UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

May 6, 1981

MEMORANDUM FOR: Chairman Hendrie
Commissioner Gilinsky
Commissioner Bradford
Commissioner Ahearne

FROM: Dennis Rathbun Dennis Rathbun

SUBJECT: 10 CFR PART 60 - DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN GEOLOGIC REPOSITORIES: TECHNICAL CRITERIA (SECY-81-267)

I agree with staff's recommendations that the proposed rule set forth in Enclosure A be published and circulated for public comment. As presently written, the rule reflects the necessary corrections and refinements to the approach that was published in the Advance Notice of Rulemaking (ANPR) one year ago and proposes appropriate technical criteria for regulating the disposal of high-level radioactive waste.

At the same time, I wish to comment on the salient features of the proposed rule.

Performance Objectives

The regulatory philosophy which is used by staff relies on the establishment of a broad, overall set of performance objectives for the design and setting of a geologic repository. (See Enclosure A, Sec. 60.111 pp. 32-34) In view of NRC's lack of experience in regulating geologic disposal, this seems like a sensible way to proceed. However, you should note that NRC's performance objectives incorporate the environmental standards to be set by EPA and implemented by NRC and that EPA's standards have not yet been published in proposed form. Although NRC staff appears to be informed on the standards being drafted by EPA staff and is confident that the NRC criteria would assure that EPA's standards are met, there is a gap in the presentation in this regard. Staff notes that Part 20 of the Commission's regulations can be used to meet the performance objective for limiting releases during the operation of a high-level waste disposal facility but that no standards have been set by NRC or by EPA for limiting releases after the closure of a disposal system. (Enclosure J, pp. 6-7). Hence, you might wish to ask staff how it plans to deal with this omission pending the establishment of limits by EPA.

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In addition to the performance objectives, the rule includes lists of conditions, favorable and adverse, by which the suitability of a site will be judged. Adverse conditions will give rise to a presumption that the site cannot meet the performance objectives. This presumption can be overcome by demonstrating that the conditions do not significantly affect repository performance or that the conditions are adequately compensated for.

The 1000-Year Containment Criterion

The waste packages are required to be designed to contain "all radionuclides for the first 1,000 years after closure and for as long thereafter as is reasonably achievable" (Enclosure A, p. 33). This is the same criterion as in § 60.111 (c) of the original ANPR (Enclosure B). DOE has suggested a shorter period (300 years) because this appears to be achievable at reasonable cost (Enclosure J, p. 31). The staff argues -- and, I believe, convincingly -- that 300 years would not cover the period when the effect of the thermal loading on the near-field repository structure would be greatest. The underground facility is not required to act as a redundant barrier during the first 1,000 years and if the thermal transient were to degrade the effectiveness of the nearby host rock in containing the waste, then isolation from the biosphere would depend primarily on maintaining the integrity of the waste package.

I believe the proposed 1000-year containment criterion is justified. If the criterion is not satisfied, then the uncertainty in the capability of the geologic setting to inhibit radionuclide migration would create a significant uncertainty in the isolation capability of the repository. The criterion is a good example of making most effective use of those barriers that are understood and amenable to improvement in order to compensate for the uncertainties in the estimates of performance of less-well understood barriers. However, the Commission should understand that the 1,000-year containment criteria is a design objective to be met with "reasonable assurance" and not a firm requirement for zero release.

Retrievability

In the original ANPR (Enclosure B) the staff's proposed criterion (§ 60.135) for retrievability was that the design and construction of the repository shall "permit retrieval of all waste packages, mechanically intact, if retrieval operations begin within 50 years after all of the waste has been emplaced." This has been revised to require that the design permit "the entire inventory of waste...[to] be retrieved on a reasonable schedule, starting at any time up to 50 years after waste emplacement operations are complete" (Enclosure A, p. 32). Both the original and revised criteria note that the retrieval time should be about the same as the time taken for repository construction and waste emplacement.

Some of the uncertainties in models can be accounted for by bounding calculations; others are not amenable to such treatment. The staff has, therefore, proposed to place a few prescriptive requirements on portions of the repository and the geologic setting whose performance can reasonably be measured and predicted (e.g., design objective of 1,000 year containment in waste package, 1,000 year groundwater transit time). These specific requirements help to define the limits of uncertainties in the overall quantitative predictions of radionuclide releases.

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Carl Walske
President

May 6, 1981

The Honorable Joseph M. Hendrie
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20005

Subject: Proposed 10 CFR 60 Technical Criteria

Dear Chairman Hendrie:

In July of 1980, the Subcommittee on High-Level Radioactive Waste of the AIF Committee on Nuclear Fuel Cycle Services submitted comment, including a technical assessment of preliminary criteria, to the Commission on the Advance Notice of Proposed Rulemaking regarding the Technical Criteria for Regulating Geologic Disposal of High-Level Radioactive Waste (10 CFR Part 60). Subsequently, an AIF Working Group on 10 CFR 60 was formed under the auspices of the Subcommittee to follow the further development of these technical criteria and to interact with the NRC staff as appropriate. The Working Group recently reviewed a March 5, 1981 draft of the 10 CFR 60 technical criteria and on April 21, members of the Working Group met with John Martin and others of the NRC staff to discuss the rationale for the technical criteria as delineated in the March 5 draft.

The purpose of this letter is to express our concern with the content of the technical criteria as drafted, the lack of responsiveness to comments previously submitted on the Advance Notice of Proposed Rulemaking, and the apparent lack of supporting documentation and analysis to justify the NRC staff approach. We have elected to make our concerns known to the Commission before issuance of the proposed rule, with the hope that the Commission will not approve release of the proposed rule until valid bases for the criteria have been prepared, adequately documented, and reviewed.

The technical criteria, as currently formulated, place an overreliance on an excessive number of detailed requirements that specify how components of the repository should be designed, in contrast to assuring the overall safety performance of the repository system. These detailed requirements have been developed without adequate evaluation of their importance to safety and in the absence of quantified safety

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goals. Many of the detailed requirements are arbitrary and are imposed without either valid technical bases or appropriate value/impact analyses.

For example, the criteria require that the high-level waste packages, to be emplaced in the geologic repository, be designed such that no radionuclides will be released from the packages for 1000 years, assuming water saturation of the underground facility. The NRC staff has not justified the need for such a zero-release requirement over such a time period. Even if the waste packages were to fail in considerably less than 1000 years, the consequences to the public health and safety would be negligible unless geology/hydrology of the repository area also changed drastically in that short geologic time period. Such an occurrence would be incredible if the repository system had been properly sited and designed.

Another example of overly detailed and unjustified requirements pertains to an unduly lengthy retrievability requirement on the waste packages after emplacement. This requirement could have significant undesirable impact on site selection, repository design, construction and operation, notwithstanding that such a requirement would provide highly questionable benefits.

Another difficulty with the proposed technical criteria is that the NRC staff has placed undue emphasis on the nature of uncertainties associated with transport of nuclear waste through the geosphere to the exclusion of other important considerations. Inadequate consideration has been given to the extent to which uncertainties can be negated or made inconsequential by bounding analysis and design; to the very large costs in both time and effort associated with quantifying and reducing uncertainties; and to the incremental magnitude of risks associated with residual uncertainties. Little or no information has been provided by the NRC staff on the extent to which the uncertainties in design parameters impact the risk to public health and safety, or how these uncertainties, when found to be safety significant, can be reduced in importance by conservative analysis and design.

Finally, the NRC technical criteria are being released in advance of the EPA's completing its applicable environmental standards to which the NRC criteria must conform. At the present time there appears to be considerable difference between the EPA approach and that being proposed by the NRC. The Commission should delay issuance of the proposed 10 CFR 60 technical criteria until the above concerns have been addressed and until the EPA has completed its criteria and the major differences in approach between the two agencies have been resolved.

Sincerely,

Carl Walske

CW:wpg

ORIGINAL

NUCLEAR REGULATORY COMMISSION

In the Matter of: COMMISSION MEETING

BRIEFING ON SECY-[illegible] 10 CFR 60 DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN GEOLOGIC REPOSITORIES: TECHNICAL CRITERIA

DATE: [illegible] PAGES: [illegible]

AT: Washington, D. C.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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BRIEFING ON SECY-81-267 - 10 CFR 60

DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES

IN GEOLOGIC REPOSITORIES: TECHNICAL CRITERIA

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Nuclear Regulatory Commission
Room 1130
1717 H Street, N.W.
Washington, D.C.

Thursday, May 7, 1981

The Commission met, pursuant to notice, at 10:12 a.m., JOSEPH M. HENDRIE, Chairman, presiding.

PRESENT:

JOSEPH M. HENDRIE, Chairman
VICTOR GILINSKY, Commissioner
PETER A. BRADFORD, Commissioner
JOHN F. AHEARNE, Commissioner

ALSO PRESENT:

SAMUEL J. CHILK
JOHN HOYLE
LEONARD BICKWIT
WILLIAM J. DIRCKS
JACK MARTIN
PAT COMELLA
GUY CUNNINGHAM
SHELDON TRUBATCH
ROBERT B. MINOGUE
MICHAEL BELL
FRANK ARSENAULT

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DISCLAIMER

This is an unofficial transcript of a meeting of the United States Nuclear Regulatory Commission held on May 7, 1981 in the Commission's offices at 1717 H Street, N. W., Washington, D. C. The meeting was open to public attendance and observation. This transcript has not been reviewed, corrected, or edited, and it may contain inaccuracies.

The transcript is intended solely for general informational purposes. As provided by 10 CFR 9.103, it is not part of the formal or informal record of decision of the matters discussed. Expressions of opinion in this transcript do not necessarily reflect final determinations or beliefs. No pleading or other paper may be filed with the Commission in any proceeding as the result of or addressed to any statement or argument contained herein, except as the Commission may authorize.

P R O C E E D I N G S

CHAIRMAN HENDRIE: If the meeting will come to order, please.

The Commission meets this morning for a briefing by the staff on a proposed rule, Part 60. It is to be the technical criteria for disposal of high level radioactive wastes in geologic repositories.

The proposition before the Commission is possible publication as a proposed rule of these technical criteria. My own guess is the Commission will need several meetings and discussions to get itself properly around this subject. Let us start now.

Bill, please go ahead.

MR. DIRCKS: We did want to report on the status of where we are today. We have completed the advance Notice of Rulemaking. We have gotten the comments in. We would like to discuss the resolution of those comments. We are proposing to the Commission that we move and go to the proposed rule phase now. We have run out of activities in response to the comments.

We think we have done everything we can do in response to those comments. We think it is time we move to go for formal comments on the proposed rule.

Jack is here to lead the discussion.

We have reached the point where we think we have done everything we possibly can with the advance notice and would like to move to the next phase.

MS. COMELLA: If you will recall, last May when we published the advance Notice, we told them where we were in terms of our progress in developing the technical criteria, how we got there. We had engaged in a great deal of dialogue with interested parties over a fairly protracted period of time and had gone through numerous drafts and how we intended to proceed further into the rulemaking.

In the advance Notice we told about the regulatory approach we were considering in developing the technical criteria and we also included in the advance Notice the draft available at that time of the technical criteria for comment.

We had sought comment on a number of issues in particular. For instance, the treatment of uncertainties. We were engaged in a new enterprise about which we had limited knowledge. There were uncertainties that we would have to resolve, both in connection with the technical problem and then confidence in the licensing decision itself.

The question of human intrusion into a geologic repository which had to isolate wastes from the accessible environment for very long periods of time was the cause of concern to many individuals. We included a discussion of where our thinking was at that time on that particular question.

The concept of the systems approach translated into a regulatory prospective meant really at what level was one going to regulate, was one going to set an overall objective for a repository and that would become the figure of merits that had to be met and form the basis of the licensing decision or would one consider major subsystems of the system and regulate it at that level.

We had a discussion of that and we sought public comment.

Another area of concern was the fact that since we are dealing with such very long periods of time, we could not really rely on experience alone. We were extrapolating to the utmost. We would have to rely to a very great extent on models, what sort of reliance would we place on models. What sort of reliance could we place on models. Where did expert judgment enter in. Those were areas of concern.

The last major area we dealt with was the concept of retrievability. We are going to put the waste in the ground but what does that mean? Just the whole period of time which the waste is being emplaced extends over quite a few years. We certainly wish to separate temporarily the decision to emplace from the decision to walk away.

We attempted to be provocative in the advance Notice and indeed we got many comments back. We found them very thoughtful. They have been extremely helpful as we have moved to the rule that you have before you today. Twenty-seven groups and individuals commented on the rule.

The breakdown generally is we had six Federal agencies commenting to us, two to three state officials; seven utilities or representatives for the utilities; two public interest groups; one professional society and nine interested individuals.

In general, individually they broke down into 400 specific comments. About 90 were directed at the regulatory approach. Twenty or so were directed at particular questions that we had asked the public to focus on and to respond to, and the last 300 were detailed comments on the draft technical criteria.

We found them very helpful. Generally, about one-third were favorable; two-thirds or so unfavorable. Half of those who disagreed felt we had gone too far in what we were suggesting we wanted to do and the other half felt we perhaps had not gone far enough.

One of the major things that came out of all the comments we had received was there was a great deal of need as we proceeded for better communication on our part of what our intent was. We had not been all that clear. We thought we had but we really had not, judging by the comments received.

There was a concern on the part of a number of commentors that we had a rather negative tone interms of our whole approach to licensing and geologic repositories.

I will give you a few examples of some of the confusion we managed to generate, and what I hope we are disspelling in our proposed rule.

Some of the individuals after reading our discussion on models concluded we were going to rely blindly on the models, while others concluded we were going to throw out any consideration to models whatsoever and therefore, what in the world were we going to base any licensing decisions on.

With respect to uncertainty, some concluded that we did not know anything about anything at all and therefore, how could be proceed, while others said enough was known already and we were much to pessimistic in terms of our assessment of the uncertainty surrounding geologic disposal.

On the systems approach, some said we had thrown it out entirely and others said we were right on.

It was very interesting. Basically we came to them from the point of view of let's see how they can help us as we move. We used them to clarify our intent in putting together the supplementary information that is part of the Federal Register Notice you have before you. We reorganized completely the regulation. We think from a structural and logical point of view, it hangs together much better. It is possible to follow it and understand what is there.

There was a lot of criticism at the time the advance Notice was published that there was not a technical basis available and enough time provided to review that. We have a rationale document that will be published and available simultaneously with consideration of the proposed rule.

We have conducted extensive discussions with the major commentors in order to try to assess whether we have understood them and whether they understand us, and to tell them what we are putting into the regulation, to get their responses and feedback.

