LAW OFFICES

LOWENSTEIN, NEWMAN, REIS, AXELRAD & TOLL

1025 CONNECTICUT AVENUE, N. W.

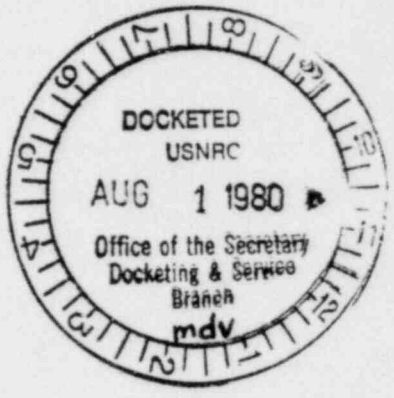
WASHINGTON, D. C. 20036

202 · 862-8400

ROBERT LOWENSTEIN
JACK R. NEWMAN
HAROLD F. REIS
MAURICE AXELRAD
DAVID R. TOLL
KATHLEEN H. SHEA
J. A. BOUKNIGHT, JR
MICHAEL A. BAUSER

E. GREGORY BARNES
ALBERT V. CARR, JR.
ANNE W. COTTINGHAM
KATHLEEN A. COX
ROBERT H. CULP
PETER G. FLYNN
WILLIAM J. FRANKLIN
STEVEN P. FRANTZ
FREDERIC S. GRAY
DOUGLAS G. GREEN
DAVID S. RASKIN

DOCKET NUMBER
PROPOSED RULE PR-60 (28)
(45 FR 31393)



July 31, 1980

Secretary
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Docketing and Service Branch

Re: Advance Notice of Proposed Rulemaking
10 CFR Part 60
Technical Criteria for Regulating
Geologic Disposal of High-Level Radio-
active Wastes
45 Fed. Reg. 31393 (May 13, 1980)

Dear Sir:

These comments are submitted on behalf of the Utility Nuclear Waste Management Group (UNWMG) in response to the subject Advance Notice of Proposed Rulemaking.

The UNWMG has reviewed the draft technical criteria and supplementary information that were published in the Federal Register. It has also had an opportunity to review briefly the Draft Technical Support Document (DTSD) that was made available in the Public Document Room, but only for the limited purpose of ascertaining whether it shed any additional light on the basis for and purposes of the draft criteria published in the Federal Register.

Our comments are contained in two enclosures:

(1) Enclosure I contains our major comments on the approach and contents of the Advance Notice, as well as our responses to the four specific questions raised by the NRC (p. 31398).

Acknowledged by card. 8/1/80. mdv

(2) Enclosure II contains detailed comments concerning a number of aspects of the draft criteria and supplementary information.

The current version of the draft criteria appears to be a significant improvement over earlier versions that we reviewed informally. However, our detailed review of the Advance Notice leads us to conclude generally that much more analysis and evaluation of regulatory approach and purposes by the NRC staff are required before a reasonable and workable rule can be published that will propose effective criteria that can be applied in a practicable way.

As set forth in our enclosed comments, some of the basic reasons for our concerns are that:

(1) We believe that it is essential for the NRC regulations to define standards and criteria for the acceptable performance of an overall disposal system so that requirements can be conservatively met through an appropriate combination of natural and engineered components. Although the Advance Notice recognizes the desirability of the "systems approach," the draft criteria improperly and unrealistically place requirements on components and subsystems that wholly ignore the overall interactive behavior and performance of the system. The resulting redundant requirements are not only unnecessary and achievable only at a needless premium in time and cost, but would deprive the Department of Energy (DOE) of reasonable flexibility in achieving system safety and performance objectives in the most effective and timely manner. They are basically inimical to a real systems approach, i.e., the tailoring of the components of the system to achieve the required overall system performance.

(2) Even if it were appropriate to impose requirements on individual components and subsystems, the Advance Notice fails to justify specific requirements in relation to the essential overall objective of protecting public health and safety and the environment. It also fails to compare the costs and benefits of such requirements versus alternatives or to consider the workability of such requirements in a regulatory framework. These problems are highlighted because both the Advance Notice and the previously proposed procedural portions of 10 CFR Part 60 (44 Fed. Reg. 70408) failed to provide a clear exposition of the rationale underlying the contemplated regulatory procedures and requirements. It is essential that all requirements be justified through an overall

rationale which reflects an appropriate understanding of relationships between characterization procedures and activities, repository system design, data acquisition, performance evaluation vis mathematical models and testing, performance objectives in relation to protection of public health and safety and the environment, etc.

(3) The draft criteria pertaining to repository siting improperly stress the effect of potentially adverse conditions, fail to recognize the distinction between important siting requirements and conditions that are desirable, but not necessary, and do not provide a baseline for guidance in the balancing of favorable and potentially unfavorable conditions.

(4) The Advance Notice seems to fail to recognize that in order to deal effectively with any uncertainty, it is first important to determine its relevance or importance to overall system performance and the sensitivity of the system performance to the factor as to which there is uncertainty. In the absence of such recognition there is a strong likelihood of proliferation of constraints and criteria that counter the systems approach, as is manifested in the draft criteria.

(5) The discussion of use of models in the licensing process requires clarification and updating, and the Advance Notice does not seem to appropriately recognize the usefulness and even necessity of models as analytical tools required in the design and prediction of performance of repository systems.

(6) The draft criteria impose unduly lengthy retrievability requirements which would have significant undesirable impacts on repository design, construction and operation and could have adverse impacts on site selection, notwithstanding that such requirements would provide highly questionable benefits.

(7) The discussion of human intrusion in the Advance Notice grossly misplaces emphasis on this issue and results in unrealistic and unnecessarily restrictive draft criteria relating to potentially adverse human activities.

We have noted the statement in the Summary that the published draft criteria "do not necessarily reflect staff positions with respect to rulemaking on this subject." (p. 31394) We assume that this denotes a willingness and a desire by the staff to take into account the numerous constructive comments that it will receive as a result of the Advance Notice and to incorporate into any proposed rule the significant improvements that have been suggested.

