ testing, then no claim is being advanced that a sufficient number of satisfactory sites exist. If "candidate sites" means tested, acceptable repository sites, the claim that such sites are likely to be found is pure speculation; by the Utilities' own account, in situ

testing is essential to determining site suitability. And, of course, the fact that the government is working on the problem of nondestructive excavation technology is no basis for confidence, since its efforts may or may not succeed.

The Utilities' apparent inability to understand the site selection problem is evidenced by another argument they advance: that nuclear power plant site selection experience is "applicable to the search for repository sites." Doc. 2, p. III-A-6. Yet repositories, unlike nuclear power plants, must be built hundreds of meters deep and must assure containment of wastes for as long as a million years. These facts, recognized by the Utilities, mark an obvious distinction which precludes any inferences from the siting experience of nuclear power plants. Indeed, the NRC has proposed draft technical criteria for repositories very different from those for power plants. 45 F.R. 31393 (May 13, 1980).

The Utilities recognize the existence of many technical siting constraints. For example, areas "subject to severe erosion by glaciers can be avoided either by choosing climates not subject to glaciation or else by appropriately choosing the topography of the site." UNWMG, Doc. 3, p. 2-20. Either of these alternatives would eliminate many areas from consideration. In addition, say the Utilities, areas should be chosen for stability, favorable hydrology, favorable rock properties, and a low potential for local resource exploration.

Id., p. 3-29. The problem, of course, is the inability to predict whether or not the area will remain stable, and the hydrology will remain favorable, far into the future. We cannot make confident predictions from the current facts. See above, pp. 33-38. Moreover, each criterion eliminates more and more sites. The Utilities all but concede that no site will meet all the technical criteria, saying that "the capability exists to make such trade-offs on a rational basis." Id., pp. 3-34, 3-36. Thus, sites with known defects and inadequacies are acceptable to the Utilities, although they can hardly assure safety.

It cannot be overemphasized that, as of now, by DOE's own account, none of the regions of the United States under study for a repository site has been found to be satisfactory, even on a superficial level (SP, pp. 65-67). This conclusion is supported by the USGS Statement of Position, which also finds uncertainties or problems with each region. For example, with respect to the Gulf Coast interior salt dome basins, USGS says that the hydrology is complex and requires further study, including the question of whether the domes are undergoing dissolution. USGS Statement, pp. 18-19. Also needing study are the faults in the region, and the possibility of future salt dome growth causing fracturing or faulting in the future. Id., pp. 19-20. The domes may also be attractive for drilling or other activities, and this may make them unsuitable. Id., p. 20.

The Permian Basis is also a questionable region. The groundwater flow system for the Los Medanos area in New Mexico was studied in connection with the aborted Waste Isolation Pilot Plant ("WIPP") project, but results of that study, says USGS, are "not applicable to a full-scale, spent fuel repository." Id., p. 22. Also needing further study are the implications of potash and potential oil and gas resources in that area, and the consequences of changes in the area's tectonic or climatic characteristics. Id., p. 23. With respect to the other areas in the Permian Basin being considered, exploration "is in the early stages." Id., p. 24.

It is similarly uncertain that the Paradox Basin will have any suitable sites. USGS says that exploration there "was begun relatively recently and much geological, geophysical and hydrologic study remains to be done to locate potential sites." Id., p. 24. In addition, the structural complexity and hydrocarbon content need further study, as does "the complex hydrology of the Paradox Basin at the depths contemplated for a repository." Id., p. 25.

Another area under consideration is the welded tuff area of the Yucca Mountain in the Nevada Test Site, but exploration was begun only recently and a feasibility study is still under way. Id., p. 25. Also, the hydrologic flow system in the area is not well known and requires additional characterization. Id. In addition, earthquakes have occurred within the vicinity of the Test Site. Id.

Similarly, says USGS, the hydraulic characteristics at relevant depths for the Hanford Reservation are not fully known, and "considerable additional drilling and careful testing" will be needed. Id., p. 27. In addition, "determination of the direction of movement of the groundwaters may prove difficult," as may modelling of water flow. Id. Furthermore, testing will be needed to assess the extent of water retardation in the area. Id. "Careful attention must also be given to the problems of repository construction and safety in a brittle, highly fractured, and water-bearing sequence of rocks." Id., p. 28.