I think we have gone about as far as we can at the moment, although I notice some letters are still coming in. That is a debatable point. From our point of view, we have tried to deal with all of the interested publics over this very long period of time and to work with them so that they understand what we are trying to do and why we are trying to do it.

I think that covers the process we have engaged in as we have moved to the rule you have before you. I will let Jack take over some of the detailed discussion of some of the specifics in the regulation.

MR. MARTIN: I think that sums it up pretty well. On the handout I put on the last couple of pages the major parts of the performance objectives which in outline form remain the same. In the detailed narratives, regulatory language has been radically restructured to be a lot clearer, we think, so that it is understandable as to what we really meant.

Essentially, we are sticking with the figure of merit to be issued by EPA on the overall system for all conditions, yet we are still going within the system to try to compensate for some of the uncertainties we know about and to eliminate some uncertainties by placing some minimum requirements on a couple of aspects of the engineered design and one aspect of the site.

In the last several months, there has been a tremendous amount of progress in this area as different groups have come to focus on how would you go about meeting some of these requirements.

I think it would be safe to say today that the focus of the debate is not so much on whether the criteria we have put out are meetable. I think most everyone agrees it looks pretty feasible. There is still a considerable amount of anxiety on how reasonable or unreasonable we might be demanding proof.

This is an area that will need quite a bit of work over the next two to three years to establish those protocols and criteria in an area that historically does not have it.

Other than the performance objectives, we have the section on siting requirements to guide the sifting and balancing of these several sites and also some requirements on design and construction in the waste package itself, which flow mainly from the kinds of considerations we have dealt with elsewhere in engineering structures like reactors and fuel cycle facilities.

We have gotten some last minute comments. We have been meeting with people right up to the last minute. We met all day yesterday with the Department of Energy. I think it would be on a letter they sent us on April 24th and I think I am accurate in saying that out of the 36 or so comments they gave us, half had already been resolved in the present version and of the other half, about ten or twelve of the comments we worked out detailed language to satisfy the comments and the remaining six or seven comments are those we agreed in principle how to go about doing it that may need some more time to work out the detailed language.

COMMISSIONER BRADFORD: When you say you have worked out detailed language, do we have that as part of this package?

MR. MARTIN: No. I plan on getting it down to you in the next couple of days. None of these are of the earth shattering types of issues. I think they are more clarifications. We can get that language with changed pages within the next week or two. I would like to shoot for the next two or three days.

I do not want to paint an overly optimistic picture, although we think we have resolved all these comments with DOE, within the context with which we are operating, they still remain as I said earlier somewhat in their words "anxious" in the absence of the detailed protocols and detailed test procedures that have been fully reviewed and agreed to, on just how do you prove some of this stuff.

If I characterized the next leg of the journey in repository development is the task at hand, to develop some protocols with the technical community and with anyone else that is interested on what constitutes acceptable proof for some of this.

For many of the items, there is no historical basis or test protocols or ASTM standards. They will have to be developed in the next few years. We are working with DOE to set up those groups and to get this worked out.

They remain anxious until that is all settled as to just where the end of this trail leads.

COMMISSIONER BRADFORD: How would a protocol work?

MR. MARTIN: I guess I could draw an analogy to a reactor vessel or something we know something about. There are all sorts of standards on how do you test the steel to make sure it is strong enough; how do you make sure it does not fracture, what are the stress limits.

These are in ASME codes and ASTM codes and they have been worked out over the years.

In the geologic repository area,that does not exist.

COMMISSIONER BRADFORD: By "protocol," do you mean something akin to a regulatory guide?

MR. MARTIN: Yes, a guide and a national concensus standard on how do you run a test that shows that you meet such and such a performance. For example, in the materials area, the Department has set up a group called the Materials Review Board, emminent scientists around the country, to review and propose such testing methods. They have invited us to join, much like we frequently do ASTM committees and see if we can work out those protocols and then publish them as reg guides. and air them publicly and see if we can build a concensus that way.

I view this very much as the situation where we were 20 years ago with pressure vessel design where the only thing we had was the ASME unfired boiler code, Section 8, which really was not very rigorous. It was a bunch of thumb rules and things that had worked fine for boilers in most cases but over the years we have had to develop Section 3, a much more rigorous approach that we use today.

That is essentially where we are in many cases in the geologic repository business, upgrading our methods, analysis and proof to sufficient rigor where they can withstand the type of tough questioning that I would anticipate we would get in the licensing process.

COMMISSIONER AHEARNE: You would foresee putting out some kind of technical guide in the next several years?

MR. MARTIN: Yes, sir. If I had to say the number one priority of the high level waste staff it would be to do just that. They have to be national concensus standards because many of these things will be conventions. They will not be direct tests of the issue in question. We would anticipate working very closely and using our public review methods to get concensus.

I think that is about where we are. I think we have had a lot of success in narrowing the issues and in building concensus among some groups. Other groups we have not really gotten there yet.

As Pat said, I think the vehicle for doing that is to get on with the next round of public comment in the next year or so. That is the end of our formal presentation.

CHAIRMAN HENDRIE: What is the stage of the EPA high level waste guidelines?

MR. MARTIN: They have a little bit different pnocess. When they are getting very near the end, they send it around for sort of a staff review of the affected government agencies. They consider those comments. Then they submit it for formal review.

We commented Monday of this week to the Administrator on their "final document."

COMMISSIONER AHEARNE: First or second stage?

MR. MARTIN: It is the first stage. Presuming DOE and the USGS have given their comments, they should be ready to submit it for public comment as soon as they can get it out of the Administrator.

Our approach was to agree with what they are doing and urge them to get on with it.

COMMISSIONER AHEARNE: We got a letter from the AIF yesterday. They say at the present time there appears to be considerable difference between the EPA approach and that being proposed by the NRC. Can you speak to that?

MR. MARTIN: Yes. I am a bit confused. We went over this with them about two weeks ago. We pointed out that the EPA sent us a letter saying they think what we are doing is entirely consistent with their approach and should be satisfactory to implement their standard and we recently sent them a letter saying we think what you are doing is right, let's get on with it.

I am a bit mystified as to where this difference is.

COMMISSIONER AHEARNE: Do you see any sign that the new Administration may be changing direction of EPA?

MR. MARTIN: Not yet. I think they really have not gotten into it at all.

COMMISSIONER AHEARNE: At the moment, as far as you can tell, there is compatibility between your approach and EPA's approach?

MR. MARTIN: Very much so.

MS. COMELLA: I think also the fact that we are know what a generally applicable environmental standard ought to look like, that we have really taken that into account and I think even if there were some changes in the form or something like that of the standard, we could still accommodate it within the context of what we have done. I do not see any problem.

CHAIRMAN HENDRIE: The EPA standard, I believe, is going to come out in terms of curies and various isotopes released over 10,000 years or something like that.

MR. MARTIN: Right.

CHAIRMAN HENDRIE: They will have to base or are basing those release amounts on some sort of generalized back calculation to a dose level?

MR. MARTIN: Yes. What they did was look at a bunch of comparable types of hazards or bodies, reactors, and a bunch of other things we live with every day and did some balancing and sorting and concluded there is a lot of other things around that people consider acceptable risks that could result in like 1,000 premature deaths over this 10,000 year period.

They picked that as a figure of merit and then back calculated using a simple analytical model as to what kinds of releases you would have to have to a typical river valley environment to get those kinds of health effects. That is the basis for the curie numbers for release.

I think they are really doing us a considerable favor because they are basing it upon curie amounts released through a boundary rather than health effects which confound the problem by predicting population patterns and settlement patterns. They did start with a health effect number for today's types of civilizations and it is comparable to ore bodies and a few other things and they back calculated what kinds of releases give you those health effects.

I am not sure whether the right word is "conservative" or "liberal," but they sort of erred on the side that would give you the bigger releases when you had a choice. They feel it should be fairly easy to meet those numbers.

We have double checked their numbers using all of our own codes and I have a tendency to agree with them that the numbers are right. We found a couple of them that look like they do not fit. I am not sure whether the problem is with our calculations or theirs. They are close.

CHAIRMAN HENDRIE: How do I connect from the EPA standards into our performance criteria?

MR. MARTIN: The performance criteria is you have to meet the EPA standard. We did not go and develop some other subset of that and pick something less. We just said their standard is the law, they have done a good job showing that is the right number and then we thought through with this very complicated geological engineered system, how do you go about with reasonable assurance demonstrating that you met those release limits.

What we have done is we have done an assessment of the areas that are very uncertain and areas where we may never be able to quantify the uncertainty and those areas that looked like they lean themselves more to quantifying uncertainty and we have picked a couple of the engineered systems and have said, if we are going to be able to make a case here for the overall system, we have to reduce the uncertainties to manageable levels.

We have essentially taken action to require engineering solutions to give you a predictable source term out of the repository, one that you can count on and is not based on a lot of the unverifiable assumptions, which of course will allow greater uncertainties in the geological transport problem which our study shows is going to be tough to narrow the uncertainties much there.

I think what we have done is taken this overall system and placed some requirements on subparts of it that we think make it a more tractable problem. The U.S. Geologic Survey pointed that out, that essentially what we have done is taken the systems approach yet placed some requirements on subcomponents of the system that give you some prospects of proving you have reasonable assurance to meeting the EPA standard and they feel as we do that is the only way to go.

CHAIRMAN HENDRIE: Let's assume Dave and his people in fact have a case which they can and will make and which will stand whatever judicial test it may be subjected to that gets from some reasonable health basis to these curies coming into the accessible environment.

From that point, working toward waste cannisters, working inward toward waste cannisters, you have a 1,000 year travel time with no credit for any physical or chemical hold up of material.

MR. MARTIN: Physical but not chemical. It is a water travel time.

CHAIRMAN HENDRIE: It is a water travel time but there is nothing that gives any credit for absorption of fission products.

That gets us to the boundary of what is called the engineered system. The engineered system has been a leakage condition which is zero for the first 1,000 years and is one ppm and 10^5 per year for each isotope thereafter.

If I could, I am now into the cannister. If I follow those prescriptions, do they match at the EPA boundary? I I start with a repository full of fission products and transuranics and leak nothing for 1,000 years and one ppm and 10^5 of each isotope thereafter per year and take 1,000 year travel time, do I then turn out to releasing over the first 10,000 years more or less curies than the EPA standard?

MR. MARTIN: With any reasonable kind of site, you should meet it. I am sure somebody could come up with a site that has such poor geochemical retardation that it does not make it. It is not an absolute guarantee. You need the EPA numbers at the end to fill in some blanks in the middle.

We did not feel we should put a requirement, for example, on the geochemical retardation. It is something that today is very difficult to measure or get agreement on.

I think I see what you are getting at.

CHAIRMAN HENDRIE: You seem to be telling me that you need some credit for hold up in the geological site in addition to the 1,000 year travel.

MR. MARTIN: Yes, sir.

CHAIRMAN HENDRIE: In order to meet the EPA standard.

MR. MARTIN: Yes.

CHAIRMAN HENDRIE: There are curies and 10,000 years of individual isotopes are on a total release from the repository?

MR. MARTIN: Yes, total integrated release over that time period.

CHAIRMAN HENDRIE: This is sort of a per-repository release to the environment and certain health effects would flow from that.

MR. MARTIN: Yes. It is a cumulative number of all sorts of possible disruptive things over that 10,000 year period which makes it a bit more complicated.

CHAIRMAN HENDRIE: One way to cut the releases is to cut the total amount of stuff that is buried?

MR. MARTIN: This is right. One could build lots of small repositories but I am not sure that is a viable way to convert this.

CHAIRMAN HENDRIE: In setting your performance criteria, what kind of a total fully loaded repository inventory do you have in mind? I do not remember reading it in the rationale for the performance criteria.

MR. MARTIN: We assume a repository about the size DOE has been publishing in their GEIS, which is essentially 60,000 cannisters or so, about three square miles of repositories of which we would probably need three or so in this country before it is over. We just sort of took that as a given, that one would not go to lots of small repositories.

CHAIRMAN HENDRIE: 60,000 cannisters is like what? Tons of heavy metal?

MR. MARTIN: I think it is about a ton. It is either a half a ton or two tons. It is in that area, per cannister.

CHAIRMAN HENDRIE: If it is a ton, it is like 600 cores, give or take a factor or two.

MR. MARTIN: Don't forget the military waste is in there as well and in terms of curies, it will be a lot smaller but in terms of numbers of cannisters, it ought to be about the same.

CHAIRMAN HENDRIE: Six hundred cores is probably something like 2,000 reactor years, 2,500 reactor years. If we have three such repositories, we would have 7500 reactor years.

Suppose we have 150 reactors and 40 years, it comes out about right.

One of the criticisms I have had of the drafts from people who have tried to follow and understand and see what would have to be done to make a case under the versions of these criteria as they perceive them coming along is they have a time back calculating and making the connection from whatever EPA assumed is health effects as a reasonable basis for health effects and making that connection and down through the performance criteria and seeing where it connects.

COMMISSIONER AHEARNE: In the absence of the EPA criteria, you can't fault Jack for not having it in.

CHAIRMAN HENDRIE: It is not in the absence of the EPA criteria. There are drafts of the EPA criteria running around and I do not have one on hand but I dare say within 15 minutes we could provide you with a table, isotope curies per 10,000 years per repository release.

People know what that is and they take that and scratch along.

We have a repository and it is something like the 60,000 cannister number which from my very crude arithmetic sounds like it would turn out to be of the order of one third of the wastes, high level wastes, from something like 150 light water reactors operating for 40 years, which is perfectly reasonable.

That is what the total source is. If I go from that inventory and nothing comes out for 1,000 years and then one part and 100,000 comes out per year thereafter past the three square mile boundary and then it takes 1,000 years to get to an accessible point, what sort of a reduction factor do I need out here in the geology and geochemistry and physical hold up?

MR. MARTIN: About 100.

CHAIRMAN HENDRIE: With that factor of 100, then you are at the EPA 10,000 year inventory release, acceptable release numbers?

MR. MARTIN: Yes.

CHAIRMAN HENDRIE: Why is Pat looking at me with such a peculiar expression?

MR. MARTIN: I would like to emphasize something. We approached the problem different than where you are leading the discussion. I guess we started from the premise that from the repository boundary to the accessible environment, we recognized the fact that we are yet to find anybody either in the DOE program or out of the DOE program that has confidence they will be able to prove rigorously they understand the geochemical retardation.

Secondly, no one today has an analytical model for predicting flow in fractured media, which eventually you get to regardless of any repository.

Depending upon who you talk to, there is optimism or pessimism as to whether we will have that in the next decade.

We approached the problem just recognizing that you have these kinds of uncertainties today and further, there is some uncertainty in the prospects for the future.