We urge the Commission to determine that no proposed rule will be published until a rule is drafted which properly implements the systems approach by imposing performance standards for the whole repository system rather than individual components and until all requirements set forth therein have been appropriately reviewed and analyzed to assure that they have a suitable basis and rationale and can be effectively applied in a regulatory framework.

Since an important purpose of the NRC rule will be to implement EPA standards, which have not yet been formally proposed, we suggest that the Commission instruct its staff to respond to comments on the Advance Notice and to defer publishing a proposed rule until it can incorporate proposed EPA standards.

Very truly yours,

Maurice Axelrad

Maurice Axelrad

Major Comments and Responses to Specific Questions

I. Major Comments

A. Systems Approach

One of the more basic concerns with this version of 10CFR60 is its identification of the "systems approach" as a fundamental requirement for implementing the deep geologic repository concept but then proceeding to place requirements on components and subsystems, presumably in the name of conservatism, that ignore the overall interactive behavior and performance of the system. The requirements for unrealistic redundancy, e.g., design a waste package and repository that assures complete safety even if the geologic barriers somehow prove to be useless and, concomitantly, find a geologic site that assures complete safety even if all the engineered barriers completely fail immediately upon repository closure. Even if such redundancy could be fully achieved, it would be obtained at a needless and inordinately expensive premium in time and cost. Inherent in requiring such extreme redundancy must be assumptions of probabilities and nature of failures which it is believed are incredible in a properly located, designed and constructed system.

An integral part of this same concern is the degree of detail in the requirements and specifications placed upon DOE. The presumed justification for this detail is to assure that all major safety-related features of the system are covered. Yet, anomalously on the other hand, much is made of the lack of direct experience in this area, the plethora of uncertainties and lack of knowledge or understanding of certain phenomena and their impacts. In our view, the system safety and performance objectives would be achieved in the most effective and timely manner if, given a clearly defined system performance objective, DOE was provided reasonable flexibility as to how that objective were to be achieved subject to close accountability and audit by NRC regarding the selection, design and interactive performance of the major features of the overall system.

In our view, the proposed use of minimum performance standards for major regulatory elements and the numerical values proposed as performance specifications are basically inimical to a real systems approach, i.e., the tailoring of the components of the system to achieve the required overall system performance.

B. Justification for Specific Requirements

Even if it were appropriate to impose requirements on individual components and subsystems, the Advance Notice fails to provide a meaningful analytical basis and rationale for the specific requirements contained in the draft criteria. In particular, there are absent both a justification for such requirements in relation to the essential overall objective, i.e., insuring protection of public health and safety and the environment, and any comparison of the cost-benefits aspects of such requirements versus other alternatives or approaches. In addition, in establishing specific requirements the Advance Notice fails to consider and discuss the workability of such requirements in a regulatory framework, including the limitations on the type of information that could reasonably be made available in satisfaction of such requirements.

C. Approach to Repository Siting

A major conceptual problem in the draft technical criteria appears in the presentation of potentially adverse conditions and favorable conditions, in §§ 60.122(b) and (c). The approach to siting expressed in these sections seems to be impractical and appears to conflict with the viewpoints expressed in the supplementary information and the DTSD. The potentially adverse conditions in § 60.122(b) are presented in an absolute manner, such that a site would be presumed to be unsuitable if they were present, even though many of the described conditions would probably not prevent achieving adequate performance. On the other hand, the favorable conditions are presented more as options than as essentials, indicating that a site should possess as many as practicable. As noted in the DTSD, some of the favorable conditions are virtually essential for adequate repository performance, and should not be optional. The draft criteria further state that the presumption that a site will not meet the performance objectives can be rebutted by demonstrating that the potentially adverse conditions are compensated by favorable conditions. However, the criteria do not provide a baseline from which the degree of compensation can be determined. In particular, the criteria do not indicate what favorable conditions, as a minimum, the repository should possess. The impression given by this emphasis on adverse conditions is that the NRC favors avoiding the "bad" instead of demonstrating the "good."

The draft criteria would be improved by recognizing the distinction between important siting requirements and conditions that are desirable, but not necessary, and by emphasizing a more positive approach to siting. The essential conditions for a repository (e.g., geologic stability, long flow paths, relatively impermeable host rock, etc.) should be highlighted

and identified as requirements early in the discussion of siting. Potentially adverse conditions that cannot be compensated by engineered barriers (e.g., potential igneous intrusion, active structural deformation, etc.) should be required to be avoided. In practice, siting studies would, and should, begin by considering fundamental needs and unacceptable flaws. Conditions that can be compensated by engineered barriers, and favorable and potentially unfavorable conditions that actually can be weighed against one another (e.g., weighing degree of fracturing against degree of geochemical retardation) should then be required in a more flexible manner. This suggested approach would be more workable for the licensing process and would be consistent with the systems approach for meeting performance objectives. It would allow DOE to optimize selected aspects of the repository system to compensate for deficiencies or uncertainties elsewhere.

D. Treatment of Uncertainties

The discussion of this important area is unclear. For example, there is an implication that our understanding of natural processes in question is based upon descriptions and models. Is not the reverse the case? We agree that avoiding potentially adverse (geologic and hydrologic) features is one way of compensating for uncertainties. Placing constraints on siting and design and performance of components also may be an effective way to reduce uncertainties. However, a prerequisite to the application of such an approach should be the determination of the relevance or importance of the uncertainty under question to the overall system performance and the sensitivity of the system performance to variations in the factor about which there is uncertainty. Otherwise there is a strong likelihood of a proliferation of constraints and criteria (manifested in this version of the draft criteria) that counter the systems approach and unnecessarily complicate repository program implementation and licensing. The statement about addressing individually the separable aspects (temporal and spatial) of geologic disposal as perhaps the surest means of dealing with uncertainties is vague and, as we interpret it, questionable. In our view, as indicated above, the surest way of dealing with uncertainties is to understand their real significance and to take such compensating action, if any, as may be needed based on such understanding.