The final area under consideration consists of the Michigan and Appalachian Basins, but USGS says that studies are "at an early stage," and no further work is now underway. Id., p. 28. A significant known disadvantage is that the region has potential for oil and gas exploration and development in horizons beneath the salt. Id. Also, little is known of the flow characteristics of the deep waters in the region. Id.

Thus, none of the six regions of the country can now be said to have any suitable repository sites, and each region needs extensive further study and testing. As noted in our initial Statement (pp. 63-64), there is no way to predict the results of these studies. Indeed, further study and testing are as likely to lead to elimination of sites or areas as to

lead to findings of acceptability. For example, DOE last year had to abandon consideration of the Palestine Salt Dome in the Gulf Interior Region because of hydrologic uncertainties -- a fatal flaw that had gone undetected during prior screenings by USGS and later by DOE. DOE Statement of Position, pp. II-104, 106. DOE itself has admitted that it may turn out that no site will be found meeting all technical criteria. (Ref. 1, p. 3.1.19). Anticipating this, the Utilities' position is that a "site need not satisfy all the selection guidelines. It is unlikely that any one site will need to provide all the idealized sought-for characteristics." Doc. 3, p. 3-34, quoting reference 53 to that Volume (emphasis in original).

Beyond that, even if satisfactory sites now exist, the testing process itself could cause fractures which could render sites unsuitable. Also, construction of a repository could cause faulting or fracturing at any site selected (SP, pp. 47, 96). The fact that so much work still needs to be done just to reach preliminary decisions on potential repository sites is ground for skepticism, rather than confidence, that the sufficient number of sites meeting technical criteria will be found.

C. Industry Has Not Shown That Institutional Obstacles To Site Selection Will Be Overcome And That A Sufficient Number Of Technically Satisfactory Sites Will Be Accepted By The Affected Public As Well As State And Local Government.

Industry concedes that institutional problems exist.

ANS, for example, acknowledges that there is "public apprehension" over the disposal issue (ANS, p. 5), and cites a report pointing out "local hostility in many places to investigation of sites" because the public is afraid "that waste management poses local, high-intensity risks..." (p. 10) (emphasis in original). Yet ANS makes no attempt to demonstrate that these recognized institutional barriers will be overcome, and there is no basis for confidence that they will.*

Similarly, AIF concludes (p. 12) that political and institutional problems are a more serious obstacle than technological problems, but that the IRG Report "has outlined a method to establish a national political consensus." Id. In fact, however, no such consensus has been established to date, and widespread opposition continues. AIF also says (pp. 32-33) that the President's message to Congress on February 12, 1980 and DOE's April 15, 1980 Statement in this proceeding "provide a sound foundation for a finding of confidence from the standpoint of institutional and political considerations." Id., p. 32. AIF's conclusion, however, is illogical, for neither of those events assures State agreement to either repository siting or waste shipments. Thus, AIF nowhere confronts State and public opposition, or the likelihood that waste disposal could be prevented by institutional objections even if all technical difficulties were resolved.

* Significantly, in Sweden as well the investigation of proposed repository sites was "hampered by the reluctance of many property owners to permit the necessary geologic mapping and the work of the drilling crews..." (Ref. 31, p. 11).

Public opposition to disposal or storage facilities, or to the transport of nuclear waste, is a factor which could prevent safe disposal or safe storage. It must be taken into account as a significant fact, whether one views such opposition as sensible or short-sighted. As a report prepared for TVA says, "public perception that transportation of spent fuel poses a potential hazard is a reality..." Appendix to the TVA Statement of Position, p. 7. Industry simply cannot ignore institutional issues, because they are crucial to the question before the Commission in this proceeding.

The Utilities recognize that "politico-institutional issues" played a part in the abandonment of Lyons, Kansas, as a repository site (Doc. 2, p. II-3). They observe that "institutional coordination [is] equal in importance to the technical issues." (Id., p. IV-3.) Their answer to the problem is twofold: (1) the States "have every incentive" to resolve all issues, because the nation needs nuclear power and because existing wastes will have to be handled somehow, and (2) if the States do not cooperate, Congress can and will impose a solution. (Id., pp. IV-6, 12, 13, 16). As in every other area, the Utilities' optimism is without foundation. History shows that in every State which has become the focus of an actual attempted site designation, public opposition has developed. (SP, pp. 13, 70-71). There is no reason to assume that State and local opposition will suddenly vanish. Many States continue to prohibit or restrict

the disposal, storage or transportation of nuclear waste within their borders despite industry's claim that nuclear power is necessary and safe.