What do you have to do to reduce the demands on that leg of the journey so that you have some hope of proving you have met the end point? We looked at the parts of the system that are relatively more easy to deal with and that is where we came up with the 1,000 year criteria on the cannister, the one part and 10^5 so at least the guy modeling this thing does not have people coming in the back door arguing about the source term while he is trying to defend the transport problem at the front door.

I think it is important to realize that in part, 1,000 year cannister life time and I keep saying "cannister" and I mean waste package life time, is in part to keep things bottled up for the 1,000 years but it is also in part to protect the waste from attacks of aggressive waste rock interactions during the high thermal period so that you can make the case that the release rate really is one part and 10^5, so you do not have some radically altered structure where there are all sorts of uncertainties as to what it even is.

We sort of approached it from that standpoint, as what can you reasonably do to nail down the parts of the problem that lend themselves to rigorous development and then what is left over that the rest of the system has to do and is there some hope of making the case? We feel there is probably a good chance that in the next several years we will be able to make the case that you do in fact have a retardation factor of 100 to 1,000.

I do not think we can do that today.

There was a very interesting thing I stumbled across at the Nevada test site the other day where they had done a geochemical retardation experiment that I could not have designed better by drilling into a test shot hole and then you could measure the amount of radioactivity in the water versus that in the soil and come up with very precise retardation proefficients and they calculated in the order of 3,000 for reuthenium.

Unfortunately, a few months later somebody drilled a well about 100 yards away and pumped it just to show they got breakthrough of tritium, which travels as fast as the water in the right amount of time and they did. They predicted that right. Unfortunately, they got reuthenium breakthrough at the same time and it really should have been 3,000 times longer.

I am sure all of this will get sorted out some day but we have also been mindful that these sorts of things will be coming up constantly over the next decade and that is why we want to make sure we are not putting too many demands on the part of the problem that may not lend itself to real rigorous treatment.

COMMISSIONER BRADFORD: Jack, tell me what you mean when you say the retarded coefficient was 3,000.

MR. MARTIN: This means if you have water that flows from here to there in one year, then the chemicals in the soil tend to track these radionuclides and the radionuclide in question should have traveled 3,000 times slower than the water transporting it. Most all of these models are based on coming up with those numbers and just calculating them.

COMMISSIONER BRADFORD: The number is a comparison to the speed with which water itself travels?

MR. MARTIN: Yes. At present there seems to be a lot of uncertainty as to how you come up with that number and how do you defend it rigorously.

We get criticized for emphasizing uncertainties but I think we have been a lot more humble about dealing with these sort of things where we get the feeling in talking to the scientists that they are a little shaky about it and it may be perhaps the people who are bullish on computer models.

CHAIRMAN HENDRIE: Is it clear in the way in which you have framed the current version of the criteria that you save yourself any of this, that is, is the requirement that you start on under 60.111(b)(1), and that says show that you meet the EPA criteria, so that is an argument that the applicant has to make quite apart from any performance criteria showing.

MR. MARTIN: That is the governing criteria.

CHAIRMAN HENDRIE: He has to make that case and what follows in terms of performance criteria for the engineered system and performance of the geologic setting and that travel time, you think are good ideas in order to break down the overall problem in the manageable segments but in terms of the applicant's problem, he still has to meet the EPA standard.

MR. MARTIN: This is right.

CHAIRMAN HENDRIE: That is, if you had not put the performance criteria in, and kept 60.111(b)(1), he has to meet these 10,000 year curie release amounts at the boundary of the proposition and might for his own purposes decide he wanted a cannister that he could show was good for 2,000 years and a release fraction which was a smidge higher or something like that, that is, since you are going to leave him having to make the full calculation from waste form to boundary of the geologic region release, release into the accessible environment, is it clear that it is either necessary or a good idea to also prescribe at this time the subelements of showing that overall performance?

MR. MARTIN: I think that is the question that has been debated the most, is that a good idea or not.

CHAIRMAN HENDRIE: If you said, we, the NRC, in preparing this rule have calculated from the EPA generally applicable standards, back to the cannister and we have decided the best way to do this is to have 1,000 year water travel time and then a certain release rate after 1,000 years, maximum release rate and a certain minimum cannister life time and if you do those three things, then you meet the EPA standard, we declare that to be so, we, the NRC, and that is written into the rule.

The showing which has to be made by the applicant is cannister life time, leakage after 1,000 years, fractional leakage and water travel time for the site.

If you said, never mind you calculating with these things, your site meets the EPA guidelines because we have done that on a generic basis in establishing these subsection performance standards.

If you were going in that direction, I would say yes, then you certainly need the performance criteria, either a single set or several alternate sets if you wanted to provide more flexibility.

Since you are going to stick to the EPA thing and require proof by the applicant in the review and adjudication that he meets that EPA standard, then is it so clear that we want to establish at this time these sub-element performance criteria?

I raise the question because while I recognize that we have certain views today about what is likely to be proveable and have portioned up the problem as best we can in the way that seems to us most rational to allow that showing to be made, is it clear that in five years we are going to feel the same way about it? I do not know.

I pose it as a problem because as long as you do anchor ultimately to a requirement for a showing that the EPA proposition is met outside of the geologic site, then it is a real question of how finally we want by regulation at this time to control the elements that go into that showing.

Would it be, for instance, better to indicate these sub-element performance criteria in a less formal way at this time and leave to a companion rulemaking in two years or three, for the setting of these things or a determination as to whether they should be part of the rule?

MS. COMELLA: Do you mean in terms of the numerical requirements, identifying the element, the subsystem elements one would regulate, identifying that now at this time and at some later time, seeing whether one would set numerical requirements on it?

Are you just saying do not specify anything except in the description, the supplementary information?

CHAIRMAN HENDRIE: Either. If you are going to say the essence of the proposition is meeting the EPA generally applicable standards for high-level waste repositories, and this is a showing required to be made by the applicant and reviewed by us and then argued over presumably in a hearing.

Is it really clear that if you were going to require that, that you also want to constrain the sub-elements of that showing in the way in which you have here?

I ask that because while I have read your rationalization document and I think it is very helpful, while I think you have made a sort of best cut we can with what we know today on those sub-elements, is it clear that we really ought to anchor those now?

I can see arguments for doing that and I can also see some arguments for not doing it.

MR. MARTIN: This is the judgment the staff had to make. It is clear to us. I think another aspect of this that one should not lose sight of is the lead times on doing many of these things are sufficiently long enough that if one does not straighten out the approach on the front end, one often does not have a choice any more when we get to the point of a proposal.

CHAIRMAN HENDRIE: You have done a lot of work along this line and thinking about how one would break down the elements of a repository performance analysis, get it down into manageable chunks and deal with those. That thinking and the conclusions you have drawn from it, at least as of today, certainly ought to be widely available and noticed as guidance and help to people.

The question I raise is not that kind but rather is it wise to set those things with the values attached to them here in the rule at this time or would you be better off to say, here is our overall performance criteria, that is, you have so many curies of each isotope over the first 10,000 years at the edge of the site, the EPA rule, and we think the problem divides itself as follows and our judgment would be you ought to have 1,000 year cannisters and one part and 100,000 per year leakage years and 1,000 year travel times, but precise definition of those as regulatory requirements will remain for rulemaking to be started in two or three years.

Would that be better or not?

MR. MINOGUE: Mr. Chairman, I would like to oomment. Clearly, there are two alternative tracks you can take in terms of implementing the EPA criteria.

If a showing is to be made in our proceeding, as we have been discussing, I think it is really important to recognize that if you put too many eggs in the geology basket, you are going to get into a real trap.

CHAIRMAN HENDRIE: I do not think you have saved the day on that.

MR. MINOGUE: What you do with this kind of balance is make it clear to the perspective applicant that he is not to put too many eggs in the geological basket. You have to put the emphasis on what you can get your hands on.

CHAIRMAN HENDRIE: You could sure make that thinking and make clear the reasons behind it in a reg guide format.

MR. MINOGUE: If you look back at the history of the last 15 years in the geology area for reactor siting and for waste siting alike, there is a consistent pattern of continuing development and growth of understanding of complex structural geology and hydrology and there is also a consistent pattern of real problems in establishing the data base, procedures to do exploratory work and so on and interpreting that.

I think it is very important to avoid the trap of putting too much of the emphasis or even allowing an applicant to come in and put too much emphasis on the geological area which is fraught with uncertainty. This is one of the comments the Geological Survey made.

CHAIRMAN HENDRIE: Let me ask you why you do not do the following; since you have thought about this at considerable length in terms of what is likely to be showable and what is not, from a lot of curies in the repository to a requirement for no more than so much comes out in 10,000 years, there are a lot of factors of ten in there.

You are trying to decide where to assign these reduction factors in the various elements of the system. You have done it, in fact. You have concluded a certain life time for the cannister, certain leakage rate from the engineered system, a water travel time.

You say you still need about a factor of 100.

MR. MARTIN: This is all under design conditions. We are not now looking at abnormal things and accidents and that sort of thing. All these factors, if everything works the way it ought to work, when people start drilling holes in it and having earthquakes and that sort of thing, that grossly complicates the system.

CHAIRMAN HENDRIE: As I understand it, you still need an additional factor of 100 out of the geochemistry. Is that what I understood you to say?

MR. MARTIN: Yes.

COMMISSIONER GILINSKY: For chemical effects.

CHAIRMAN HENDRIE: And physical absorption, but not the physical effect of the transport time.

COMMISSIONER GILINSKY: Not the flow.

CHAIRMAN HENDRIE: You are not 100 below the EPA standard?

MR. MARTIN: When you start taking into account the other things one has to do to meet the same numbers apply also to accidents like people drilling holes in it. It is really not that simple.

The factor of 100 is if it is allowed to flow all the way out to the accessible environment.

COMMISSIONER GILINSKY: You are saying at least a factor of 100?

~~tions-to-be-maintained.--All-systems-important-to-safety-shall-be-designed to-permit-them-to-be-maintained-at-all-times-in-a-functional-mode.~~]

(6)[~~(7)~~] Inspection, testing, and maintenance. The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness.

(7)[~~(8)~~] Criticality control. All systems for processing, transporting, handling, storage, retrieval, emplacement, and isolation of radioactive waste shall be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Each system shall be designed for criticality safety under normal and accident conditions. The calculated effective multiplication factor (k_{eff}) must be sufficiently below unity to show at least a 5% margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation.

(8)[~~(9)~~] Instrumentation and control systems. The design shall include provisions for [~~I~~] instrumentation and control systems [~~shall be-designed~~] to monitor and control the behavior of engineered systems important to safety over anticipated ranges for normal operation and for accident conditions. [~~The-systems-shall-be-designed-with-sufficient redundancy-to-ensure-that-adequate-margins-of-safety-are-maintained~~]

(9)[~~(10)~~] Compliance with mining regulations. To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977, as to the construction and operation of the geologic repository operations

Appendix B

MR. MARTIN: Yes. If someone drills a hole in it, and that is one of the accidents we have to look at, we may need a lot more than that.

CHAIRMAN HENDRIE: You keep saying you do not want to depend all that much on people having to make showings about the geochemical behavior and holding things up. On the other hand, there is nothing here which I see which relieves the applicant of having to make precisely those showings, among other things, even with your cannister and engineered system leakage time, you still have a factor of 100 to show in the mean case or reference case and you do require the overall showing to be made.

It appears to me that he has the problem which you say you are trying to save him from having.

MR. MARTIN: He does not have it as much. That is the point.

CHAIRMAN HENDRIE: How do you know? He might figure he would whether have a 10,000 year cannister and only show a factor of ten out in the geochemistry.

MR. MARTIN: He is certainly encouraged to go in that direction.

CHAIRMAN HENDRIE: He is encouraged to go in that direction but he does not get any credit for it. If he shows a 10,000 year cannister and part and 10^6 instead of 10^5 leakage rate, he still needs a 1,000 year water transit time.

If you had said, the criterion for a license is 1,000 cannister and 10^5 per year leakage rate from the engineered system after 1,000 years and 1,000 year water transit time to the accessible environment and I guess you would have to say and a factor of 100 hold up in the geochemistry in that last section and that is it, and we declare if you do that, you have met the EPA standard.

MS. COMELLA: You are assuming you have an EPA standard. We have seen drafts of EPA standards. In order to set this kind of criteria you are talking about, one must have an EPA standard that is effective.

CHAIRMAN HENDRIE: Your document which you want me to publish as a proposed rule of the Commission says the applicant shall show his repository meets the generally applicable environmental standards that may have been established by the EPA. You have required it.

Furthermore, you say, I have to know what those things are before I can do these performance criteria. You have established performance criteria that you want me to publish as a rule.

I do not understand what you said.

MS. COMELLA: I have been listening very carefully and I have been trying to make certain I understand exactly what you are saying. To me, this is the way I look at the problem. The applicant's problem, once he comes in with an application, is to have the application approved and the license be granted. What we have tried to think about is how can we build confidence in what the applicant has submitted so that a lieensing decision can be made and that is one of the reasons for reaching the decision we have made in our recommendation to you and it is a judgment, it is if we include performance objectives at the subsystem level, we can increase confidence that the overall system performance objective can be met and hence, have more confidence in the licensing decision then is made.

I realize the wording could be construed to imply we have accepted an EPA standard. It is meant to imply that we have given thought to what a generally applicable environmental standard looks like, we believe that setting these performance objectives at the subsystem level will contribute to the showing that standard is met.

CHAIRMAN HENDRIE: That is not what the rule says. The rule says the geologic setting shall be selected and the subsurface facility designed so as to assure, and this means there has to be somebody to make a finding that assurance has been offered and the applicant has to make a case that gives that assurance, assure that releases of radioactive materials in the geologic repository following permanent closure conforms to such generally applicable environmental standards as may have been established by the EPA.

This is one clear cut thing the applicant has to do.

No matter if he met all of your performance criteria, by substantial margins, he still has to make this finding. He has to make this case.

What I am saying is you have overconstrained the system. I do not say that is bad. I say so far I find it is just not clear that overconstrain at this point is the wisest course.

MR. MARTIN: I think there is a point missing. Let's take design conditions, no accidents or all the other things the EPA standard applies to; if everything works as designed, I think you are correct that the cannister or the package design of 1,000 years, the 100,000 year release time, given a factor of 100 or so retardation, that ought to assure meeting the EPA standard under normal design conditions.

That is what our criteria apply to. It says under anticipated design conditions.

COMMISSIONER GILINSKY: You do not have that factor of 100 in the rule.

