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Natural Resources Defense Council, Inc.

25 KEARNY STREET
SAN FRANCISCO, CALIFORNIA 94108
415 421-6561

Washington Office
1725 I STREET, N.W.
SUITE 600
WASHINGTON, D.C. 20006
202 223-8210

New York Office
122 EAST 42ND STREET
NEW YORK, N.Y. 10017
212 949-0049

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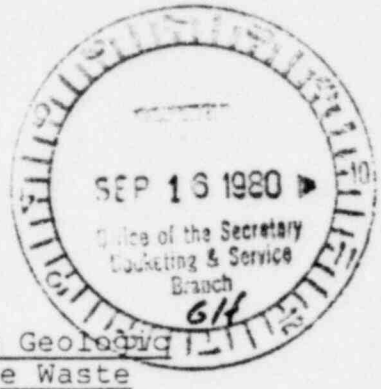

Secretary of the Nuclear Regulatory Commission
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Docketing and Service Branch

Re: Technical Criteria for Regulating Geologic Disposal of High-Level Radioactive Waste (45 Federal Register 31393; May 13, 1980)

The Natural Resources Defense Council, Inc., hereby submits its comments on the Nuclear Regulatory Commission's Proposed Technical Criteria for Regulating Geologic Disposal of High-Level Radioactive Waste (45 Federal Register 31393). The philosophy underlying these criteria reflects careful consideration by the Commission of the complex problem of regulating radioactive waste disposal. However, the proposed technical criteria are in some respects vague and do not carry out the Commission's philosophy. The criteria do not set a standard for measuring the adequacy of high level waste repositories. Instead, the Commission measures performance by allowing "reasonable assurances" to be given that radioactivity will be contained at levels which are merely "as low as reasonably achievable." More importantly, the criteria do not establish a defense-in-depth approach with independent barriers.

Acknowledged by card... 9/15/80

The proposed criteria are particularly ambiguous and weak with respect to: (1) retrievability; (2) the utilization of mathematical modelling; and (3) the geologic siting requirements. The Commission requires retrievability to allow mitigation or complete withdrawal from a site if problems are detected after wastes are emplaced. But, the criteria do not explain why a 50-year retrievability period was chosen or the circumstances which would necessitate retrieval (§ 60.111(a)(3)). The discussion of retrievability is too general to ensure that retrieval is utilized as the Commission intended. With respect to modelling, the Commission has decided not to require modelling as a basis for decision-making, but to allow the use of models when it is appropriate. Even though the NRC does not specifically state which problems are appropriately modelled, it effectively requires the use of models to assure the adequacy of engineered barriers by requiring that these barriers contain radionuclides for 1,000 years (§§ 60.111(c)(1)-(4)). By effectively requiring the use of models to satisfy criteria, the Commission has ignored its own caveats regarding the uncertain nature and possible inaccuracies of model results.

Finally, the Commission's geologic siting requirements do not address directly the need to locate repositories at sites which groundwater is essentially unavailable for transport of radionuclides. The hydrologic criteria are too general and do

not set a standard for acceptable hydrologic conditions which are independent of the other barriers.

Although the Commission attempted to provide stringent site selection criteria, these criteria are weakened by the opportunity to "demonstrate" that the existence of specific unfavorable features will not adversely affect the repository (§ 60.122(b)). The Commission made its site selection criteria dependent on the identification and understanding of physical features. The categorization of features into adverse and favorable conditions is a necessary guide to the early stages of site selection. By defining adverse conditions, the Commission has made a determination that these conditions threaten safe operation of a repository. This judgement and the utility of these criteria are severely eroded by the opportunity to demonstrate that unfavorable conditions do not adversely affect the repository. In addition, the opportunity to demonstrate no adverse effect does not maintain the independence of the multiple barriers.

We urge the Commission to consider its criteria and their application in more specific terms and in particular to ensure consistency between the intent of these regulations and the criteria themselves.

Sincerely,

Georgia Yuan
Project Geologist

Thomas B. Cochran
Staff Scientist

1. The Commission has not set a standard for measuring the performance of the repository system.

The proposed criteria do not define precisely the Commission's requirements for repository performance. Instead, the criteria contain vague phrases such as "reasonable assurance," "as low as reasonably achievable," and "within acceptable limits," to discuss the level of containment which must be provided by the repository. The Commission undermines its own efforts to regulate the licensing of waste repositories with imprecise standards for judging safe containment.