E. Codification of Models in Licensing Process

In this important subject area, clarification and updating of the discussion in the supplementary information (pp. 31397-8) are needed. For example, we question the validity of the statement to the effect that "old models in which there is the greatest confidence because of their 'proven' use appear to

be as qualitative as they are quantitative." The discussion appears to support the use of models to develop technical criteria but on the other hand states that the technical justification for technical criteria should not be based on the results of quantitative modeling. This appears to be inconsistent. Further, it is not at all apparent how the draft criteria relate, if they do at all, to the discussion on models and their codification.

While the various limitations of models pertinent to repository system analysis and design are recognized, their use is essential, particularly with respect to the prediction of system performance in the future. First of all, there is no other methodology or approach that will be better. The major and even critical utilitarian feature of models is that assumptions involved in the model, its structure and the quantitative inputs into the model must be rigorously and specifically identified and recorded and therefore the models and their results are amenable to rational, critical review and evaluation. Expert opinion, while certainly useful, is, in essence, based on internalized models or subjective judgments, which are less susceptible to critical analysis.

The appropriate use and utility of models does not necessarily depend on their being developed to the point of an "elegant theory embodied in a mathematical description which represents a culmination of human thought" (whatever that might mean), but more on the proper understanding of the model itself, its limitations and the determination of realistic inputs to the model taking into account their uncertainties. Because of the importance of application of models to repository system analysis, design and prediction of performance, it is clear that some degree of model codification will be required. Otherwise technical decisions are likely to be based on ad hoc and even nontechnical judgments that are further likely to result in inconsistencies, excessive conservatism and unnecessary delay in the accomplishment of objectives.

Accordingly, it is strongly suggested that proposed technical criteria recognize the usefulness and even necessity of models as analytical tools required in the design and prediction of performance of repository systems. The application of such models does not exclude the incorporation of "expert opinion" in the necessary decision making processes. Indeed, it is the combination of systematic, logical procedures for analysis (models) and quantitative descriptions of uncertainties with expert opinion that is explicit and amenable to critical analysis which represents what has come to be known as "decision analysis." The criteria at this time need not and should not specify detailed model characteristics or requirements.

Additional discussion of the use of models in the licensing process is set forth in Appendix A, which contains comments prepared by The Analytic Science Corporation.

F. Retrievability

Retrievability of emplaced wastes is specified for a period of time that could be as long as 100 years from the start of repository operations. While it is recognized that a repository site would have to be abandoned whenever critically adverse circumstances might dictate, the likelihood of such circumstances evolving is vanishingly small. Accordingly, the provision for retrievability for such extensive periods is an excessive and unrealistic requirement. As is recognized in the discussion of this subject in the Advance Notice, such a requirement has a significant undesirable impact on repository design, construction and operation, particularly as it relates to potential occupational radiation exposure of workers in the repository. It also is counter to a rational systems approach and quite conceivably could complicate the use of salt, a generally acceptable repository formation, as a host rock, on a very weak and tenuous basis. In our view, the period of retrievability is more logically and realistically related to the amount of time (likely less than 10 years) during which useful in situ repository performance related information can be acquired. In any case, because of the large potential negative impacts and highly questionable benefits of such a long retrievability requirement, a more convincing rationale would have to be provided to justify any such requirement.

G. Human Intrusion

The discussion of the human intrusion problem in the supplementary information (Nature of the Problem (5) and Considerations (7)) is internally inconsistent and, in our view, grossly misplaces emphasis on this issue. We would agree that, theoretically, over the long term human intrusion cannot be prevented. However, the implied notion that some society far into the future which possesses the geologic knowledge to determine the nature and extent of useful resources 600 meters underground and the technical capability to drill into and exploit such resources will at the same time be unaware of or unable to detect the presence of radioactive material or man-made artifacts, borders on the ludicrous. Then to suggest that the only logical recourse is to avoid sites which may invite such intrusion when spent nuclear fuel with its inherent resource value is being disposed of is anomalous, to say the least. Moreover, to state that the problem of human intrusion moots much of the previous discussions on the nature of the problem conveys the incorrect impression that, comparatively, other considerations and the criteria that

might be related to them are really of no practical significance. As a result of this flawed thinking and the indication of a lack of understanding of the necessary distinction between containment and isolation */, i.e., protection of the public water supplies, for example, versus protection of individuals intruding into the waste (cf. footnote 1, p. 31395), unrealistic and unnecessarily restrictive criteria related to "potentially adverse human activities" are proposed.

II. Response to Questions (p. 31398)

Question 1: Does the list of considerations above clearly, adequately, and fully identify the relevant issues involved in disposal of HLW?

Response: While the list of considerations identifies many of the important technical issues related to HLW disposal, we believe that in several instances the discussions concerning these issues are lacking in clarity, perspective and supporting rationale. Our major comments in Part I of this enclosure have identified a number of these defects.

Question 2: Would a rule structured along the lines of the referenced draft rule reasonably deal with the issues in an appropriate manner?

Response: Substantial changes to the contents of the draft rule are required before one could conclude that it reasonably deals with the issues in an appropriate manner. Some of the major deficiencies relate to what we consider to be inadequate recognition of the systems approach and the absence of supportable bases and rationales for most of the quantitative requirements proposed in the rule. Again, reference is made to our major comments in Part I of this enclosure, as well as the detailed comments in Enclosure II.

Question 3: In light of the fact that EPA has responsibility and authority to set the generally applicable environmental standard for radiation in the environment from the disposal of HLW, with what factors/issues should an NRC environmental impact statement on technical criteria deal?

---

*/ See In the Matter of Proposed Rulemaking on the Storage and Disposal of Nuclear Waste, The Capability for Disposing of High-Level Wastes Safely (Vol. 2 of Statement of Position in UNWMG and EEI), July 7, 1980, pp. I-4 to I-9.