MR. MARTIN: No, we did not put that in the rule. I will tell you why. The EPA standard does not apply just to normal design conditions. It applies to all creditable circumstances, accidents, intrusions, the whole variety of things that get into an accident type situation.

Even with the factor of 100, those several criteria would not ensure meeting the EPA standard.

COMMISSIONER GILINSKY: It seems to me even under what you call design conditions, the system is not necessarily overdesigned or overspecified if there is still that factor of 100 that needs to be met.

CHAIRMAN HENDRIE: If you were going to ride on the performance criteria alone, you would need another specification.

COMMISSIONER GILINSKY: I am wondering whether it is right that you do not get credit for a better container and a lower leakage rate if in the first instance you are eating into that factor of 100.

CHAIRMAN HENDRIE: I would assume if the guy has a better container, he can show you a 10,000 year container, he certainly meets your 1,000 year requirement. I would think he would get to use his 10,000 showing in terms of the overall meeting of the EPA standard.

MR. MARTIN: If he can make the case it is good for 10,000 years including accidents and all that sort of thing.

CHAIRMAN HENDRIE: Your judgment is he is not going to be able to make that case.

MR. BELL: Michael Bell from the Waste Management Staff. I think there must be a misimpression on the part of some of the Commissioners. Each of those numerical criteria at minimum are phrased so that it is at least 1,000 years and in our discussion, we said we encourage DOE to try to do better than that if the costs and benefits turn out favorable and we intend to give credit and they can compensate for some of the uncertainties and buy better packages, lowering their release rate or longer groundwater travel times. All three of those are phrased as minimum requirements.

CHAIRMAN HENDRIE: John?

COMMISSIONER AHEARNE: The issue of these requirements has been one that has been wrestled with for a long time. I think you are wrong because there will be a repository built and there is a lot of work that DOE will be putting into both the design of it, the design of the packaging, the development of barriers and so forth and to just have a very loose overall criterion laid on, I think is not going to give the country as good a chance for getting a successful repository then if we go out with these performance criteria.

As Mike just pointed out, they are sub-elements. As Jack and you have dialogued, they do not guarantee but they are critical sub-elements and they essentially represent several years of effort by a lot of people, not just NRC people. Jack has done a really incredible job of trying to pull together the sum of the knowledge that exists around the country on the various critical technical questions involved.

This is an attempt to provide some best distillation of a lot of that knowledge in the hopes that the national repository program can continue going forward.

I think we would be remiss if we did not include these requirements that are in here.

CHAIRMAN HENDRIE: It sounds great and my only problem is I remain to be convinced that publication as a requirement in the rules of the sub-elements is the best thing at this time.

Suppose you decide in three years, although there may be good reasons for thinking you would not decide this, but suppose you said, the release fractions are going to be harder to show from the engineered system than we thought. We picked 10^5 per year and that looked like it would be all right, we picked sort of a midrange value.

Suppose in three years you decide it would be a lot harder to show that than we thought but it turns out the metallurgists have produced cannisteronium, which is an alloy of aluminum and New York City garbage. There is nothing that is going to touch it!

COMMISSIONER AHEARNE: Intrusion control device!

CHAIRMAN HENDRIE: What we really should have had was 10^4 per year leakage rate and 100,000 container. I guess if you get to a 10,000 container, you have met the EPA requirements and never mind what the rest of the system does. It could be running water into the Crowden reservoir.

I agree you have been working on this long enough and talking to people and you have a pretty good sense where the development program should go so that speculations of this kind are at least improbable events.

That is kind of what I have in mind, not quite that extreme. You would certainly want this kind of discussion to be out there and let people know about it. Is it clear you want to anchor this stuff as a rule at this time?

You think yes but why? I suspect because your internal decisionmaking machine says so!

Can you explain why what I suggest may be a better path but is in fact is not going to help and anchoring these things in regulation form at this time is all that much greater?

COMMISSIONER AHEARNE: Greater or lesser, obviously, are subjective judgments. The scenario you suggest, what you are underlining is the concern that at some stage EPA will come out with specific criteria and there are many ways of putting together all those factors of meeting it and just proving the performance standards as Jack has said does not get you all the way to that standard.

You are in a way asking the DOE to do a double proof, to meet two sets of criteria. The difficulty is the process of the development of cannisters, research on cannisters, development of engineering barriers and site exploration and analysis and modeling goes on. At the present time there is very little guidance being given to the DOE as to how the NRC is going to approach that licensing and review process.

This is sort of a balancing of what is the most probable path that we and the EPA and DOE will go down to have the most likelihood in the mid-1980's of being able to get to the point where we can go through a successful licensing process for a repository.

The points you make are quite valid. My conclusion is in balancing where the DOE is and the state of knowledge, this is a more likely path to get to a successful repository than to leave all those questions open.

It is subjective. Although I grant your scenario could happen, I donot think it is as likely as my scenario.

CHAIRMAN HENDRIE: I am not sure I would do your scenario any damage if this rule -- here is a portion for you to contemplate. You go out with this rule as it is and you say what we contemplate after you make comments is we are going to go final with sections A, B, D or whatever of the rule but we are going to keep the performance criteria as a proposed rule for comment, we are going to keep it open for two years before we move on it. That certainly puts it out in front of people.

I would have published it as a reg guide or at least if I decided it was better not to anchor it at this time, I would probably publish it as a reg guide but you could put it out as a proposed rule and just say you propose to keep the comment period open on the performance criteria for some extended period. You are saying we have thought about it very carefully and here is where we think we are going today.

I am not saying what you have here is not the right way to go and is not the optimum way to go. I am saying I am having trouble being sure it in fact is optimum.

On the reactor side, it took is an awful long time to know what to write down in the regulation, that is, assuming we know now.

Frank?

MR. ARSENAULT: In listening to what has been said, I notice there were some added dimensions that are difficult to express in a debate like this but I think they help you relate what is going on to some of the experiences we had with reactors and explain better why the ancillary NRC criteria might be desirable.

As Pat pointed out, the problem is one of ensuring acceptability of the demonstration of performance to the EPA standard. The problem with that lies in the uncertainties associated with that demonstration of performance.

The problem eluminating better the basis for these NRC criteria comes out of two things; one first has to realize the EPA standard covers a full range of scenarios and each of these has to be identified and characterized and the radionuclide releases predicted for the individual circumstances represented by those scenarios.

The second point is that the overall performance evaluation can be subdivided into models that represent the individual barriers that could be identified in the system.

The acceptance of the demonstration of performance would be based on our conception of the validity of that demonstration given the uncertainties associated with its calculation. There are several kinds of uncertainties and therein lies the rub.

The first are the uncertainties associated with the data, the data that goes into the evaluation. These generally are accessible and would allow us to quantify the contribution to overall uncertainties.

The second rests in the uncertainty associated with the validity of the models. This is much more difficult to quantify and you are left with a degree of uncertainty concerning the degree to which you have characterized the uncertainty.

The final source of uncertainty is in the completeness question and that is whether or not you have identified all of these scenarios for which you have computed performance and that is essentially an unquantifiable source of uncertainty.

As is the uncertainty that you come away from evaluating the validity of the models, that is an unquantifiable residual uncertainty. This unquantifiable residual uncertainty can be expressed as confidence. There is a distinction between "uncertainty" and "confidence."

When you are finished with this evaluation of performance and the assessment of the uncertainties associated with the performance, you are still left with the question, how confident are you that you have done this well?

The sources of uncertainty are such that we feel we need to enhance the confidence of the NRC staff in this evaluation by providing some ancillary criteria, hopefully we could identify independent barriers for which such criteria could be established so that when we are finished with the evaluation of performance, we have not only demonstrated that the repository meets it, if in fact it does, but we also feel we have properly quantified the uncertainties associated with that evaluation and finally, we have established conditions which give us confidence that the acceptability of the repository or the repository is acceptable based on the evaluation.

The three individual criteria that show up in the rule were selected so as to enhance their independence; containment, the release rate and the geology are in effect as independent a set of barriers as we could find.

The quantitative levels are a matter of judgment. I felt comfortable with them personally because each of them results in a retardation radionuclide release for a period of time that results in natural decay occurring to a level where the residual radioactivity is comparable to that of the ore from which the original fuel was taken.

The quantitative level seems to be a comfortable level, that is a range within existing technology and in the case of the 1,000 year groundwater time, would not rule out a large number of sites.

It is the combination of reduction of uncertainty in calculation as well as enhancement of confidence in the results of the evaluation and the selection of barriers that are independent, thus, providing further enhancement and confidence.

CHAIRMAN HENDRIE: I am with you and with the proposition most of the way down the track but just before you get into the station, I am still having trouble hanging on to the train.

There is nothing in what I have said which suggests this work that underlies this is not very valuable and there is nothing I have said which suggests this work should not be put before the waiting world and in particular the people who will be applicants in full official form.

The only place I am still scratching my head is, is it a good idea to set these things down in subsystem performance criteria at this time as the regulations.

In spite of what you say about helping to relieve the uncertainties, I do not know it does that.

Let me give you an for instance. An applicant comes in and he has a container and he waves his corrosion rate test at you. He thinks the container is good for 5,000 years and in fact he already knows because he knows he needs 5,000 years out of that container in order to meet the EPA standard for some scenario.

You have a 1,000 year proposition and you are reviewing and looking at his data and muttering these are only four year accelerated corrosion tests. You come down to the conclusion that he meets the 1,000 year life time criteria for the container.

Now what are you going to do when he is doing the scenario calculation to meet the EPA standard? You are going to give him credit for the 1,000 years. Are you going to give him credit for the 5,000 years?

MR. MARTIN: Sure, if he can make the case, and if the analyses show it. I think that is entirely consistent.

CHAIRMAN HENDRIE: Why bother to have 1,000 year criteria then?

COMMISSIONER AHEARNE: Because it was very helpful when he went through the program.

CHAIRMAN HENDRIE: As a rule?

COMMISSIONER AHEARNE: The same set of arguments.

MR. MARTIN: I think this also gets back to the question of should you have multiple independent barriers or not.

That is another aspect of it, to have a minimum number of reasonably independent multiple barriers.

CHAIRMAN HENDRIE: If you just went back and hung on the EPA standard only and did not specify any sub-element aspects, you might lose that. I agree with the independent barrier concept.

I have wrangled this question about should the sub-elements go in regulations now or should they be published in a suitable form and people told this is where we are going but it will not come down final until later. I just do not know at the moment.

Vic?

COMMISSIONER GILINSKY: I was going to ask you a question.

CHAIRMAN HENDRIE: Twenty-five minutes. Is that the question?

(LAUGHTER.)

COMMISSIONER GILINSKY: The thing that puzzles me about your point of view is since the applicant is going to need several more orders of magnitude to meet the EPA standard, the place he is most likely to have trouble in demonstrating is on the geological aspects of a problem. He is probably going to lean more heavily on the container and the repository.

I do not see these minimum standards are going to stand in his way. The one place where things may be overly rigid is the example you gave, where you are trading off the container versus the repository and if there is some great breakthrough, I am sure an adjustment can be made.

CHAIRMAN HENDRIE: We can always go back and adjust the rule if that seems appropriate. As time goes on and DOE work goes ahead and perhaps they begin to look at some sites where there will be progressively higher thresholds for rule changes, the agency will then bear the burden of being accused of adjusting the rules of the game to suit what our friends at DOE are doing.

You are going to come to a place where because of that kind of criticism being made, you are going to find it pretty hard to do much in the way of rule changes.

COMMISSIONER GILINSKY: The more dangerous situation would be if one had set the various performance standards too low and were relying too heavily on geochemistry and then got into a situation where that would prove very difficult to calculate.

CHAIRMAN HENDRIE: Am I assured that is not the case with the present criteria?

COMMISSIONER GILINSKY: I do not see how relieving the performance standards on the container and the repository can improve that.

CHAIRMAN HENDRIE: Offhand, I do not either. Since you are left with a substantial showing to make about the geochemistry that led me to ask, if that is the case, is it all that good an idea to anchor these other elements at this time. Maybe it is from the standpoint that recognition of the multiple barrier concept is highly desirable and that the performance criteria achieved that and that the numerical values in the performance criteria are hopefully not all that impossible to meet and not very much of a constraint on the system, that is certainly a line of argument which is reasonable.

MR. MARTIN: I happen to think there is a connection between these numbers being in that advance Notice of Rulemaking and the very large amount of progress that has been made in the eight or nine months in finding ways of doing tests that appear to be relatively achieveable.

I just question how much enthusiasm there would have been for doing that had it not been the realization that this is something we should really look at.

MS. COMPELLA: I would like to second that. That is with regard to should it be in a reg guide versus a regulation. One of the things that has gone through my mind is it has served as a focus for thought. It has fostered that critical thinking that goes into the very questions you were asking.

I have not been able to think of a better form to extract that sort of thought that needs to be done.

CHAIRMAN HENDRIE: It is a proposed rule at this stage. John?

MR. TRUBATCH: If I may, having had recent experience with two other rules, the fact that it is a proposed rule I think does not mean there does not have to be substantial technical basis for these numbers now.

Is the supporting documentation organized in a way to --

COMMISSIONER AHEARNE: Yes, very well organized.

CHAIRMAN HENDRIE: I will not disagree. It came late to my hands.

COMMISSIONER AHEARNE: It came late to everyone.

CHAIRMAN HENDRIE: Good, I am glad I was not selected for maltreatment. I read it with some care. It is much better than we do in most of these cases.

I think there is a perfectly valid basis for the rulemaking in terms of the documentation and the work at hand. My question is not is there any procedural weakness. I think it is in better shape than most. Is it wise to anchor on these sub-element numbers at this time.

I have a few minor detailed questions that I would like to sort before we quit.

COMMISSIONER AHEARNE: I have some of those. Since we are quitting soon, I will talk to Jack or Pat later. It is a lot of minor questions.

CHAIRMAN HENDRIE: Would it be better to do that since it is 11:53 a.m., would it not be better to schedule a continuation of this meeting?

We all have detailed questions. I will reassault you with philosophical arguments!

One thing which would be handy is what has the EPA got in draft form that is not hopelessly burdensome to read? Is there something circulating that suggests the kinds of things that went into their thinking in setting those curie release numbers and the kinds of things they think have to be examined?

MR. MARTIN: I can get you a copy of what we recently reviewed and commented on which has been pretty stable for the last several months.

CHAIRMAN HENDRIE: How large is it?

MR. MARTIN: Maybe ten or twelve pages of explanation and two or three pages of standard.

COMMISSIONER AHEARNE: Easy reading!

CHAIRMAN HENDRIE: That is probably right at the outer limit of my attention span.

MR. MARTIN: We can tear off a few pages of introductory material.

CHAIRMAN HENDRIE: That sounds useful.