The lack of specific standards allows the Department to respond with a state-of-the-art approach to repository development. All the Commission requires is containment of radioactivity at presently achievable levels. There is no discussion of whether these levels are safe. Finally, the Commission must recognize that there is little incentive and no requirement for the Department to develop better containment than is currently achievable.

For example, the performance requirements for the engineered systems (§ 60.111(c)) do not treat the engineered barriers as independent barriers as would be appropriate in a defense-in-depth approach. In order for these requirements to ensure the independence of the barrier, the conditions for performance should assume that all other barriers have failed. This would mean that there would be complete dissolution of the waste not merely "some" (§ 60.111(c)(2)(ii)). In addition to strengthening the independence of the barriers, the Commission

should clarify its intent in § 60.111(c)(3)(ii) regarding TRU waste. The applicability of § 60.111(c)(1), (c)(3)(i) and (c)(3)(ii) to TRU should be restated so that is is clear that section (c)(1) and (c)(3)(i) apply to TRU which is commingled with other waste in the high-level waste package and that (c)(3)(ii) applies only to TRU wastes which are not commingled.

The performance standards are unnecessarily vague and should be changed to require an assessment of repository performance which does not rely on what is presently achievable but what is safe.

2. <u>The 50-year retrievability period is not supported and the circumstances warranting retrievability are not explained.</u>

The Commission requires the repository to be designed to accommodate retrievability up to fifty years after cessation of operations (§ 60.111(a)(3)). This time period, like others in the criteria (<u>see</u> § 60.111(c)) is not supported by the Commission. We support the concept of defining a specific time period for retrievability in order to accommodate confirmation of the ability of the repository to contain radionuclides. However, the assigning of a specific number of years is seemingly arbitrary. NRDC suggests instead the following criterion for retrievability:

> "The radioactive waste should be stored in a retrievable manner for the period during which the repository is open, or until it can be assured with high confidence that all waste

> disposal criteria are met, whichever is the longer period." 1/

The length of this period of time is highly uncertain since the validation of models predicting long-term and far-field effects has not yet been accomplished. 2/ The effectiveness of this criterion depends on how the NRC defines the other criteria which must be met. Our criterion is suggested assuming that the other criteria which must be met require independent barriers using a defense-in-depth approach. 3/

The Commission has not related retrievability directly to situations which may pose health hazards but appears to intend retrievability primarily to allow the technology of waste disposal to mature and to allow "corrective actions":

> ". . . it is 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 . . . [therefore] it might be desirable to postpone any irreversible (or not easily reversible) decisions until the maximum amount of reasonably obtainable information about how well the repository is functioning . . . . The staff believes that it may be desirable to maintain the option to retrieve the wastes for a period

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1/ Rotow, D., et al., Radioactive Waste Management Part II, Managing Uncertainty: Establishing Design Criteria Through Defense in Depth, Prepared by the Natural Resources Defense Council for the U.S. Department of Energy, Contract ER-78-C-01-6596, 1978, p. 28.

2/ Interagency Review Group on Nuclear Waste Management, Draft Report of the Subgroup on Alternative Technology Strategies, T/D 28818, Appendix A, August 7, 1978, pp. 34-35.

3/ See Rotow, D., et al. for further discussion of this approach.

> of time after the last waste is emplaced . . . ." (p. 31398)

The NRC has not considered the circumstances requiring corrective action in terms of radiological releases, but appears to have only considered the retrieval of wastes in situations which pose no immediate danger or threat to public health. For example, the Commission requires that the waste be retrieved "in about the same period as that during which they were emplaced" (§ 60.111(a)(3)) and that:

> "The Department shall design and construct the geologic repository operations area to permit retrieval of all waste packages, mechanically intact if retrieval operations begin within 50 years after all of the waste has been emplaced and if the geologic repository has not been decommissioned . . . " (§ 60.135)

Furthermore, the Commission requires storage of the retrieved wastes until shipment off site but does not specify the length of time that storage for this purpose will be allowed or the meaning of "off site":

> "The Department shall design and construct surface facilities to facilitate safe and prompt retrieval of wastes including facilities to inspect, repair, decontaminate, and store retrieved wastes prior to their shipment off site." (§ 60.132(b)(2))

The Commission has not anticipated more severe problems which might warrant retrieval of wastes and has assumed that storage and mitigation are sufficient responses to the need for retrieval.