It cannot be assumed, as proposed by the Utilities, that Congress will force the States to accept commercial waste repositories. To date, Congress has not attempted to do this, and there is no assurance that, in the face of strong opposition by States and by the public, it will do so in the future. Moreover, Congressional power to force such a solution is very doubtful, and any legislation seeking to do this would surely be challenged in court, where the outcome is uncertain. Thus, there is no basis for confidence that Congress will either attempt to force a solution, or that it would succeed if it did so attempt.

D. Industry Has Not Demonstrated An Adequate Understanding Of Rock Properties and Waste-Rock Interactions.

As USGS observes in its Statement of Position (p. 12), among the many data gaps and unsolved technical problems facing repository development is the fact that spent fuel is heterogeneous, and that studies to characterize it "and determine the mechanisms and rate of its alteration in a repository setting are beginning... but results to date are fragmentary." Accordingly:

> DOE's program for developing the capability to successfully dispose of spent fuel will require several years of substantial effort and funding to assure confidence in the long-term performance of this waste form.

Id. Thus, a factual basis for confidence does not exist today. Further, potential chemical reactions among the spent fuel, container, overpack and backfill materials, groundwater and host rock "will have to be explored." Id., p. 13. Also, the effects of heat need further study. Id., p. 14. In short, "the uncertainties associated with hot wastes that interact chemically and mechanically with the rock and fluid system appear very high." (Ref. 4, p. 6). Similarly, DOE has candidly acknowledged that "important gaps exist in knowledge regarding rock properties and responses under extreme conditions of temperature, stress and radiation over long periods of time" (Ref. 1, p. 3.1.26).

The Utilities agree that understanding rock properties is "fundamental to site identification and characterization" (UNWMG, Doc. 2, p. III-A-13), and yet recognize some of the many technical problems with repository development. With respect to thermal effects of the deposited waste, they say:

> Heat may have a potentially harmful effect on host rock media through loss of strength and possible increased permeability due to fracturing. In salt, thermal gradients can induce brine migration in the direction of waste containers, a process that could result in accelerated corrosion. In all media, elevated temperatures promote corrosion of canisters. Expansion of rock followed by subsequent contraction, which is due to the heat of radioactive decay of the waste over hundreds of years, may tend to promote uplift and subsequent subsidence of the ground surface above the repository, which might induce additional fracturing of the rock.

UNWMG, Doc. 3, p. 3-24. Some of the phenomena caused by heat are said to be well understood, "while the fundamental mechanisms of others are yet to be fully explained. All of them must be carefully evaluated in the course of designing a particular repository." Id., p. 2-30.

The Utilities also concede that additional studies should be conducted. "The potential for and consequences of migration of radioactivity in groundwater should be the principal subject of safety analyses of particular repositories." Id., p. 2-29. Also: "In the areas of sorption, groundwater flow in fractured media, and leaching, an improved scientific understanding would be helpful." Id., pp. 2-25, 26. Similarly, gas transport is said to require further investigation. Id., p. 2-28.

Industry's principal answer to the problems of heat and temperature is longer interim storage (50 years is suggested), lower loadings per canister, and wider spacing between canisters. UNWMG, Doc. 2, p. III-B-14.* This answer is inadequate because we may be unable to store spent fuel for

* Industry also asserts that work on thermomechanical models "is well underway, and answers should be available by the time the site selection process is complete". UNWMG, Doc. 2, p. III-D-13. (emphasis supplied). Until these models and the data which they need are both available, we cannot be confident that the proposed thermal loadings are safe. Industry also suggests ventilation. (Id., p. III-D-4). However, that would reduce the thermal load only during repository operation, not after closure.