COMMISSIONER AHEARNE: I would just like to say I am overjoyed to see it here and I think it is an excellent product. It shows a great amount of work very well done.

CHAIRMAN HENDRIE: Here! Here! Thank you very much.

(The meeting adjourned at 12:00 p.m.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

NUCLEAR REGULATORY COMMISSION

in the matter of: Briefing on SECY-81-267 - 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories: Technical Criteria

Date of Proceeding: Thursday, May 7, 1981

Docket Number: __________

Place of Proceeding: Room 1130, 1717 H St., N.W., Washington, D.C.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Marilynn M. Nations

Official Reporter (Typed)

____

Official Reporter (Signature)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 11 1981

MEMORANDUM FOR: Samuel J. Chilk, Secretary of the Commission

FROM: William J. Dircks, Executive Director for Operations

SUBJECT: TRANSMITTAL OF DEPARTMENT OF ENERGY COMMENTS ON MARCH 5, 1981 DRAFT OF 10 CFR PART 60 TECHNICAL CRITERIA AND RESOLUTION OF DOE COMMENTS

Enclosed is a copy of the April 24, 1981 letter to John B. Martin from Sheldon Meyers, Deputy Assistant Secretary for Nuclear Waste Management, Department of Energy (DOE), commenting on a draft of the 10 CFR Part 60 technical criteria that was distributed at the NRC-sponsored symposium on high-level waste disposal held in Gatlinburg, Tennessee, March 10-13, 1981 (Attachment 1). These comments were discussed in a meeting with DOE staff on May 6, 1981, where it was agreed that a number of the comments were not applicable to the proposed rule forwarded to the Commission with SECY-81-267 and clarification of the NRC staff's intent on a number of other items was requested.

Attachment 2 contains proposed revisions to Enclosure A of SECY-81-267 in response to these DOE comments in comparative text.

Attachment 3 provides a discussion of the resolution of the comments.

Attachment 4 identifies a number of additional clarifying changes to proposed Subpart E.

The working draft of the Environmental Protection Agency High Level Waste Standard requested by Chairman Hendrie is being sent separately to the Commissioners.

for

William J. Dircks
Executive Director
for Operations

Contact: M. J. Bell (WMHL)
42-74173

8105210535 72pp

Department of Energy
Washington, D.C. 20545

Mr. John B. Martin, Director
Division of Waste Management
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Martin:

While we have not yet completed our review of the technical criteria to be included in 10 CFR 60, I am forwarding to you a number of comments concerning issues that we believe should and can be resolved before the document is resubmitted to the Commissioners. Our comments are based on the March 5, 1981 version of the document that was distributed at the Commission-sponsored symposium on waste management regulations held in Gatlinburg, Tennessee.

These comments are provided in the spirit, noted during the discussion of the procedural portion of 10 CFR 60, which encouraged resolution of issues at the earliest possible time. My staff will be pleased to meet with the Commission staff to discuss these issues and establish a means for their resolution in a timely fashion.

Sincerely,

Sheldon Meyers

Sheldon Meyers
Deputy Assistant Secretary
for Nuclear Waste Management
Office of Nuclear Energy

Enclosure

cc w/encl:
Tom Rehm, Office of Executive
Director of Operations

Attachment 1

Enclosure

DOE Comments on the March ~~8~~ 5, 1981
Draft of 10 CFR 60 Technical Criteria

60.102 Concepts

60.102(b)(2) and 60.102(c)(1)

Two terms introduced in these sections need to be more carefully defined. The two terms are "storage" and "geologic repository operations area." In section 60.102(b)(2) it is stated that the "geologic repository operations area" is that area where radioactive waste handling activities are conducted. Section 60.102(1)(c) implies that the "geologic repository operations area" is that used for "storage" (which includes disposal) of high-level waste. Disposal is defined but storage is not. We believe that it is essential that these terms be clearly defined.

60.102(c)

This section seems to be mistitled. This title implies that the section will specify the functions of the geologic repository operations area. It does not. This section addresses the requirements necessary to invoke NRC control over a repository and a statement that TRU waste sent to a high-level waste repository will have to be treated as though it were high-level waste. The Department believes it would be beneficial if NRC staff stated the functions they believed that the geologic repository operations area should perform.

The reasons for treating TRU-waste in an identical manner to the high-level waste are not obvious. Depending on the assumed conditions, physical and chemical phenomena taking place in a repository, and the level of credit given to man-made barriers, this requirement could result in the need to convert all TRU-waste to a leach-resistant waste form. If this is the objective it might be more appropriate to state it directly.

60.102(f)

This section is most unclear concerning the concept and definition of the "containment period." Initially it states that the containment period would be defined as that time in which waste would be contained by the waste package portion of the engineered system or approximately 1000 years. However, in section 60.102(g) the definition of the containment period seems to be broadened to a time frame in which isolation is achieved by the "geologic repository." The geologic repository is defined (60.102 (d)) as the geologic repository operations area plus the geologic setting. Obviously the volume and time frame for containment are drastically different for each case.

60.102(g)

The definition of the term "isolation" needs to be reconsidered. The term isolation denotes a spatial separation, in this case of the radionuclides from the accessible environment. In this section it is stated that isolation is still maintained even after radionuclides enter the accessible environment as long as the concentrations stay below specified limits. The definition in 60.2 needs to be reconsidered.

60.111 Performance Objectives

<u>60.111(a)(3)</u>

As now stated, the repository will have to be designed for a life of 130 to 150 years. Is this the time frame the Commission envisioned when this requirement was proposed?

<u>60.111(b)(1)</u>

The term and concept of the "overall system" is introduced in this section. However, the subsystems, components and elements of the overall system are never referenced, they can only be deduced through implication. We are assuming that the "overall system" is defined by the bounds of the "geologic repository."

The level of performance in keeping radionuclides from the accessible environment is apparently specified by currently-unrevealed EPA standards. It would be more appropriate to cite the EPA standards directly if that is what is intended.

<u>60.111(b)(3)</u>

This section addresses the performance requirement placed on the geologic setting. In normal design practice, the function a facility, system, component, or structure is to perform is outlined before the performance level is specified. That structure might be used here so that the Commission staff can communicate what they expect the geologic setting will contribute to the repository.

<u>60.111(b)(4)</u>

This section establishes a requirement that a repository be located in a setting where the ground water travel time between the boundary of the underground facility and the accessible environment is at least 1000 years. We would like the NRC staff to explain the basis for the establishment of this figure.

60.122 Requirements for the Geologic Setting

<u>60.122(a)(1)</u>

This section identifies conditions within the "geologic setting" that contribute to waste isolation. It is extremely unclear as to how large an area might be included in the "geologic setting". A condition that is suppose to contribute to isolation is a low population density in the "geologic setting." Low population density may be desirable for a certain distance around a repository but the population density itself will not actually contribute to isolation. By definition the "geologic setting" is one of the three elements that constitutes the "geologic repository." If this implies, thereby, that this "geologic setting" is actually an exclusion zone, then the population may well be zero.

The term "mineral assemblages" is an important consideration in the repository's performance. It needs to be defined. It is also not clear whether the Department will have to show that the retardation for every nuclide will be increased by these assemblages.

Within this section it is stated that a condition that may contribute to waste isolation is the emplacement of the waste a minimum depth of 300 meters below the surface. We would appreciate understanding the technical rationale used to establish the number.

60.122(b)(2)

The term "disturbed zone" is defined for a second time in this section. In fact the term has three different definitions in this rule which are not necessarily consistent. Per the definition in this section, the disturbed zone passes through the accessible environment and thereby eliminates the possibility for a 1000 year ground water travel time between the two. It would be better if there was only one definition for the "disturbed zone" that was compatible with other requirements already identified.

This section identifies conditions in the disturbed zone that might adversely affect waste isolation. In that context we are not certain how to interpret item (xi) regarding earthquakes. This requires that the frequency and magnitude of earthquakes in the disturbed zone be less than in the geologic setting. Since the geologic setting completely surrounds the disturbed zone it is not clear that a differentiation can be made.

60.122(c)(2)(xix)

In this section attention needs to be given to the definition of the term "stability" as it relates to underground openings. The use of "stability" in this context does not appear to be consistent with the definition in 60.2. This requirement could be interpreted to rule out rocks that are subject to creep under lithostatic pressure. It could be interpreted to imply that the structure not require supports. This appears to be in conflict with 60.123(c)(5)(i) which outlines the structural supports required for stability.

60.122(b)(5)(iv)

The concept of requiring exploratory boreholes to be colocated with shafts for the facility appears to be a valid method of reducing the number of boreholes that must be plugged. However, this assumption is valid only if one assumes that the borehole and shaft are coincident over their entire length. This may not be the case since small diameter boreholes can often deviate laterally more than $1/4^{o}$ and could, at some point, extend beyond the confines of the shaft. If this occurred it would be difficult to determine and could result in a length of borehole remaining unplugged. For safety reasons, therefore, drill holes might better be plugged and certified independently of any shaft construction. It is also not clear how this requirement would affect the use of angled holes which the NRC staff believes are important to collect data on vertical permeability in fractured rock.

60.122(d)(2)

A requirement is established to evaluate undiscovered mineral deposits at the site. In view of the level of characterization required under this rule, we believe that if resources are not found they should be assumed not to be there.

60.122(d)(3)

This section attempts to define the information to be obtained during sub-surface exploration. This discussion is particularly vague and confusing. For example, it requires that the bulk geomechanical properties be provided for the geologic media. While the term "geomechanical properties" connotes a level of specificity, it does not denote which mechanical properties are desired. It is important for them to be defined since several geomechanical properties will be impossible to obtain for the "bulk" material. The same point holds true for the terms "bulk hydrological properties" and "bulk geochemical conditions." Parameters of pore pressure and ambient stress, which are cited as examples, are not bulk geomechanical properties but physical conditions found at the specific site.

The requirement "to determine the response of the bulk geomechanical, hydro-geological and geochemical systems to the anticipated thermal loading, given the pattern of fractures and other discontinuities..." may well be impossible to accomplish due to the shear magnitude (size) of the rock mass involved. A firm conclusion on this cannot be drawn at this time because of the general lack of specificity as to the information wanted.

60.132 Requirements for Design and Construction

60.132(a)(1)

We are not sure how to interpret the requirement that containment and iso-lation within the waste package and the underground facility be based on independent chemical and physical principles. For example, containment within a waste package will be enhanced by sorption and sorption will be a mechanism to retard travel through the underground facility. In each case the material doing the sorbing will be different but the principle will not. Would this situation fail to satisfy the NRC requirement?

60.132(a)(5)(ii)

The requirement to utilize noncombustible materials in the repository would appear to prohibit the use of wood for structural support. Is this intended? If so, why?

60.132(a)(8)

The waste package is a system important to safety. After it is emplaced in a hole in the repository, is it the intent that it be removed for periodic inspection, testing and maintenance? If not, this section should be modified to recognize the passive nature of a repository and that some safety related systems, once in place will not be inspected, tested, or maintained.

<u>60.132(c)</u>

This section requires compliance with the performance objective outlined in section 60.111(b). This requires that the underground facility control the release of each radionuclide to less than 1 part in 10^5 annually of the amount that is present in any given year following 1000 years after decommissioning. This would imply that as the quantity of any individual isotope approaches zero due to radioactive decay that almost zero release from the underground facility would be required. Why would this be an essential requirement to protect public health and safety?

It is not clear why the release rate definition was changed to be referenced against the quantity of each radionuclide. We believe that the release rate referenced against the total inventory, as specified in the May 1980 version of the technical criteria, would be appropriate rather than the current draft.

<u>60.132(c)(5)(i)</u>

The use of the term "operation period" is unclear. Does this period include the 50 years after completion of emplacement plus the time necessary to effect retrieval?

<u>60.132(c)(6)</u>

The requirement that the design of the underground facility <u>shall</u> be based on the excavation method that would limit damage to the rock is overly restrictive. Obviously it should be a consideration but not necessarily the basis for the design.

<u>60.132(c)(7)</u>

It is not clear why the system to control the flow of gas or water into the underground facility should be capable of doing analytical chemistry on water and gas samples. The reason for this requirement should be provided.

<u>60.132(c)(9)</u>

Subsection (iii) and (vii) appear to be redundant.

<u>60.132(d)</u>

This section requires that boreholes and shafts be "sealed" over their entire length. The term "sealed" is not defined although there is a requirement placed on the materials to be used. It would be more appropriate to place a requirement on the performance of the total seal system as opposed to its individual components.

60.133 Requirements for the Waste Package and its Components

60.133(a)

The Department has reviewed the logic developed by NRC that established the requirement that a waste package provide containment for 1000 years. While the Department understands the logic behind the concept, we are not sure how demonstration of compliance with the performance objective can be met as specified in this section. We believe that there is high probability that the objective can be met, but we are not sure at this time that short term testing can be confidently extrapolated for the required time frame to the degree necessary to satisfy the demonstration of compliance required. Based on our current understanding of measurement science, performance evaluation, and long-term predictive capability, this may require significant advances in each of these areas. We believe that a thorough review of the basis for NRC acceptance of demonstration of compliance needs to be undertaken before this requirement is approved.

60.133(c)

There appears to be a major inconsistency in the waste package definition in this section and in the definition in 60.2. In 60.2 it requires that the package be bounded by a hermetically sealed canister. That requirement is not reflected or even referenced in this section. We believe that the requirements as specified in this section are adequate and the need for a boundary that is hermetically sealed is not necessary.

60.137 Performance Validation

60.137(b)(1)

The term "validation" is used very freely in this section. There is a specific requirement that the Commission be notified if "validation" is not achieved in various technical areas. In view of this requirement, validation should be defined in order to establish the baseline for appropriate action.

60.137(c)

This section requires an in-situ testing program to evaluate various components of the repository. The Department is prepared to conduct such testing programs. However, we would like to know which data the Commission believes important to make a decision concerning the safety of the repository.

ENCLOSURE A

Supplementary Information and draft Technical Criteria

NUCLEAR REGULATORY COMMISSION

10 CFR Part 60 Subparts E, F, G, H

DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN GEOLOGIC
REPOSITORIES: TECHNICAL CRITERIA

AGENCY: Nuclear Regulatory Commission.

ACTION: Proposed Rule.

SUMMARY: The NRC is publishing proposed amendments which specify technical criteria for disposal of high-level radioactive wastes (HLW) in geologic repositories. The proposed criteria address siting, design, and performance of a geologic repository, and the design and performance of the package which contains the waste within the geologic repository. Also included are criteria for monitoring and testing programs, performance confirmation, quality assurance, and personnel training and certification.