The retrievability requirement needs to be more detailed and considered directly in relation to health hazards which may

warrant retrieval. In particular, the Commission should integrate monitoring activities and the collection of information necessary for detecting hazardous situations with the need to retrieve the wastes. Finally, the Commission must provide a rationale for choosing a 50-year retrievability period.

2. The Commission's philosophy on modelling is not reflected in its requirements for performance of engineered barriers.

The Commission requires that engineered barriers, including the repository and the waste package, meet performance standards which assure containment of radionuclides 1,000 years after decommissioning (§ 60.111(c)). Assuring containment for 1,000 years necessitates the use of mathematical modelling since neither in situ tests nor past experience can be relied upon for this determination. However, the Commission is very detailed in its account of the problems with models and reliance on their results (p. 31397, consideration #5) and points out that models may not be credible in showing that performance standards are met for engineered barriers:

> "The lack of empirical data on the performance of engineered barriers or the inability to obtain credible data may preclude the development or use of credible quantitative models in showing that either the uncertainties are addressed properly in the performance standards or the performance standards are met in a particular licensing action." (p. 31398)

Therefore, the Commission on the one hand asserts that models may be inappropriate but persists in promulgating criteria which effectively require modelling the performance of an engineered barrier for 1,000 years.

We are skeptical that current modelling capabilities can accurately predict conditions required by the Commission as stated below:

> "Starting 1,000 years after decommissioning of the geologic repository operations area, the radionuclides present in high level waste will be released from the underground facility at an annual rate that is as low as reasonably achievable and is in no case greater than an annual rate of one part in one hundred thousand of the total activity present in high level waste within the underground facility 1,000 years after decommissioning assuming expected processes and events." (§ 60.111(c)(3)(i), emphasis added.)

This prediction would depend on knowing at least groundwater flow through the repository area 1,000 years after decommissioning, a condition which can only be estimated with a high degree of uncertainty. The Commission has failed to consider its own caveats and philosophy regarding modelling in promulgating these criteria for engineered barriers and has failed to explain if and how the criteria could be met without modelling.

The Commission's statement regarding the applicability of the models to the criteria provides little information and appears to state merely that criteria should not depend on results from models except when a model result can add to the determination that the criterion has been met:

> ". . . it is desirable to specify technical criteria associated with the regulatable elements in such a manner as not to predicate their technical justification on the results of quantitative modelling, except in those instances where quantitative modelling can contribute to their technical justification . . ." (p. 31398)

In addition to this meaningless statement, the Commission suggests that the appropriateness of models "will be supported largely through expert opinion." Furthermore, the "'uncertainties' arising from differences in expert opinion" will be handled by "judging the acceptability of the consequences" and assuring that "the judgement itself will be detailed in the public record" (p. 31397(5)(e-g)). Airing differing expert opinions is not an acceptable substitute or hedge against the inability to validate model results.

If the Commission feels compelled to rely on model results to satisfy its reponsibilities to see that the Department has met licensing criteria, then it must also require validation of those models. In situ testing as one form of validation could be appropriate for some models. The Commission appears to recognize the value of obtaining site properties in situ (§ 60.122(a)(9)(iii-vi)), but avoids the validation of transport models and failure scenarios by accepting uncertainty and relying on "experts."

The Commission's criteria and philosophy on modelling are ambiguous and inconsistent and may result only in weakening the licensing process.

3. The Commission's selection criteria do not address directly the presence of aquifers at the repository site.

The Commission appears to recognize the importance of hydrologic conditions to repository safety and specifies 4 adverse hydrologic conditions which could be a basis for

rejection of a site (§ 60.122(b)(3)). However, the Commission never discusses the single most important aspect of the groundwater hydrology -- the need to ensure that the proximate confining units are free from all aquifers. The Commission instead discusses in several places (for example §§ 60.111(4)(iii), 60.122(a)(9)(iv), and 60.122(c)(1)(ii)(b)) the properties of the site and the waste form which will retard the movement of water containing radionuclides, but does not directly address the siting of a repository in an area where water now and in the future will not be present in appreciable amounts. In order for the geologic conditions to serve as an independent barrier, one must assume that the waste form and the repository structure have failed and that any water in the area of the repository will contact the waste. The properties of the confining units may act to retard the movement of radionuclides, but retardation would be unnecessary if water was naturally unavailable. The primary thrust then, of the hydrologic criterion should be choosing a site free from aquifers.