Response: We believe that one of the principal components of the NRC EIS on technical criteria should be cost-benefit analysis of the basic regulatory approach adopted in the regulation then proposed versus alternative approaches, as well as cost-benefit analyses of specific quantitative requirements proposed in the regulation versus differing requirements or different quantifications. Thus, for example, we have suggested that proper implementation of the systems approach would involve establishment of a performance requirement applicable to the entire system. If, in lieu of or in addition to such overall performance standard, NRC proposes (as do the draft criteria) to impose requirements on individual components or subsystems, the EIS should discuss in detail the incremental benefits and the incremental costs of such requirements. An important part of such analysis would be a quantification of whether such requirements would achieve any additional level of assurance of protection of the public health and safety and the environment. It would also be important, of course, to quantify the environmental, economic and social costs that would result from such requirements. If an approach or requirement would tend to complicate or prevent the use of an otherwise acceptable formation, the adverse effects of unavailability of such formation should also be considered.

Apart from the cost-benefit analysis of the basic approach, such analyses should also be performed comparing individual requirements with alternatives thereto. In all of these cost-benefit analyses one of the factors that should explicitly be considered is the impact of the approach or the criteria on the schedule for repository development. As noted in several comments, a number of criteria appear to engender the possibility of significant delays in program implementation (e.g., requirements for extensive exploration and testing to increase assurances of respository safety). Such delays are likely to have important cost-benefit implications that should be considered to help assure that the criteria are beneficial. Such analyses and evaluations would also be important in helping to establish what level of assurance regarding data acquisition, testing, etc., is appropriate. Needless to say, such cost-benefit analyses are also essential with respect to other quantified requirements including retrievability, waste package performance, radionuclide release rates, etc.

The cost-benefit analyses should also take into account some of the indirect impacts that would result from delays in repository program implementation resulting from additional time-consuming requirements imposed in NRC regulations. Such impacts would include environmental and economic costs associated with additional interim storage, as well as the impact of delays in repository operation on public acceptance of nuclear power.

Question 4: What are the environmental impacts of criteria constructed in accordance with the above-cited principles? What alternative criteria exist and what are their impacts?

Response: In our response to Question 3 we have identified some of the impacts which must be taken into account in a cost-benefit analysis of the basic approach and quantitative requirements reflected in the draft criteria. Our previous comments have identified our basic concerns with the current basic approach and quantitative requirements and have suggested adherence to the systems approach. We believe that rigorous cost-benefit analyses will demonstrate that the draft criteria should be significantly revised.

COMMENTARY ON CONSIDERATION (5), CODIFICATION OF MODELS IN LICENSING PROCESS (10 CFR Part 60, F.R. 45, 31397-98)

1. Introduction

The subject discussion notes that

> "The question of whether regulations should codify models to be used in licensing disposal of HLW or whether the criteria shoud (sic) only allow the use of models is a controversial one."

We argue that the question is critical (in the "importance" sense) as well as controversial. As acknowledged in the sentence immediately following the above quotation, the NRC staff recognizes that models are the only means by which they can fulfill their responsibilities for conditions beyond which it can be proven that adequate public safety is assured. Properly and cautiously,, the staff concludes that models are only as useful as expert judgment thinks they are. But how much is expert opinion better than modeling especially when it is necessary to deal with "..." uncertainties" arising from differences in expert opinion..." (F.R. 45, 31397)?

This commentary offers suggestions concerning how the NRC can philosophically and strategically approach use of models with respect to regulating long-term safety of radioactive waste disposal in geologic formations. We concur that interplay between modeling and expert judgment is necessary. We believe, however, that careful, detailed consideration of

how that interplay functions with respect to status within the licensing process is mandatory. The discussion provided under the subject Consideration (5) does a good job of exposition of relevant issues but it provides limited basis for resolution of them. We offer below some suggestions on how to proceed.

Sections 2, 3, and 4 provide comments on the NRC discussion. Section 5 summarizes these comments, and Section 6 lists references.

2. "...the present state of modeling is closer to qualitative than quantitative."

Not so. The models are highly quantitative and highly detailed in some cases. The results (outputs) of the models are seen to be qualitative because of lack of certainty that the models are accurate reflections of the phenomena, processes, and events they presume to represent. This is expert opinion in action. The "experts" acknowledge, better than anyone else, their lack of certainty about what will occur, how and when "it" will occur, and the consequences that will result. In perspective, this is the classic hedging against absolute certainty that is trained into members of the scientific community.

How do we improve confidence in model outputs (results)? Not by increasing model complexity. Without exception, available models are based on first principles, e.g., the Navier-Stokes equations. The issue is, how well can such models be adapted to realities such as anisotropic flow in non-homogeneous media and a mixture of nuclide holdup phenomena that are modeled empirically and simplistically? These are the sources of "uncertainty", i.e., sources of diversity of expert opinion and lack of confidence in quantitative outputs from quantitative models. This issue is addressed in more detail in Section 3 below.

We suggest that it would be useful for NRC staff to review and apply in detail some of the principles of modeling described by Aris (Ref. 1). As Aris shows, there is a rich (centuries long) basis for use of mathematical models. The challenges the NRC faces are not unique; similar modeling problems have been encountered in other situations. Review and analysis of approaches used in analogous modeling problems could give the NRC perspective and a rationale for the approach they select.

3. "...the validity of any licensing finding is linked to the means by which uncertainty is uncovered, explored, and treated."

The NRC discussion does not follow through on this important statement, i.e., it does not suggest means by which uncertainty issues might be addressed. In particular, it does not acknowledge factors and relationships that can provide a basis for judgments concerning uncertainty in model results.

Three basic factors affect uncertainty in model results:

- Capability of the model to represent relevant phenomena. There are two aspects to this capability: inclusiveness (has anything been left out?) and mode of representation (ranging from first-principles to purely empirical).
- Availability of data to quantify physical constants in the model. There are two data-related issues: scope, accuracy, and precision of data for the as-sited, as-designed repository system, and changes in data values that might result from future events and processes that change the state of the system from its initial condition.