150 days split

DATE: Comments received after [~~90~~ days after publication] will be considered if it is practical to do so, but assurance of consideration cannot be given except for comments received on or before this date.

ADDRESS: Written comments or suggestions on the proposed amendments should be sent to the Secretary of the Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch. Copies of comments may be examined in the U.S. Nuclear Regulatory Commission Public Document Room, 1717 H Street NW., Washington, D.C.

FOR FURTHER INFORMATION CONTACT: Frank J. Arsenault, Director of the Division of Health, Siting and Waste Management, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Telephone (301) 427-4350.

SUPPLEMENTARY INFORMATION:

Background

On December 6, 1979 the Nuclear Regulatory Commission (Commission or NRC) published for comment proposed procedures for licensing geologic disposal of high-level radioactive wastes. The licensing procedures were published in final form on February 25, 1981 (46 FR 13971). On May 13, 1980 (45 FR 31393) the Commission published for comment an Advance Notice of Proposed Rulemaking (ANPR) concerning technical criteria for regulating disposal of high-level radioactive wastes (HLW) in geologic repositories. Included with the advance notice was a draft of the technical criteria under development by the staff. The public was asked to provide comment on several issues discussed in the advance notice and to reflect on the draft technical criteria in light of that discussion. The comments received were numerous and covered the full range of issues related to the technical criteria. The technical criteria being proposed here reflect some changes from the ANPR made in consideration of those comments. The Commission has prepared an analysis of the comments which explains the changes made from the ANPR, and intends to publish soon the comments and the analysis as a NUREG document. A draft of this NUREG has been placed in the Commission's Public Document Room for review. In addition, the staff has begun a program to develop guidance as to the methods that it regards as satisfactory for demonstrating compliance with the requirements of the proposed rule.

The technical criteria being set forth here as proposed rulemaking are a result of the Commission's further effort in regulating geologic disposal of HLW by the Department of Energy (DOE). The rationale for the performance objectives and Environmental Impact Assessment supporting this rulemaking are also available in the Commission's Public Document Room. In developing these criteria we have not reexamined DOE's programmatic choice of disposal technology resulting from its Generic Environmental Impact Statement, inasmuch as the Commission has expressly reserved until a later time possible consideration of matters within the scope of that generic statement (44 FR 70408). Accordingly, the technical criteria apply only to disposal in geologic repositories and do not address other possible or potential disposal methods. Similarly, in that DOE's current plans call for disposal at sufficient depth to be in the area termed the saturated zone, these criteria were developed for disposal in saturated media. Additional or alternative criteria may need to be developed for regulating disposal in the nonsaturated or "vadose zone".

Authority

Sections 202(3) and (4) of the Energy Reorganization Act of 1974, as amended, provide the Commission with licensing and regulatory authority regarding DOE facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed under the Atomic Energy Act and certain other long-term HLW storage facilities of the DOE. Pursuant to that authority, the Commission is developing criteria appropriate to regulating geologic disposal of HLW by the DOE. The requirements and criteria contained in this proposed rule are a result of that effort.

Relation to Generally Applicable Standards for Radiation in the Environment Established by the Environmental Protection Agency

The Environmental Protection Agency (EPA) has the authority and responsibility for setting generally applicable standards for radiation in the environment. It is the responsibility of the NRC to implement those standards in its licensing actions and assure that the public health and safety are protected. Although no EPA standard for disposal of HLW yet exists, these proposed technical criteria for regulating geologic disposal of HLW have been developed to be compatible with a generally applicable environmental standard. Specifically, the performance objectives and criteria speak to the functional elements of geologic disposal of HLW and the analyses required to give confidence that these functional elements will perform as intended.

Disruptive Processes and Events

The NRC's implementing regulations assume that licensing decisions will be based, in part, on the results of analysis of the consequences of processes and events which potentially could disrupt a repository. Thus, throughout the criteria are requirements that the design basis take into account processes and events with the potential to disrupt a geologic repository. If the process or event is anticipated, i.e., likely, then the design basis requires barriers which would not fail in ~~any~~ a way that would result in the repository's not meeting ~~its~~ the performance objectives. If the process or event is unlikely, then the overall system must still limit the release of radionuclides.

Multiple Barriers

The proposed technical criteria were developed not only with the understanding that EPA's generally applicable environmental standard

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would need to be implemented, at least in part, by performing calculations to predict performance, but also with the knowledge that some of those calculations would be complex and uncertain. Natural systems are difficult to characterize and any understanding of the site will have significant limitations and uncertainties. Those properties which pertain to isolation of HLW are difficult to measure and the measurements which are made will be subject to several sources of error and uncertainty. The physical and chemical processes which isolate the wastes are themselves varied and complex. Further, those processes are especially difficult to understand in the area close to the emplaced wastes because that area is physically and chemically disturbed by the heat generated by those wastes.

However, a geologic repository consists of engineered features as well as the natural geologic environment. Any evaluation of repository performance, therefore, will consider the waste form and other engineering which is elemental to the repository as a system. By partitioning of the engineered system into two major barriers, the waste package and the underground facility, and establishing performance objectives for each, the Commission has sought to exploit the ability to design the engineered features to meet specific performance objectives as a means of reducing some of the uncertainties in the calculations of overall repository performance.

In addition, the requirements for containment, controlled release rate, and 1000-year groundwater transit time are three criteria which act independently of the overall repository performance to provide confidence that the wastes will be isolated at least for as long as they are most hazardous.

Containment and Isolation

During the first several hundred years following emplacement of the wastes, both the radioactivity of and the heat generated by the wastes are attributable mainly to the decay of the short-lived nuclides, primarily fission products. At about one thousand years after emplacement both the radioactivity and heat generated have diminished by about three orders of magnitude. As the decay of the long-lived isotopes, primarily actinides, begins to dominate, both the radioactivity and thermal output of the wastes continue to fall until almost one hundred thousand to one million years after emplacement. By that time both have diminished by about 5 orders of magnitude and both heat and radioactivity become roughly constant due to the ingrowth of daughter isotopes, primarily Ra 225, Ra 226 and their daughters.

The technical criteria would require the engineered system to be designed so that the wastes are contained within the waste package for the first thousand years following emplacement. Following this period, containment is no longer assumed and the function of the waste package and underground facility is to control the release of radionuclides from the underground facility. By requiring containment during the period when the thermal conditions around the waste packages are most severe, evaluation of repository performance is greatly simplified to considerations of the degree of conservatism in the containment design relative to events and processes that might affect the performance during the containment period.

Although both the radioactivity of and heat generated by the decay of the wastes have diminished about 3 orders of magnitude during the containment period, the area surrounding the emplaced wastes will not return to temperatures near those before the wastes were emplaced until after about 10^4 years. As mentioned earlier, the thermal disturbance of the area near the emplaced wastes adds significantly to the uncertainties in the calculation of the transport of the radioisotopes through the geologic environment. The technical criteria are intended to compensate for uncertainties by imposing further design requirements on the waste package and underground facility, thereby limiting the source term by controlling the release rate.

Role of the Site

The Commission neither intends nor expects either containment to be lost completely at 1,000 years following emplacement or the engineered system's contribution to the control of the release of wastes to cease abruptly at some later time. However, the Commission recognizes that at some point the design capabilities of the engineered system will be lost and that the geologic setting--the site--must provide the isolation of the wastes from the environment, and has translated this requirement into a performance objective for the geologic setting. The Commission also recognizes that isolation is, in fact, a controlled release to the environment which could span ~~hundreds of~~ many thousands of years, and that the release of radioisotopes, and the potential exposures to individuals which could result, should be addressed in the evaluation of a repository. A complement to the evaluation of the effects of design basis processes and events which might disrupt the repository is a projection of how the repository, unperturbed by discrete external events, will evolve through the centuries as a result of the geologic processes operating at the site. Hence, an amendment is being proposed to that portion of Subpart B of 10 CFR Part 60 which describes the contents of the Safety Analysis Report of DOE's application for geologic disposal of HLW which would require DOE to (1) project the expected performance of the proposed geologic repository noting the rates and quantities of expected releases of radioisotopes to the accessible environments as a function of time, and (2) estimate likely maximum individual doses to humans which could result from those releases.

Retrievability

The licensing procedures of 10 CFR Part 60 were written assuming that there would be a program of testing and measurement of the thermal, mechanical, and chemical properties of the major engineered barriers to confirm their expected performance. The Commission would like to tie the requirement for retrievability of the wastes to the expected time needed to execute the performance confirmation program. However, at present it appears to the Commission that neither the specific nature nor the period needed for execution of the performance confirmation program will be certain until construction of the repository is substantially complete; that is, until the actual licensing to receive wastes at a geologic repository. Hence it is difficult at this time to use the performance confirmation program as a basis for establishing a period of retrievability. Nonetheless, the DOE is now making critical decisions regarding the design of geologic repositories which will have a direct effect upon how long the option to retrieve wastes can be maintained, and upon the difficulty which will be encountered in exercising that option, should that be necessary for protection of the public health and safety. Therefore, as a practical matter, the proposed rule sets forth a requirement that the engineered system be designed so that the option to retrieve the waste can be preserved for up to fifty years following completion of emplacement. Thus, the waste package and the underground facility would be designed so that their natural degradation would not be the determinant of when the Commission would decide whether to permit closure of the repository. Rather, the Commission would be assured of the option to let the conduct cf the performance confirmation program indicate when it is appropriate to make such a decision. In particular, the Commission is concerned that the thermo-mechanical design of the underground facility be such that the openings can be maintained until the Commission either decides to permanently close the repository or to take corrective action, which may include retrieval. The Commission does not want to approve construction of a design which will foreclose options for future decisionmakers.

The retrievability requirement does not specify the form in which the wastes are to be retrievable or that wastes by "readily retrievable." The requirement is simply that all the wastes be retrievable during a period equal to the period of construction and emplacement. The DOE's plans for retrieval are specifically requested as part of its license application and the practicability of its proposal will be considered by the staff.

Human Intrusion

Some concern has been raised on the issue of human intrusion into a geologic repository. Human intrusion could conceivably occur either inadvertently or deliberately. Inadvertent intrusion is the accidental breaching of the repository in the course of some activity unrelated to the existence of the repository, e.g., exploration for or development of resources. For inadvertent intrusion to occur, the institutional controls, site markers, public records, and societal memory of the repository's existence must have been ineffective or have ceased to exist. Deliberate or intentional intrusion, on the other hand, assumes a conscious decision to breach the repository; for example, in order to recover the high-level waste itself, or exploit a mineral associated with the site.

Historical evidence indicates that there is substantial continuity of information transfer over time. There are numerous examples of knowledge, including complex information, being preserved for thousands of years. This has occurred even in the absence of printing and modern information transfer and storage systems. Furthermore, this information transfer has survived disruptive events, such as wars, natural disasters, and dramatic changes in the social and political fabric of societies. The combination of the historical record of information transfer, provisions for a well-marked and extensively documented site location, and the scale and technology of the operation needed to drill deeply enough to penetrate a geologic repository argue strongly that inadvertent intrusion as described above is highly improbable, at least for the first several hundred years during which the wastes are most hazardous. Selecting a site for a repository which is unattractive with respect to both resource value and scientific interest further adds to the improbability of inadvertent human intrusion. It is also logical to assume that any future generation possessing the technical capability to locate and explore for resources at the depth of a repository would also possess the capability to assess the nature of the material discovered, to mitigate consequences of the breach and to reestablish administrative control over the area if needed. Finally, it is inconsistent to assume the scientific and technical capability to identify and explore an anomalous heat source several hundred meters beneath the earth's surface and not assume that those exploring would have some idea of either what might be the cause of the anomaly or what steps to take to mitigate any untoward consequence of that exploration.

The above arguments do not apply to the case of deliberate intrusion. The repository itself could be attractive and invite intrusion simply because of the resource potential of the wastes themselves. Intrusion to recover the wastes demands (1) knowledge of the existence and nature of the repository, and (2) effort of the same magnitude as that undertaken to emplace the wastes. Hence intrusion of this sort can only be the result of a conscious, collective societal decision to recover the wastes.

In light of the above, the proposed technical criteria are written to direct site selection towards selection of sites of little resource value. Further, the proposed criteria would require reliable documentation of the existence and location of the repository and the nature of the wastes emplaced therein.

Intrusion for the purpose of sabotage or terrorism has also been mentioned as a possibility. However, due to the nature of geologic disposal, there seems to be very little possibility that terrorists or saboteurs could breach a repository. Breach of the repository would require extensive use of machinery for drilling and excavating over a considerable period of time. It is highly improbable that a terrorist group could accomplish this covertly.

Major Features of the Proposed Rule

1. Overall Description

The proposed technical criteria have been written to address the following: performance objectives and requirements for siting, design and construction of the repository, the waste package, confirmation of repository performance, quality assurance, and the training and certification of personnel. As appropriate, these topics are divided in turn to address separately requirements which apply during construction, waste emplacement, and after closure of the repository-the latter termed decommissioning. Although the licensing procedures indicate that there would be separate subparts for siting and design requirements, viz. Subparts E and F, respectively (cf. §60.31(a)(2)), the NRC now believes that the site and design are so interdependent that such a distinction is artificial and misleading. For example, although the requirement to place the underground facility at a minimum depth of 300 meters is clearly a design requirement, it is manifested as a siting requirement since unless the site has a host rock of sufficient thickness at sufficient depth, the above design requirement cannot be met. Hence the proposed subpart E to 10 CFR Part 60 contains both site and design requirements.

To enable the Commission to reach a finding as to whether the generally applicable environmental standard for disposal of HLW is met and that the public health and safety will be protected, a careful and exhaustive analyses of all the features of the repository will be needed. That analysis necessarily must be both qualitative and quantitative. The analyses performed can and will be largely quantitative during the period that greatest reliance can be placed upon the engineered system, up to about 10,000 years after closure. Thereafter, although the issues of concern, and certainly the physics of a repository itself, do not change, the numerical uncertainties begin to become so large that calculations become more indicative of expected repository behavior rather than definitive of actual performance. Hence, such calculations will be supplemented more heavily by qualitative descriptions, arguments, and analogs to achieve confidence in the success of a repository.

In sum, the technical criteria perform two tasks. First they serve to guide DOE in siting, designing, constructing, and operating a repository in such a manner that there can be reasonable confidence that the public health and safety will be protected. Second, they serve to guide DOE in those same areas in such a manner that there can be reasonable confidence that the analyses needed to determine whether the public health and safety is protected can be performed.