Even the Commission's definition of aquifer (§ 60.2) is weak since it requires that the unit "yields significant quantities of water to wells or springs." We suggest instead that the Commission recognize the potential for change in hydraulic head and define aquifers as units which "are capable of yielding significant quantities of water to wells or springs."

Since the hydrologic aspects of the site are recognized as one of the most important sources for failure of the repository

to retain radionuclides[4/], the Commission should discuss at the outset and particularly in § 60.122(c)(1)(ii)(b) -- Favorable characteristics -- the need to choose locations which are presently free from aquifers and are in climatic zones which are not likely to be afected by increases in precipitation during the period of necessary isolation.

4. The Commission has weakened its approach to siting geologic repositories by providing an opportunity to demonstrate that unfavorable site conditions do not adversely affect repository performance.

The Commission has adopted an approach to siting which depends on the definition of "adverse" and "favorable" site conditions. This approach allows the early rejection of a site based on known physical conditions and removes the need to understand the risk or the effect of the condition on the repository in order to determine that a condition is unacceptable. Adverse site conditions are presumed to warrant a site unacceptable because they are associated with uncertainties which are difficult to bound or to fully understand. Therefore, we believe this approach is conservative and appropriately utilized at all stages of site selection.

4/ See, U.S. Geological Survey Circular 779, Geologic Disposal of High-Level Radioactive Wastes - Earth Science Perspectives, 1978, pp. 7-9 and National Academy of Sciences, Geological Criteria for Repositories for High Level Radioactive Wastes, 1978, p. 9-11 for discussions of hydrologic conditions.

Unfortunately, the Commission has significantly weakened its own determination of what constitutes an unacceptable condition by providing four stipulations which can be used to demonstrate acceptability (§ 60.122(b)). By providing this opportunity the Commission has lessened the importance of rejecting sites based on site characteristics and emphasized the determination of risk.

The second stipulation, in particular, effectively requires modelling of potentially adverse conditions. Modelling would presumably be used to calculate an expected dose or release of radioactivity resulting from the adverse condition. However, the significance or acceptability of that dose is not defined by the Commission. In any event, the model results can only be viewed as highly uncertain and of questionable accuracy given the problems of modelling future human activities and natural events. With this stipulation, the NRC has shifted its basis for determining if a site satisfies the criteria from physical features to results from mathematical models.

Stipulation 4 contains vague terms which the Commission needs to define. Stipulation 4 suggests that adverse conditions can be "remedied during construction, operation or decommissioning of the repository." The meaning of remedy is unclear. Without a precise definition, remedy may mean that engineered barriers can be used to correct potential adverse natural conditions. Moreover, remedy could mean mining of mineral resources to remove the potential threat of human

intrusion as was proposed for the Waste Isolation Pilot Plant.[5/] Clearly, the flaw in the latter remedy is that the potential for exploration exists regardless of the existence of the resource, since it is the surface features suggesting that the resource is there which attract exploration. An earlier draft of the NRC criteria recognized that is was the attraction and not necessarily the resource itself which attracted future exploration:

> "A geologic repository operations area and control zone shall not be located where: . . . (iii) There exists the type of geologic structures in which resources have been found at depth." (Draft 5 of 10 C.F.R. 60, p. 18, § 60.122(c)(1)).

The Commission consistently fails to recognize that the exploitation of resources in the future will be motivated by a completely different set of market and technological conditions than exist today or existed in the past. Sections 60.122(a)(8) and 60.122(b)(1)(iii) require a resource assessment which is based on "present technology and market conditions." The NRC should recognize that future development is completely unrelated to current market conditions.If an area appears attractive, it is a potential candidate for exploration regardless of the "remedy" offered by extraction of the ore.

The rationale for providing the "no adverse effect" stipulations is unclear and the NRC should consider particularly the

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5/ U.S. Department of Energy, Draft Environmental Impact Statement, Waste Isolation Pilot Plant, Volume 1, 1979, p. 9-15.

potential weakening of its siting approach. These stipulations significantly undercut the Commission's determination of adverse site conditions and will result in emphasizing the results of mathematical models in licensing decisions and the dependence rather than the independence of multiple barriers.