- The scope and validity of assumptions (scenarios) concerning future events and processes that change the state of the repository system.

The NRC can and should develop a strategy for dealing with these sources of uncertainty on the basis of the following:

- Hundreds of models dealing with various aspects of repository system performance are available or being developed (Ref. 2). Uncertainty with respect to model capabilities can be made small by proper choice of model(s). Consensus expert judgment can confirm that the models are an insignificant source of uncertainty.

- The extent to which data are a source of uncertainties in model results will depend on data variability, the adequacy of measurement of variability, and the adequacy of representation of variability in the model(s). Since engineered features of a repository system can be characterized with a high degree of accuracy, the major possibilities for data uncertainties are associated with the site geology and hydrology.

  The role of site data in uncertainties will depend on the homogeneity of the site geology and hydrology and the degree of charcterization. Characterization activities needed to establish reliable numerical values for site parameters will also depend on homogeneity. Selection of models (and their associated data requirements) will in turn depend on the degree of characterization accomplished or needed.

  The upshot of the above is that uncertainty, choice of model, site characteristics, and site characterization are all related to each other. The important thing is that the relationships can be characterized. Deliberate, informed, rational choices of model-data acquisition-geology systems can therefore be made and selected with, for example, the objective of minimizing uncertainty resulting from numerical data inputs to the models.

The bottom line is that uncertainty issued can be reasonably and effectively addressed. Uncertainty cannot be eliminated, but it can be characterized, evaluated, and to some extent controlled.

4. Itemized specific comments

A. "...an elegant theory embodied in a mathematical description which represents a culmination of human thought..." may be possible, but it may also not be necessary. Nor may it be an appropriate measure of the adequacy of disposal modeling. Elegant theories of fluid motions in turbulent flow have been conceived, but they are of no practical use. The complexity and diversity of disposal systems similarly precludes practical use of elegant models. The state of the modeling art should be evaluated in terms of what is necessary, not in terms of what is possible.

B. When modeling the role of geology in repository safety performance, two distinct functions must be addressed: the role of the geology as a possible cause of deterioration of repository performance, and its role as a possible mitigator of consequences of deterioration of performance. A "good" geology does not necessarily play both roles, and the regulations should not require dual roles. Bedded salt with a long history of stability minimizes potential that the geology will be a cause of performance deterioration; it's poor nuclide holdup capability limits its potential as a mitigator of consequences. This antithesis illustrates, incidentally, why risk calculations are necessary for evaluating repository performance.

With respect to this subject, we note that proposed rules, paragraph 60.111(4)(i), (ii), and (iii) are dangerously near demanding a dual role for the geology.

C. A key issue in use of models in licensing disposal is use of performance-deteriorating scenarios when using the models. This is an issue quite distinct from those related to the capability and viability of the models themselves: use of "perfect" models might be highly imperfect.

Questions concerning the scope and content of performance-deteriorating scenarios are now well recognized; the NRC must find a way to deal effectively with them. With respect to this function, we offer the following observations:

- The repository doesn't know if water intrusion s the result of natural processes, human action, repository-induced phenomena, or combinations of these. The scenarios and the performance assessment results may depend strongly, however, on the characteristics and relative frequency (i.e., probability) of these alternative potential causes of performance deterioration. A high level of NRC effort on scenario definition and analysis would pay dividends with respect to "...the validity of... licensing finding(s)...".

- Aside from catastrophic external events, physical property changes that can produce safety performance deterioration are rather constrained: nature's proclivity to minimize free energy is pervasive. How much change (performance deterioration) can there really be as a result of realistic scenarios, especially with respect to the margin of safety built into the repository?

D. The above discussion leads to the observation that judgment has two distinct roles relative to use of modeling in NRC's disposal licensing responsibilities: with respect to selection and use of mathematical models, and with respect to selection and use of performance-affecting scenarios. Need for judgment vis-a-vis use of models can be minimized; the need vis-a-vis scenarios can be directed so as to maximize confidence in results.

5. Summary

To indicate that the choice with respect to use of models in disposal licensing is to "codify" or to "allow" is to make an unnecessary sharp distinction of options. A key need for NRC judgment concerns what to codify -- and how -- and what not to codify (and why not).

A sound basis for judgments concerning use of models and expert judgment can be developed. As suggested by preceding discussion, there is no single rule. Much can be done to maximize confidence in results obtained from models and to maximize confidence in expert judgment concerning the uncertainties in those results. This can be done by "analyzing the analysis", i.e., by analyzing the site, scenario, design, and data relationships that affect selection and use of models and affect the reliability of modeling results.

6. References

1. Aris, R., "Mathematical Modeling Techniques", Pitman, 1978.

2. "Tabulation of Waste Isolation Computer Models", ONWI-78, December 1979 (two volumes).

Enclosure II
UNWMG Comments
re 10 CFR Part 60

Detailed Comments Concerning Supplementary Information and Technical Criteria

I. Supplementary Information

A. Nature of the Problem

1. Lifetime of the Repository

(a) The delineation of the five distinct problem areas would be more useful if there was at least a brief indication of their interrelationship and relative importance, i.e., how they relate to a systems approach. The second problem might better be identified as "geophysical characteristics pertinent to system performance."

(b) It is important to recognize that the period during which fission products dominate is only a few hundred (300-500) years. This subject is discussed in Section I of Volume 2, The Capability for Disposing of High-Level Wastes Safely, of the Statement of Position filed on behalf of the Utility Nuclear Waste Management Group and the Edison Electric Institute on July 7, 1980, in the NRC Waste Confidence Rulemaking. In the detailed analysis, which is based on the radionuclide retention requirements necessary to achieve an overall system performance (expressed in terms of maximum exposure to individuals), it is demonstrated that after a few hundred years these retention requirements are comparable to those associated with a 2% natural uranium ore body from which the waste originated.