2. Performance objectives

The design and operation of the repository are prescribed to be such that during the period that wastes are being emplaced and performance assessed, exposure to workers and releases of radioactivity to the environment must be within limits set by the Commission and the EPA. Further, the repository is to be designed so that the option can be preserved to retrieve the emplaced wastes beginning at anytime up to 50 years following completion of emplacement. Following permanent closure, the repository must perform so that releases are within the limits prescribed by the generally applicable environmental standard which will be set by the EPA. Further, the design of the repository must include a waste package and an underground facility, as well as the site, as barriers to radionuclide migration.

The performance of the engineered system (waste package and underground facility) following permanent closure is specified to require containment of the wastes within the waste package for at least 1,000 years following closure, when temperatures in the repository are substantially elevated, and control of the release of nuclides to the geologic environment thereafter.

Transuranic waste (TRU) may be disposed of in a geologic repository. Since transuranic waste does not generate significant amounts of heat, there is no advantage to containment for any specified period. Hence, the requirement for TRU waste is simply a controlled release equivalent to that for HLW, provided they are physically separated from the HLW so that they wl1 not experience a significant increase in temperature.

3. Siting Requirements

Although no specific site suitability or exclusion requirements are given in the criteria, stability and minimum groundwater travel times are specified as required site characteristics. In addition, the technical criteria identify site characteristics considered favorable for a repository as well as characteristics which, if present at the site, would lead to a presumption that the site is not suitable for hosting a repository. The Commission has judged that these should not be made absolute requirements because the impact of these characteristics on overall performance would be site specific. The Commission's approach requires that the combination of conditions at the selected site provide reasonable assurance that the performance objectives will be achieved. Further, if adverse conditions are identified as being present, they must be thoroughly characterized and analyzed and it must be demonstrated that the conditions are compensated for by repository design or by favorable conditions in the geologic setting.

4. Design and Construction

In addition to the requirements on designing for natural phenomena, criticality control, radiation protection, and effluent control, the proposed technical criteria require the design of the repository to accommodate potential interaction of the waste, the underground facility, and the site. Requirements are also placed upon the design of the equipment to be used for handling the wastes, the performance and purpose of the backfill material, and design and performance of borehole and shaft seals. Further, there are requirements related to the methods of construction. The Commission believes such requirements are necessary to assure that the ability of the repository to contain and isolate the wastes will not be compromised by the construction of the repository.

The proposed technical criteria would require that the subsurface facility be designed so that it could be constructed and operated in accordance with relevant Federal mining regulations, which specify design requirements for certain items of electrical and mechanical equipment and govern the use of explosives.

These criteria are a blend of general and detailed prescriptive requirements. They have been developed from Commission experience and practice in the licensing of other nuclear facilities such as power plants and fuel cycle facilities. While there are differences in the systems and components addressed by these criteria from those of power plants or fuel cycle facilities, and the criteria have been written appropriate to a geologic repository, the proposed criteria represent a common practice based on experience which has shown that the above items need to be regulated. The level of detail of these criteria reflects the Commission's current thinking on how to regulate effectively geologic disposal of HLW. However, the Commission continues to examine other possibilities for promulgating the more detailed of these requirements.

5. Waste Package

The proposed requirements for the design of the waste package emphasize its role as a key component of the overall engineered system.

Besides being required to contribute to the engineered system's meeting containment and controlled release performance objectives, both compatibility with the underground facility and the site and a method of unique identification are required of the waste package. Included in the section of the proposed technical criteria which deals with the waste package are requirements that the waste form itself contained within the package be consolidated and non-pyrophoric.

6. Performance Confirmation

The proposed technical criteria include requirements for a program of testing and measurement. The main purpose of this program is to confirm the assumptions, data, and analyses which led to the findings that permitted construction of the repository and subsequent emplacement of the wastes. Further, the performance confirmation program includes requirements for monitoring of key geologic and hydrologic parameters throughout site characterization, construction, and emplacement to detect any significant changes in the conditions which supported the above findings during, or due to operations at the site. Also included in the program would be tests of the effectiveness of borehole and shaft seals and of backfill placement procedures.

REGULATORY FLEXIBILITY CERTIFICATION: In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. This proposed rule affects only the Department of Energy, and does not fall within the purview of the Act.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, the National Environmental Policy Act of 1969, as amended, and sections 552 and 553 of title 5 of the United States Code, notice is hereby given that adoption of the following amendments to Title 10, Chapter I, Code of Federal Regulations is contemplated.

1. The authority citation for Part 60 reads as follows:

Authority: Secs. 51, 53, 62, 63, 65, 81, 161b., f., i., o., p., 182, 183, Pub. L. 83-703, as amended, 68 Stat. 929, 930, 932, 933, 935, 948, 953, 954, as amended (42 U.S.C. 2071, 2073, 2092, 2093, 2095, 2111, 2201, 2232, 2233); Secs. 202, 206, Pub. L. 93-438, 88 Stat. 1244, 1246 (42 U.S.C. 5842, 5846); Sec. 14, Pub. L. 95-601 (42 U.S.C. 2021a); Sec. 102(2)(c), Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332).

2. Section 60.2 is amended to read as follows:*

§60.2 Definitions

For the purposes of this Part--

<u>"Accessible Environment" means those portions of the environment directly in contact with or readily available for use by human beings.</u> [~~It includes the earth's atmosphere, the land surface, surface waters, and the oceans. It also includes presently used potable aquifers and those which have been designated as underground sources of drinking water by the Environmental Protection Agency.~~]

*Comparative text in which deletions are struck through and additions are underscored has been used for the proposed amendments to Section 60.2, 60.10, 60.21, and 60.51. This is done for the Commission's convenience and comparative text will not be used in the Federal Register Notice.

"Anticipated Processes and Events" means those natural processes and events that are reasonably likely to occur during the period the intended performance objective must be achieved and from which the design bases for the engineered system are derived.

"Barrier" means any material or structure that prevents or substantially delays movement of water or radionuclides.

"Candidate area" means a geologic and hydrologic system within which a geologic repository may be located.

"Commencement of construction" means clearing of land, surface or subsurface excavation, or other substantial action that would adversely affect the environment of a site, but does not include changes desirable for the temporary use of the land for public recreational uses, site characterization activities, other preconstruction monitoring and investigation necessary to establish background information related to the suitability of a site or to the protection of environmental values, or procurement or manufacture of components of the geologic repository operations area.

"Commission" means the Nuclear Regulatory Commission or its duly authorized representatives.

"Containment" means the act of keeping radioactive waste within a designated boundary.

"Decommissioning," or "permanent closure," means final backfilling of subsurface facilities, sealing of shafts, and decontamination and dismantlement of surface facilities.

"Disposal" means the isolation of radioactive wastes from the biosphere.

"Disturbed zone" means that portion of the geologic setting that is significantly affected by construction of the subsurface facility or by the heat generated by the emplacement of radioactive waste.

"Director" means the Director of the Nuclear Regulatory Commission's Office of Nuclear Material Safety and Safeguards.

"DOE" means the U.S. Department of Energy or its duly authorized representatives.

"Engineered system" means the waste packages and the underground facility.

"Far field" means the portion of the geologic setting that lies beyond the disturbed zone.

"Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands and including at a minimum that area subject to a one percent or greater chance of flooding in any given year.

"Geologic repository" means a system [~~which is intended to be used for, or may be used~~] for the disposal of radioactive wastes in excavated geologic [~~formations~~] media. A geologic repository includes (1) the geologic repository operations area, and (2) the geologic setting.

"Geologic repository operations area" means an HLW facility that is part of a geologic repository, including both surface and subsurface areas, where waste handling activities are conducted.

"Geologic setting" or "site" is the spatially distributed geologic, hydrologic, and geochemical systems that provide isolation of the radioactive waste.

"High-level radioactive waste" or "HLW" means (1) irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted.

"HLW facility" means a facility subject to the licensing and related regulatory authority of the Commission pursuant to Sections 202(3) and 202(4) of the Energy Reorganization Act of 1974 (88 Stat 1244).*

"Host rock" means the geologic medium in which the waste is emplaced.

"Hydrogeologic unit" means any soil or rock unit or subsurface zone that has a distinct influence on the storage or movement of ground water by virtue of its porosity or permeability.

"Important to safety," with reference to structures, systems, and components, means those structures, systems, and components that provide reasonable assurance that radioactive waste can be received, handled, and stored without undue risk to the health and safety of the public.

"Indian Tribe" means an Indian tribe as defined in the Indian Self-Determination and Education Assistance Act (Public Law 93-638).

"Isolation" means inhibiting the transport of radioactive material so that amounts and concentrations of such material entering the accessible environment will be kept within prescribed limits.

*These are DOE "facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed under such act (the Atomic Energy Act)" and "Retrievable Surface Storage Facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive wastes generated by (DOE), which are not used for, or are part of, research and development activities."

"Medium" or "geologic medium" is a body of rock characterized by lithologic homogeneity.

"Overpack" means any buffer material, receptacle, wrapper, box or other structure, that is both within and an integral part of a waste package. It encloses and protects the waste form so as to meet the performance objectives.

"Public Document Room" means the place at 1717 H Street NW., Washington, D.C., at which records of the Commission will ordinarily be made available for public inspection and any other place, the location of which has been published in the FEDERAL REGISTER, at which public records of the Commission pertaining to a particular geologic repository are made available for public inspection.

"Radioactive waste" or "waste" means HLW and any other radioactive materials other than HLW that are received for emplacement in a geologic repository.

"Site" means the geologic setting.

"Site characterization" means the program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a parameters of a particular site relevant to the procedures under this part. Site characterization includes a program of borings, surface excavations and borings, and in situ testing at depth needed to determine the suitability of the site for a geologic repository, but does not include preliminary borings and geophysical testing needed to decide whether site characterization should be undertaken.

"Stability" means that the nature and rates of natural processes such as erosion and faulting have been and are projected to be such that their effects will not jeopardize isolation of the radioactive waste.

"Subsurface facility" means the underground portions of the geologic repository operations area including openings, backfill materials, shafts and boreholes as well as shaft and borehole seals.

"Transuranic wastes" or TRU wastes" means radioactive waste containing alpha emitting transuranic elements, with radioactive half-lives greater than five [one] years, in excess of 10 nanocuries per gram.

"Tribal organization" means a Tribal organzation as defined in the Indian Self-Determination and Education Assistance Act (Public Law 93-638).

"Underground facility" means the underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals.

"Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

"Waste form" means the radioactive waste materials and any encapsulating or stabilizing materials, exclusive of containers.

"Waste package" means the airtight, watertight, sealed container which includes the waste form and any ancillary enclosures, including shielding, discrete backfill and overpacks.

3. Section 60.10 is amended by adding paragraph (d) to read as follows:

§60.10 Site characterization.

(a) Prior to submittal of an application for a license to be issued under this part the DOE shall conduct a program of site characterization with respect to the site to be described in such application.

(b) Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced.

(c) As provided in §51.40 of this chapter, DOE is also required to conduct a program of site characterization, including in situ testing at depth, with respect to alternative sites.

<u>(d) The program of site characterization shall be conducted in accordance with the following</u>:

<u>(i) Investigations to obtain the required information shall be conducted to limit adverse effects on the long-term performance of the geologic repository to the extent practicable.</u>

<u>(ii) As a minimum the location of exploratory boreholes and shafts shall be selected so as to limit the total number of subsurface penetrations above and around the underground facility.</u>

<u>(iii) To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for repository construction and operation or where large unexcavated pillars are planned.</u>

<u>(iv) Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with repository design and construction.</u>

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4. Paragraph (c)(1) of §60.21 is amended to read as follows:

§60.21 Content of Application.

* * * * *

(c) The Safety Analysis Report shall include:

(1) A description and [analysis] assessment of the site at which the proposed geologic repository operations area is to be located with appropriate attention to those features of the site that might affect facility design and performance. The description of the site shall identify the limits of the accessible environment with respect to the location of the geologic repository operations area.

(i) The description of the site shall also include the following information regarding subsurface conditions in the vicinity of the proposed underground facility--

(A) The orientation, distribution, aperture in-filling and origin of fractures, discontinuities, and heterogeneities;

(B) The presence and characteristics of other potential pathways such as solution features, breccia pipes, or other permeable anomalies;

(C) The bulk geomechanical properties and conditions, including pore pressure and ambient stress conditions;

(D) The bulk hydrogeologic properties and conditions;

(E) The bulk geochemical properties; and

(F) The anticipated response characteristics of the bulk geomechanical, hydrogeologic, and geochemical systems to the maximum design thermal loading, given the pattern of fractures and other discontinuities and the heat transfer properties of the rock mass and groundwater.

(ii) The assessment shall contain--

(A) An analysis of the geology, geophysics, hydrogeology, geochemistry, and meteorology of the site;

(B) [~~Realistic~~] Analyses [~~using conservative assumptions~~] to determine the degree to which each of the favorable and adverse conditions, if present, has been characterized, and the extent to which it contributes to isolation.

(C) [~~A projection~~] An evaluation of the expected performance of the proposed geologic repository noting the rates and quantities of expected releases of radioisotopes to the accessible environment as a functon of time, and estimates of the likely maximum individual doses which could result from those releases. In executing this evaluation DOE shall assume that those processes operating on the site are those which have been operating on it during the Quaternary Period and superpose the perturbations caused by the presence of emplaced radioactive waste on the natural processes.

(D) An analysis of the expected performance of [and] the major design structures, systems, and components, both surface and subsurface, that bear significantly on the suitability of the geologic repository for disposal of radioactive waste with respect to the anticipated processes and events and natural phenomena from which the design bases are derived. For the purposes of this analysis, [~~I~~]it [~~will~~] shall be assumed that operations at the geologic repository operations area will be carried out at the maximum capacity and rate of receipt of radioactive waste stated in the application.

(E) An explanation of measures used to confirm the models used to perform the assessments required in paragraphs (A) through (D). Analyses and models that will be used to predict future conditions and changes in the geologic setting shall be confirmed by using field tests, in situ tests, field-verified laboratory tests, monitoring data, or natural analog studies.

* * * * *

5. Paragraph (c)(3) of §60.21 is amended to read as follows:

(c) The Safety Analysis Report shall include:

* * * * *

(3) A description and analysis of the design and performance requirements for structures, systems, and components of the geologic repository which are important to safety. [~~The~~]This analysis [~~and evaluation~~] shall consider--(i) the margins of safety under normal conditions and under conditions that may result from anticipated operational occurrences, including those of natural origin; (ii) the adequacy of structures, systems, and components provided for the prevention of accidents and mitigation of the consequences of accidents, including those caused by natural phenomena; and (iii) the effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features [~~with-particular-attention-to-the-alternatives-which-would-provide longer~~] which are important to radionuclide containment and isolation.