50 years at the earth's surface, or to increase the spacing between canisters, as industry suggests. DOE has projected 6.5 years of surface storage before spent fuel is placed in repositories. (Ref. 2, p. 1.1.2) Increasing the storage period to 50 years would therefore require a several-fold increase in the amount of storage space needed.* It also increases the hazards of surface storage; indeed, there is no basis for confidence that spent fuel can be safely stored even for 50 years (see below, pp. 58-60). Moreover, since we also cannot be confident that even a small number of storage facilities will be acceptable to the public, we certainly cannot assume that an arbitrarily large number will be established.

Even more problematic is the fact that reducing the loading per canister would increase the number of repositories needed, as would increasing the distance between canisters; the combination of these actions could require a several-fold increase in the number of repositories needed. Since a dozen or more repositories would be needed even without taking these actions, it is apparent that these actions could require the establishment of dozens of repositories. Needless to say, since the establishment of even <u>one</u> repository meeting all technical requirements and gaining all necessary approvals

* Of course, present inventories will be aged more than 6.5 years by the time they are emplaced, because no repository now exists and none will be open for some time, if ever. However, DOE's draft EIS states that once the backlog has been emplaced, all spent fuel will be emplaced after only 6.5 years of aging. Ref. 2, pp. 1.1.2, 10.3.1-10.3.2, and Table 10.B.3.

is in great doubt, the Commission cannot have confidence that dozens of repositories can be established. Thus, industry's "solution" to the thermal problem is illusory.

And, temperature is not the only problem for which industry has no answer. Long-term waste-rock interactions in general cannot be predicted. Industry relies on "extrapolation" of short-term tests and ongoing federal research programs to fill this gap, but, as we have already shown, both the data and the models needed even to attempt long-term analysis are unavailable. Indeed, in recognizing that laboratory rock samples cannot be assumed to be representative of the entire rock mass, industry concedes that site-specific subsurface investigations and tests will be required. Since no candidate sites have been selected, and thus in situ testing has not been conducted, we do not know enough about waste-rock interactions to be confident that they will pose no problems. As the IRG found, "at least several years of experimental work needs to be conducted" to determine just the chemical reactions between spent fuel and the host rock, not to mention the problems of heat, radiation, or migration in groundwater. SP, 82.

Despite their admission that many data gaps exist, the Utilities oppose certain demands for further research. They say that although scientists have pointed out many data gaps requiring study, not all the areas are necessarily important, and the call for research may represent nothing more than the "researchers' curiosity and personal priorities." UNWMG, Doc. 3, pp. 2-40, 41. There is simply no basis for

saying that the USGS, President Carter and the IRG are calling for unnecessary research. To the contrary, they are correct in saying that we should understand the underlying processes at the outset rather than proceed blindly and hastily in the unprecedented attempt to assure safety one million years into the future.

E. Industry Has Not Demonstrated That Any Rock Medium Is Acceptable For Construction Of Repositories.

Industry has not established the suitability of any host rock medium or media. As demonstrated in our Statement, neither salt, granite, shale, nor basalt has been shown to be suitable, and in fact many known defects with each medium make it questionable, at best, whether any of them will be found acceptable.

Industry's principal discussion of this issue is in reference to salt, which is asserted to be acceptable. (UNWMG, Doc. 2, pp. II-2, IV-2). The Utilities acknowledge, however, that "saturated brine solutions may form around the canister and cause deterioration of the canister and waste form... [and] bedded salt may provide a potentially hostile environment for the waste form and canister." UNWMG, Doc. 3, p. 2-53. Further, industry fails to discuss other serious troubles known to exist with salt. No mention is made of the fact that creep in salt is not adequately understood and that creep can cause a salt formation to collapse literally overnight;

or that salt may be plagued by "focusing" and breccia pipes; or that disposal of 30 million tons of mined salt from each repository presents a serious environmental hazard. (SP, pp. 84-90). These factors, as explained in more detail in our Statement of Position, preclude a finding of confidence that repositories can be established safely in salt.*

F. Industry Admits That The Technology For Sealing Repositories Is Necessary, Yet Not Available.

Industry acknowledges that "how well shafts and boreholes are sealed represents an important aspect of the degree of confidence in the integrity of the surrounding geological structures," and that "shaft sealing is not a simple extention of borehole-plugging techniques." UNWMG, Doc. 2, pp. III-H-5, III-F-2. Yet, as industry also admits, the "durability [of current cementing technology] over the long