(c) Clarification is needed as to the difference between site suitability criteria and site acceptability criteria.

(d) We see no reason why NRC regulations should require that MSHA regulations "where applicable" should be observed. This appears to invite extraneous ambiguity and controversy into the NRC licensing process. If the MSHA regulations are applicable, they can be enforced by MSHA.

(e) The statement that "a substantial heat output from the wastes if not properly accommodated could compromise the integrity of the repository" is indicative of the generally negative approach that appears too frequently in the draft regulations. It would appear more useful and realistic to simply state that the heat output must be accommodated in order not to compromise the performance of the overall system.

2. Physical Extent

We agree that features producing effects on the repository that are "not readily understood" should be avoided, particularly for the major ones, and other features should be "made tractable" or mitigated. This concept is the key to effective siting, and its application should greatly reduce the extent of significant technical dispute and resultant institutional opposition.

3. Waste/Rock Interaction

The statement that the chemical and thermal properties of the wastes undoubtedly will have a significant interaction with the rock unit into which they are emplaced is another example of the negative approach. We believe that technology exists to enable the design of a waste package and backfill that will preclude significant interaction. The statement in the Advance Notice would be more useful and realistic if it were directed at a general requirement that such interactions will be designed against so that the overall system performance requirement will not be compromised.

4. Treatment of Uncertainties

(a) The statement that "geologic disposal is an entirely new enterprise--no experience exists..." is unduly negative in its tone. While it is true that man-made high-level radioactive wastes have not been disposed of for long periods on a production basis, there are applicable analogs and existing knowledge and data from the geologic record that provide a significant scientific and technological base with which to adequately cope with this "problem." As discussed in our major comments, it is essential to understand the significance of so-called "uncertainties" in order to deal with them appropriately. Implying that relevant knowledge and data does not exist (or ignoring its pertinence) does not help in achieving such understanding.

(b) We do not understand how one can achieve useful or meaningful separation of temporal and spatial aspects of geologic disposal when they are so interrelated.

5. Human Intrusions

See our major comments on this subject.

B. Underlying Principles

1. Particularly since it is expected that the EPA standard will be expressed in terms of a radiation dose limit to the individual, we believe that this approach (rather than release limits) should be reflected in NRC technical criteria.

2. We do not understand subsection (5), which should be clarified.

3. In subsection (7) as indicated previously the distinction between site suitability and site-facility acceptability is not clear. Further explanation is needed of the intended distinction.

z

C. Considerations

1. Systems Approach

(a) In general, but with some exceptions, this discussion seems reasonable. Unfortunately, however, as noted elsewhere in our comments, the Advance Notice then seems to ignore and even to contradict implementation of the systems approach concept and to substitute over-emphasis and over-specificity on component details.

(b) The considerations should recognize that currently we are talking about a repository that will not be in operation for a number of years. In view of this, it is not realistic to expect generic specifications developed now to meet the requirements of a site-specific situation that far in the future. Instead, we believe the emphasis should be on the systems approach in which the criteria relate to overall performance, particularly at this stage of program implementation.

(c) The point is made, erroneously we believe, that to the greatest extent possible, the performance of engineered systems should be insensitive to changes in geologic and hydrologic characteristics of the repository. We believe the reverse is true.

2. Use of Minimum Performance Standards for Major Regulatory Elements

Our major comments reflect our concern as to the improper focus on standards imposed on components and subsystems rather than the performance of the repository system as a whole. As to such overall standard we suggest that a more direct articulation would be to first acknowledge the requirement to meet EPA

standards, explaining that all credible events and their consequences need to be postulated and evaluated to ascertain whether the EPA standards are met. Secondly, the term "performance requirement" should be defined and its relationship to the EPA standard should be described.

3. The Nature of the Major Regulatory Elements

The natural barrier, i.e., the site, should first have characteristics needed for waste containment and isolation. One of these characteristics is stability. Of equal importance is little or no water flow. Simplicity is a different type of attribute; it aids selection of geohydrological models and confidence in results obtained from the use of such models.

4. Adequacy of Favorable and Unfavorable Site Characteristics to Impose Proper Technical Restrictions

In our view, the order and strength of describing unfavorable vs. favorable characteristics are misplaced, revealing a negative approach to licensing that does not contribute constructively to the procedure nor the outcome. Unfavorable site characteristics are dealt with absolutely, while favorable ones are considered relatively, unduly emphasizing what makes a site bad rather than what makes it good. Also, the statement that site acceptability criteria have not been identified is unclear, particularly since the draft rule includes a number of criteria regarding site acceptability, suggesting that they have been and can be identified. Clearly, there will have to be included better guidance as to how favorable and potentially unfavorable site conditions can be weighed against one another or compensated for by other system features.

5. Codification of Models in Licensing Process

See earlier comments.

6. Retrievability

See earlier comments.

7. Human Intrusion Problem

See earlier comments.

II. Subpart E--Technical Criteria

A. § 60.2 Definitions

1. Aquifer

The phrase "significant quantities of water" is ambiguous and can lead to conflicting interpretations. This should be improved with a more definitive term.

2. Confining Unit

This definition is also unclear. It would be improved by inserting "adjacent to an aquifer" after "hydrologic unit." After all, a confining unit should confine something, e.g., an impermeable shale bed overlying a permeable sandstone layer. In this sense a mass of granite is not a confining unit just because it is relatively impermeable, nor is it proper to consider a salt dome itself as a confining unit.

3. Decommissioning

This is a misleading term. After backfilling and sealing is when the basic functioning of the repository begins. Suggest substitution of the word "closure."

4. Expected Processes and Events

It is unreasonable to limit this definition only to those natural processes and events that are likely to degrade the engineered elements. Processes and events may also occur that would improve containment and isolation and not adversely affect engineered elements. We suggest changing "degrade" to "occur," and deleting "the engineered elements of the geologic repository.