* Industry argues that Project Salt Vault proved the feasibility of waste disposal in geologic repositories generally and in salt in particular, because wastes were emplaced there for two years. (ANS, p. 17; UNWMG, Doc. 2, p. II-3). The truth, of course, is that the Lyons, Kansas experience was a notorious failure by the Government in its attempt to solve the waste problem 10 years ago. Project Salt Vault demonstrated that any site, in any medium, which appears suitable for a repository may later be found unsuitable, even after years of testing and experimentation. Moreover, with specific reference to salt, it is significant that a key factor in the abandonment of the Lyons site was the threat of water nearby. Since salt is highly soluble (Ref. 2, p. 7.2.4), and since water is almost universally present in the underground (Ref. 20, p. 521), any potential salt formation is vulnerable to underground water, which might or might not be discovered in time, as it was in Kansas, to abort plans for disposal.

time periods needed for radioactive waste isolation has yet to be proven." It says that "the capability of present technology for the sealing of shafts and boreholes to maintain the integrity of seals beyond 50 to 100 years has not been confirmed by modern standards." Id., Doc. 3, p. 3-27. (emphasis in original).

Industry's answer, predictably, is that DOE "has initiated plans and programs" which "will lead to field testing and demonstration of satisfactory plug designs." Id., Doc. 2, p. III-F-4. "Studies will be conducted to establish the longevity of the seals in the media. Laboratory investigations ... will be carried out... Borehole plugging is an issue being considered for future research and development efforts in Europe... [DOE is conducting] "an impressive amount of work." Id., pp. II-F-4, 5, 6, II-H-5 (all emphases supplied). But, as already observed, plans and hopes for research do not establish confidence that solutions are at hand. Until the research is done and the studies have been conducted, there is simply no way of knowing whether "satisfactory plug designs" will emerge, or whether those designs will be achievable in practice. The Court of Appeals, in rejecting the Commission's earlier declaration of confidence, which had been based on the fact that the Government was actively working on the disposal problem, made it clear that the decision in this rulemaking must be grounded in concrete, existing facts rather than hope for the future. The facts about sealing are admittedly

insufficient to justify confidence at this time.*

G. Industry Concedes That The Necessary Monitoring Of Radioactive Releases From Each Repository In The Years Following Closure Is Not Feasible.

The Department of Energy believes that a monitoring system should operate for a few centuries after closure of a repository. (Ref. 1, p. 3.1.63). Yet industry does not accept this requirement, and instead takes the view that it cannot be met:

> [A]ny monitoring for the escape of radioactivity... from the repository complex itself, will have to be done without significant compromise to the integrity of the repository. Accordingly, since the monitors will have to be located at some distance from the radioactivity, they will not provide any indication of movement of radioactivity in less than centuries.

UNWMG, Doc. 2, p. III-G-1. This view, of course, assumes that migration rates will be very slow, a contention we have shown to be unsupported. SP, pp. 83-84; see also above, pp. 12-14.

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* Before sealing, during the period when the repository is in operation, there will of course be holes in the ground leading down to the repository. According to industry: "Inflow of surface water due to thunderstorms or local flood is not expected to occur. Siting and design criteria will largely eliminate this possibility, and appropriate protection against groundwater inflow during construction and operation can be provided." UNWMG, Doc. 2, pp. III-E-4, 5. This statement is not explained, and no references are cited. Moreover, the IRG found, as common sense would dictate, that as long as the rooms and passages of the repository remain open, flooding is possible. (Ref. 12, p. 83). NRC staff is also concerned about flooding prior to sealing. (Ref. 7, p. 3-30). See SP, pp. 98, 99.

But even if, as industry says, migration is so slow that it cannot be detected in "less than centuries," the monitoring instruments will no longer be functioning at that time; no instruments have been shown to be capable of operating for so long. Thus it cannot be said with confidence that future generations will be adequately warned about releases of radioactivity from the repositories.*

* Even with a perfect monitoring system, repositories should not be established if all known problems, gaps and defects have not been resolved. Monitoring would be powerless to prevent releases of radioactivity; at best, it could only warn people to leave the contaminated area.

III. INDUSTRY HAS FAILED TO DEMONSTRATE A FACTUAL BASIS FOR CONFIDENCE THAT NUCLEAR WASTE WILL BE SAFELY STORED UNTIL SAFELY DISPOSED OF.

Industry claims to have confidence in safe, indefinite long-term storage based on operating experience over the past twenty years. But it ignores many things, such as the many accidents that have already occurred during storage in this country, and the serious explosion in the Soviet Union which required the resettlement of population from an area of 38 to 380 square miles. (pp. 104-108 of our Statement). Industry also closes its eyes to the generic unresolved safety issue entitled "Control of loads near spent fuel," NUREG-0510, Identification of Unresolved Safety Issues Relating To Nuclear Power Plants, p. A-16. The NRC there recognizes that if a heavy object were to fall into the spent fuel storage pool, there could be a large release of radioactivity.

The problem of an accident at a storage facility is most severe. If an accident occurs at a nuclear plant, the danger can often be reduced by promptly shutting down the plant. A storage facility, by contrast, cannot be shut down, because there will not be back-up storage capacity available on site. In light of the dearth of storage capacity off-site, as well as the hazards of transportation, there may be no safe way to remove or handle the spent fuel in the event of an accident at a storage facility.

Similarly, industry ignores the fact that storage might be needed for many decades or centuries if repositories are not established sooner. Twenty years of experience cannot establish confidence for such a long future period. A report prepared for the Tennessee Valley Authority ("TVA") has said about techniques for storing spent fuel:

> [S]ince operating experience for more than 20 years is not available, a very long passage of time (i.e., several decades or longer) also may make the fuel assemblies less reliable by weakening the cladding, which means that the current methods for storing these assemblies are interim measures.

Appendix to the TVA Statement of Position, p. 10.

Long-term storage, therefore, will require new techniques for storing spent fuel -- techniques which to date have not been developed or shown to be safe. TVA says in its Statement (p. 11) that it is studying future concepts and "emerging technologies" for storage, but these cannot be relied upon at present. The truth is that no safe technique has been demonstrated for long-term storage. The longer the period of storage, the more likely it is that serious accidents will occur. Indeed, storage facilities are especially vulnerable to acts of sabotage or terrorism, the risk of which increases as the period of storage lengthens.

Because it might be necessary for a very long time, storage, like final disposal, is subject to the uncertainty stemming from our inability to predict changes in government, society or human activities decades into the future. We cannot be sure that future societies will adequately care for the stored waste to prevent releases of radiation. It is possible that utility companies storing waste on site will go bankrupt or seek to abandon their storage facilities. It also may be that the government institutions responsible for safety will cease to function.

Another problem with indefinite long-term storage is the likely public opposition to any proposed new storage facilities (SP, pp. 108-110). This issue, like institutional issues generally, is virtually ignored by industry, yet it could prevent the long-term storage envisioned by industry and DOE.*

* Industry and DOE list the Nuclear Fuel Services, Inc. facility in West Valley, New York, as a facility which could be used in the near future for away-from-reactor storage of spent fuel. They neglect, however, to mention that the State of New York has not agreed to such use.

CONCLUSION

We have shown above, and in our Statement of Position, that there is no factual basis for confidence today that nuclear waste will be safely disposed of by any given date, and that the Statements of DOE and the industry avoid the relevant issues which must govern this Commission's determination. In particular, we have demonstrated that DOE and the industry virtually ignore the institutional obstacles to resolution of the waste disposal dilemma. They also assume, without support, that the necessary number of technically and institutionally acceptable sites will be found despite the fact that no site has yet been identified, that years of laboratory research and *in situ* testing will be necessary, and that none of the regions being considered is known to be scientifically acceptable. Moreover, industry has not shown that all of the technical gaps, deficiences and uncertainties which have prevented waste disposal to date will be resolved by any given date. We have also shown that there is no basis for confidence that nuclear waste will be safely stored for the indefinite period until safe disposal is available -- a period which might last for decades or centuries or more.

We therefore urge the Commission to make a finding of no confidence on both disposal and storage, and to impose a moratorium on the licensing of new nuclear plants until the technical and institutional problems of nuclear waste disposal have been resolved.

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