5. Floodplain

This definition is clarified later in the criteria as being in the context of an Executive Order precluding federal construction in a floodplain, which is that area flooded by a calculated hundred-year storm. However, as a technical definition it is ambiguous because it implies that a floodplain does or does not exist if it has a greater or lesser chance of flooding relative to some arbitrary amount. This would be patently absurd, and similar reasoning can hardly be applied to defining other geologic/geomorphic features, e.g., volcano.

6. Geologic Repository

It seems overly broad to include in this definition "all surface and subsurface areas where natural events or activities of man may change the extent to which wastes are isolated." Strict application of this definition could include parts of surface-water basins that are several tens of kilometers from the site, and other features at similar distances. While it is agreed that these features are important to the repository and should be evaluated as part of the repository system, they are not a direct part of the repository. Use of a term such as "region of influence," which does not suggest a specific geographic location, would be preferred.

B. § 60.101 Purpose

1. Paragraph (d)

In light of what we believe are excessively detailed specifications and requirements contained in the proposed technical criteria (instead of performance criteria) it is ironic to see such a statement.

2. Paragraph (e)

How is "saturation" defined for salt?

C. § 60.111 Performance Objectives

1. Paragraph (a)(2)

Suggest substitute "closure" for "decommissioning."

2. Paragraph (a)(3)

See previous comment on "retrievability."

3. Paragraph (c)(1)

No technical justification given for 1000 years. 300 years is suggested as technically justifiable, i.e., fission product period.

4. Paragraph (c)(2)(ii)

Again, there is no basis for 1000 years (see comment re paragraph (c)(1) above). Also, the required assumption that some of the waste dissolves soon after decommissioning (closure) is internally contradictory with other requirements. How much is some?

5. Paragraph (c)(3)(i)

This wording makes the unreasonable assumption that radionuclides will be released after 1000 years, and is misleading in that it implies the facility will be designed to start releasing radionuclides at that time. While this may be helpful in reducing the concentration, this has not been the intent of the NRC heretofore. We suggest rewording the sentence to eliminate this interpretation.

6. Paragraphs (c)(3)(i) and (ii)

Presumably the heading of paragraph 3 should read after "closure." No rationale is given for this release rate requirement, it bears no quantitative relationship to potential radiation exposure of people and is impossible of direct proof. Parenthetically, where is such a criterion to be applied and evaluated, i.e., what is the boundary of the underground facility? These paragraphs need serious re-analysis.

7. Paragraph (c)(4)(iii)

It is not clear whether this paragraph is intended to refer to travel times for specific radionuclides (if so, which) or to travel time for water. Once again there is no technical rationale for the 1000-year period.

D. § 60.121 Site and Environs Ownership and Control

1. Paragraph (c)

The required assumption that institutional controls (presumably beginning after closure) will only last 100 years is unrealistically restrictive in the light of extensive historical evidence.

E. § 60.122 Siting Requirements

1. Paragraph (a)(2)(i)

There is no technical basis for the 100-km radius for investigations. The requirement should be directed at features or factors potentially affecting the repository site. Depending on the specific features and the specific site it could be more or less than 100 km.

2. Paragraph (a)(7)

It is not clear what the intent or scope of "continuous" verification and assessment of changes in site conditions are.

3. Paragraph (a)(8)

There should be some clarification of the purpose for this resource assessment requirement. Since presumably this requirement is related to the possibility of human intrusion the significance of exploitation under present technology and market conditions is irrelevant. How would such an assessment relate to or be compared with the value of the site as a waste repository?

4. Paragraph (a)(9)

The emphasis on thermal loading is inappropriate since this factor is so readily amenable to direct control. The requirements for input data identified in paragraphs (i) through (vi) are inordinate. If interpreted literally within the volume noted it is quite likely to destroy the utility of the proposed site for repository purposes. The implied level of data indicated seems quite impractical to achieve and presents an undesirable opportunity for endless discussion as to when this requirement is satisfied.

5. Paragraph (b)

The reference at the end of the introductory portion of this paragraph should obviously be to § 60.122(a)(9). This whole paragraph, including the subparagraphs discussed below, represent a "negative" approach to repository siting (see major comments), and seems inconsistent with the systems approach. The indication that "rebuttal" of adverse presumptions may be possible comes much too late in the paragraph. Moreover, it is questionable whether some of the potentially adverse conditions or human activities identified justify a presumption that the geologic repository will not meet the performance objectives, (e.g., shallow drill holes, shallow mining and resources, etc.). Some of the requirements can be construed (totally incorrectly, in our view) as eliminating the use of salt formations.

6. Paragraphs (b)(1)(iii) and (b)(1)(iv)

These paragraphs presumably would eliminate from further consideration sites where there are economically exploitable resources or there are resources that are of above-average value for other areas in the region containing the geologic repository. The value of such resources will clearly be a matter of degree and,

in any case, should be compared with the value of the repository itself. There should be no reason for eliminating a site area because it contains resources of relatively low value, particularly if the resources are located at insignificant depths. An apparent justification for excluding areas with substantial resource values, as presented in the DTSD, is to assure that the site has no greater potential for being explored than any other site. However, even if such resource values are present it does not seem reasonable to categorically exclude otherwise suitable sites solely on that basis. At most, the presence of these resources should lead to consideration of the types of specific impacts that exploration might have upon repository integrity and the potential effect, if any, of such impacts upon the repository's satisfaction of performance standards. Such consideration is not likely to lead to the exclusion of a site with suitable natural characteristics as the location of a well-designed repository.

7. Paragraph (b)(2)

In general, this part of the draft rule does not encourage a workable approach to siting. The adverse conditions in this section are presented in an absolute manner, stating that their presence will give rise to the presumption that performance objectives will not be met, unless proven otherwise by DOE. However, several of the described conditions would be unlikely to prevent adequate performance. In contrast, the favorable conditions in § 60.122(c) are presented almost as options, with the statement that sites having as many favorable characteristics as practicable are preferred. Many of these favorable characteristics, however, are important for adequate repository performance. The tone of these two sections, in combination with the adverse conditions being presented first in the rule, suggests a "negative" approach to siting. That is, it suggests emphasis on avoiding specified adverse conditions in the initial phases of siting, thus delaying attention to favorable conditions until the later phases of site-specific investigation. The rule should be structured to encourage a more workable approach. In discussing application of the adverse conditions requirements to siting, the DTSD (Section 5.1) states: "It should be emphasized here that it is the intent of these

requirements not to require absolute proof (underlining in original) that a specified condition either exists or does not, but to require a reasonably vigorous and state-of-the-art investigation and evaluation." This intent is not expressed by the draft rule. Instead, potentially adverse conditions are presented in a generally absolute manner.

8. Paragraph (b)(2)(i)

The term "extreme bedrock incision" is vague. The highest rates of erosion that have been estimated over periods of tens to hundreds of thousands of years would be very unlikely to compromise the integrity of a typical repository in the 10,000-year period that this rule addresses. If retained, this term would be better replaced with wording along the line of "erosion rates that could compromise repository performance."

9. Paragraph (b)(2)(ii)

The problem with this requirement is that any deposit of evaporite minerals is likely to contain some evidence of minor dissolutioning, much or all of which may no longer take place because of changed hydrologic conditions. Examples include the caprock of salt domes and the argillaceous interbeds in bedded salt formations. Presumably the paragraph's intent is to exclude large dissolution features and active dissolution features of any size. If so, it could be improved by specifying "evidence of substantial dissolution...that has occurred under hydrologic conditions that may be anticipated during the repository lifetime." This would be consistent with the discussion in the DTSD (§ 5.2.2.2.).

10. Paragraph (b)(3)(iv)

The concern here has nothing to do with rock movement along or across the fault or fracture zone, and age of last movement is irrelevant. Coming as it does under the section on hydrologic conditions, this paragraph is apparently concerned with the ability of the fault or fracture zone to significantly transmit ground water. In that case, it is not just the existence of the fault or fracture zone that matters, but whether it is of a nature that water can move along it, which may indeed not be possible for many such features. Application of this paragraph as written would unnecessarily eliminate many otherwise suitable sites, particularly those in basalt and granite. It should be revised to reflect the level of hydrologic conductivity along faults or fractures zones that will be considered significantly adverse.

11. Paragraph (b)(4)

There are other geochemical conditions that may cause adverse reactions between the waste or engineered systems and the host rock or fluids that may be unacceptable in the repository. Moreover, low retardation by itself should not be an exclusion factor because some media, e.g., salt, can provide adequate repository performance without retardation, and because retardation can be provided by engineering design of selected backfill materials (e.g., bentonite).

The role of sorption in the repository system, as discussed in the DTSD, is somewhat of a paradox. Geochemical properties of a site, particularly sorption, are cited as the most significant barrier to radionuclide movement, although it is also noted that some nuclides are little affected by sorption. The potential for major variations in retardation within a rock unit, as discussed in DTSD § 3.3.3.3., appears to be a major factor in the perceived need for extensive in situ testing to assure suitability of a repository. However, the DTSD also emphasizes a number of uncertainties associated with sorption and concludes in § 5.2.4 that sorption should be considered "...a dubious but necessary safety margin."

The need for retardation in the natural repository system is based on analyses such as those by de Marsily and coworkers (1977, Science, v. 197, pp. 519-527). The analyses by de Marsily indicate that radionuclides can be transported from a repository to the environment, even in a host rock of low permeability, in an unacceptably short period of time without sorption, and that travel times can be orders of magnitude longer if sorption is considered. However, there are three important factors that should also be considered in determining the appropriate emphasis on natural sorption properties for siting:

(a) The analyses by de Marsily assume groundwater flow vertically upward from a repository at 500 meters depth. This type of groundwater flow occurs in nature only under limited hydrologic conditions that readily can be avoided in siting. Vertical flow from convection caused by the heat in the repository also can be avoided by appropriate repository design. Accordingly, the flow paths from a repository can be orders of magnitude longer than assumed by de Marsily.

(b) The natural sorption properties of a site can be supplemented by using bentonite or other high-sorption materials in the repository backfill. In this manner, sorption can also be used as an engineered barrier.

(c) Sorption may not assure that a repository meets the system performance objectives or the EPA requirements. Because some nuclides are retarded little if at all by sorption, long groundwater travel times may be needed in addition to whatever sorption properties are present.

In view of these factors, it seems more desirable to emphasize groundwater travel time in siting, as this is very much a site related property, and to allow the DOE the option of providing sorption as an engineered barrier. This approach can facilitate siting and the meeting of the performance objectives while providing the desired safety margins.

12. Untitled Paragraph at the End of § 60.122(b)(p. 31402)

The stated requirements for rebutting the presumption that a repository will not meet performance objectives are unclear as presented. It appears that DOE is required to (1) characterize the adverse feature, if detected, or its potential presence, if undetected; (2) evaluate its effect; (3) demonstrate that it is compensated by favorable conditions; and (4) demonstrate that it can be remedied. It is unlikely that all of these requirements would be needed for many of the unfavorable but possibly insignificant conditions described in the proposed rule. For example, boreholes, erosional features, evidence of dissolutioning, or ancient fracture zones may be characterized, evaluated, and shown to have no adverse effect on performance without additional compensation or remedy.

The requirement that potentially adverse conditions be characterized to include the extent to which the feature may be present and undetected by the site investigation could cause extreme delay in licensing because of the difficulties inherent in proving a negative. Potentially adverse conditions listed in the proposed rule include features (such as the examples cited above) that may be very difficult to resolve fully even though they are unlikely to render a site unsuitable. The criteria should clearly indicate that the requirement for characterizing undetected features applies to those features of sufficient extent to impair performance.

The requirement to demonstrate that the unfavorable condition is compensated by favorable conditions is particularly unclear. The manner in which the favorable and unfavorable conditions are presented in the proposed rule does not provide a baseline from which the degree of compensation can be determined.