* * * * *

6. Paragraph (c)(13) of §60.21 is amended to read as follows:

(c) The Safety Analysis Report shall include:

* * * * *

(13) An identification and evaluation of the natural resources at the site, including undiscovered deposits, the exploitation of which could affect the ability of the site to isolate radioactives wastes. Undiscovered deposits of resources characteristic of the area shall be evaluated by reasonable inference based on geological and geophysical evidence. Such evaluation of resources including undiscovered deposits, shall be conducted for the disturbed zone and for areas of similar size that are representative of and are within the geologic setting. For natural resources with current markets the resources shall be assessed, with estimates provided of both gross and net value. The estimate of net value shall take into account current development, extraction and marketing costs. For natural resources without current markets, but which would be marketable given credible projected changes in economic or technological factors, the resources shall be described by physical factors such as tonnage or other amount, grade, and quality.

*   *   *   *   *

7. Paragraph (a)(2) of §60.31 is amended to read as follows:

§60.31 Construction authorization.

*   *   *   *   *

(2) The site and design comply with the criteria contained in Subpart[s] E [and-F-of-this-part].

*   *   *   *   *

8. Paragraph (a)(2) of §60.51 is amended to read as follows:

§60.51 License amendment to decommission.

*   *   *   *   *

(a)(2) A detailed description of the measures to be employed--such as land use controls, construction of monuments, and preservation of records--to regulate or prevent activities that could impair the long-term isolation of emplaced waste within the geologic repository and to assure that relevant information will be preserved for the use of future generations. <u>As a minimum, such measures shall include</u> --

<u>(i) Identification of the geologic repository operations area by monuments that have been designed, fabricated, and emplaced to be as permanent as is practicable; and</u>

<u>(ii) Placement of records of the location of the geologic repository operations area and the nature and hazard of the waste in the archives of local and Federal government agencies, and archives elsewhere in the world, that would be likely to be consulted by potential human intruders.</u>

9. New Subpart E, "Technical Criteria," Subpart F "Performance Confirmation," Subpart G, "Quality Assurance" and Subpart H, "Training and Certification of Personnel" are added to 10 CFR Part 60.*

SUBPART E--DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN GEOLOGIC REPOSITORIES: TECHNICAL CRITERIA

§60.101 Scope.

(a) This subpart states the performance objectives to be achieved and the technical criteria to be met by the DOE in order for the Commission to make the findings called for in Subpart B of this part.

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*Comparative text is neither needed nor used for Subparts E, F, G, or H, because they are composed entirely of new material.

(b) The Commission will apply the technical criteria in this subpart in making findings that the activities authorized by a license, or any amendment thereof, will not constitute undue risk to the health and safety of the public.

(c) The Commission will also apply the technical criteria in this subpart in making determinations with respect to the issuance of a construction authorization.

(d) Omissions in this subpart do not relieve DOE from the requirement of providing necessary safety features in the design of a specific facility.

§60.102 Concepts.

(a) The HLW facility.

NRC exercises licensing and related regulatory authority over those facilities described in section 202(3) and (4) of the Energy Reorganization Act of 1974. Any of these facilities is designated an HLW facility.

(b) The geologic repository operations area.

(1) This part deals with the exercise of authority with respect to a particular class of HLW facility -- namely a geologic repository operations area.

(2) A geologic repository operations area consists of those surface and subsurface areas that are part of a geologic repository where radioactive waste handling activities are conducted. The underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals is designated the underground facility.

[~~(c)--Function-of-the-geologic-repository-operations-area:~~]

[~~(1)~~] (3) The exercise of Commission authority requires that the geologic repository operations area be used for storage (which includes disposal) of high-level radioactive wastes (HLW).

[~~(2)~~] (4) HLW includes irradiated reactor fuel as well as reprocessing wastes. However, if DOE proposes to use the geologic repository operations area for storage of radioactive waste other than HLW, the storage of this radioactive waste is subject to the requirements of this part. Thus, the storage of transuranic-contaminated waste (TRU), though not itself a form of HLW, must conform to the requirements of this part if it is stored in a geologic repository operations area.

[~~(d)~~] (c) Areas adjacent to the geologic repository operations area.

Although the activities subject to regulation under this part are those to be carried out at the geologic repository operations area, the licensing process also considers characteristics of adjacent areas. First, there is to be an area, within which DOE is to exercise specified controls to prevent adverse human actions. Second, there is a larger area, designated the geologic setting or site which includes the spatially distributed geologic, hydrologic, and geochemical systems that provide isolation of the radioactive waste from the accessible environment. The geologic repository operations area plus the geologic setting make up the geologic repository. Within the geologic setting, particular attention must be given to the characteristics of the host rock as well as any rock units surrounding the host rock.

[~~(e)~~] (d) Stages in the licensing process.

The licensing process takes into account activities and processes that may occur over a long span of time. The site characterization stage, though begun before submission of a license application, may result in consequences requiring evaluation in the license review. The construction stage would follow, after issuance of a construction authorization. A period of operations follows the issuance of a license by the Commission. The period of operations includes the time during which emplacement of wastes occurs; and any subsequent period prior to permanent closure during which the emplaced wastes are retrievable; and permanent closure, which includes final backfilling of subsurface facilities, sealing of shafts, decontaminating and dismantling of surface facilities. Permanent closure represents the end of active human activities with the geologic repository operations area and engineered systems. If specified conditions are met, the license may thereafter be terminated. Decisions in the licensing process take future events and processes into account.

[(f)] (e) Containment.

Early during the repository life, when radiation and thermal levels are high and the consequences of events are especially difficult to predict rigorously, then special emphasis is placed upon the ability to contain the wastes by waste packages within an engineered system. This is known as the containment period. The engineered system includes the waste packages as well as the underground facility. A waste package includes:

(1) The waste form which consists of the radioactive waste materials and any associated encapsulating or stabilizing materials.

(2) The container which is the first major sealed enclosure that holds the waste form.

(3) Overpacks which consist of any buffer material, receptacle, wrapper, box or other structure, that is both within and an integral part of a waste package. It encloses and protects the waste form so as to meet the performance objectives.

[~~(g)~~] (f) Isolation.

Following the containment period special emphasis is placed upon the ability to achieve isolation of the wastes by virtue of the characteristics of the geologic repository. Isolation means the act of inhibiting the transport of radioactive material to the accessible environment in amounts and concentrations within [~~specified~~] prescribed limits. The accessible environment means those portions of the environment directly in contact with or readily available for use by human beings. [~~It-includes the-earth's-atmosphere;-the-land-surface;-surface-waters;-and-the-oceans. It-also-includes-presently-used-potable-aquifers-and-those-which-have-been designated-as-underground-sources-of-drinking-water-by-the-Environmental Protection-Agency.~~]

§60.111 Performance objectives.

(a) Performance of the geologic repository operations area through permanent closure.

(1) Protection against radiation exposures and releases of [~~radiological~~] radioactive material. The geologic repository operations area shall be designec so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in Part 20 of this Chapter and any generally applicable environmental standards established by the Environmental Protection Agency.

(2) Retrievability of waste. The geologic repository operations area shall be designed so that the entire inventory of waste could be

retrieved on a reasonable schedule, starting at any time up to 50 years after waste emplacement operations are complete. A reasonable schedule for retrieval is one that requires no longer than about the same overall period of time than was devoted to the construction of the geologic repository operations area and the emplacement of wastes.

(b) Performance of the geologic repository after permanent closure.

(1) Overall system performance. The geologic setting shall be selected and the subsurface facility designed so as to assure that releases of radioactive materials from the geologic repository following permanent closure conform to such generally applicable environmental radiation protection standards as may have been established by the Environmental Protection Agency.

(2) Performance of the engineered system.

(i) Containment of wastes. The engineered system shall be designed so that even if full or partial saturation of the underground facility were to occur, and assuming anticipated processes and events, the waste packages will contain all radionuclides for the first 1,000 years after permanent closure and for as long thereafter as is reasonably achievable. This requirement does not apply to TRU waste unless TRU waste is emplaced close enough to HLW that the TRU release rate can be significantly affected by the heat generated by the HLW.

(ii) Control of releases.

(A) For HLW, the engineered system shall be designed so that, after the first 1,000 years following permanent closure, the rate of release of radionuclides from the underground facility is as low as is reasonably achievable. As a minimum, the design shall provide that, assuming anticipated processes and events, the annual release of any radionuclide does not exceed one part in 100,000 of the maximum amount of that radionuclide calculated to be present in the underground facility (assuming no release from the underground facility) at any time after 1,000 years following permanent closure.

(B) For TRU waste, the engineered system shall be designed so that following permanent closure the rate of release of radionuclides from the underground facility is as low as is reasonably achievable. As a minimum, the design shall provide that, assuming anticipated processes and events, the annual release of any radionuclide does not exceed one part in 100,000 of the maximum amount calculated to be present in the underground facility (assuming no release from the underground facility) at the time of permanent closure.

(3) Performance of the geologic setting.

(i) Containment period. During the containment period, the geologic setting shall mitigate the impacts of premature failure of the engineered system. The ability of the geologic setting to isolate wastes during the isolation period, in accordance with paragraph (b)(3)(ii) of this section, shall be deemed to satisfy this requirement.

(ii) Isolation period. Following the containment period, the geologic setting, in conjunction with the engineered system as long as that system is expected to function, and alone thereafter, shall be capable of isolating radioactive waste so that transport of radionuclides to the accessible environment shall be in amounts and concentrations that conform to such generally applicable environmental standards as may have been established by the Environmental Protection Agency and thereby will not result in significant doses to any [~~individual~~] member of the public. For the purposes of this paragraph, the evaluation of the site shall be based upon the assumption that those processes operating on the site are those which have been operating on it during the Quaternary Period, with perturbations caused by the presence of emplaced radioactive wastes superimposed thereon.

§60.112 Required characteristics of the geologic setting.

(a) The geologic setting shall have exhibited structural and tectonic stability since the start of the Quaternary Period.

(b) The geologic setting shall have exhibited hydrogeologic, geochemical, and geomorphic stability since the start of the Quaternary Period.

(c) The geologic repository shall be located so that pre-waste emplacement groundwater travel times through the far field to the accessible environment are at least 1,000 years.

§60.121 Requirements for ownership and control of the geologic repository operations area.

(a) Ownership of the geologic repository operations area.

The geologic repository operations area shall be located in and on lands that are either acquired lands under the jurisdiction and control of the DOE, or lands permanently withdrawn and reserved for its use. Such lands shall be held free and clear of all encumbrances, if significant, such as: (i) rights arising under the general mining laws; (ii) easements for right-of-way; and (iii) all other rights arising under lease, rights of entry, deed, patent, mortgage, appropriation, prescription, or otherwise.

(b) Establishment of controls.

Appropriate controls shall be established outside of the geologic repository operations area. The DOE shall exercise any jurisdiction and control over surface and subsurface estates necessary to prevent adverse human actions that could significantly reduce the site or engineered system's ability to achieve isolation. The rights of the DOE may take the form of appropriate possessory interests, servitudes, or withdrawals from location or patent under the general mining laws.

ADDITIONAL REQUIREMENTS FOR THE GEOLOGIC SETTING

§ 60.122 Favorable conditions.

Each of the following conditions may contribute to the ability of the geologic setting to meet the performance objectives relating to isolation of the waste. In addition to meeting the mandatory requirements of §60.112, a geologic setting shall exhibit an appropriate combination of these conditions so that, together with the engineered system, the favorable conditions present are sufficient to provide reasonable assurance that such performance objectives will be met.

(a) The nature and rates of tectonic processes that have occurred since the start of the Quaternary Period are such that, when projected, they would <u>not affect or would</u> favorably affect the ability of the geologic repository to isolate the waste.

(b) The nature and rates of structural processes that have occurred since the start of the Quaternary Period are such that, when projected, they would <u>not affect or would</u> favorably affect the ability of the geologic repository to isolate the waste.

(c) The nature and rates of hydrogeological processes that have occurred since the start of the Quaternary Period are such that, when projected, they would <u>not affect or would</u> favorably affect the ability of the geologic repository to isolate the waste.

(d) The nature and rates of geochemical processes that have occurred since the start of the Quaternary Period are such that, when projected, they would not affect or would favorably affect the ability of the geologic repository tc isolate the waste.

(e) The nature and rates of geomorphic processes that have occurred since the start of the Quaternary Period are such that, when projected, they would not affect or would favorably affect the ability of the geologic repository to isolate the waste.

(f) A low population density.

(g) A host rock that provides the following ground water characteristics (1) low groundwater content; (2) inhibits groundwater circulation in the host rock; (3) inhibits groundwater flow between hydrogeologic units or along shafts, drifts, and boreholes; and (4) groundwater travel times, under pre-waste emplacement conditions, between the underground facility and the accessible environment that by far exceed 1,000 years.

(h) Geochemical conditions that (1) promote precipitation or sorption of radionuclides; (2) inhibit the formation of particulates, colloids, and inorganic and organic complexes that increase the mobility of radionuclides; and (3) inhibit the transport of radionuclides by particulates, colloids, and complexes.

(i) Mineral assemblages that, when subjected to anticipated thermal loading, will remain unaltered or alter to mineral assemblages having increased capacity to inhibit [waste] radionuclide migration.

(j) Conditions that permit the emplacement of waste at a minimum depth of 300 meters from the ground surface. (The ground surface shall be deemed to be the elevation of the lowest point on the surface above the disturbed zone.)

(k) Any local condition of the disturbed zone that contributes to isolation.

§60.123 Potentially adverse conditions.

The following are potentially adverse conditions. The presence of any such conditions will give rise to a presumption that isolation of wastes in the geologic setting will not meet the performance objectives.

(a) <u>Adverse conditions in the geologic setting</u>.

(1) Potential for failure of man-made surface water impoundments that could cause flooding of the geologic repository operations area.

(2) Potential, based on existing geologic and hydrologic conditions, that construction of large-scale surface water impoundments may significantly affect the geologic repository through changes in the regional groundwater flow system.

(3) Potential for human activity to significantly affect the geologic repository through changes in the hydrogeology. This activity includes, but is not limited to groundwater withdrawal, extensive irrigation, subsurface injection of fluids, underground pumped storage facilities, underground military activity, or mining.

(4) Earthquakes which have occurred historically that if they were to be repeated could affect the geologic repository significantly.

(5) A fault in the geologic setting that has been active since the start of the Quaternary Period and which is within a distance of the disturbed zone that is less than the smallest dimension of the fault rupture surface.

(6) Potential for adverse impacts on the geologic repository resulting from the occupancy and modification of floodplains.

(7) Potential for natural phenomena such as landslides, subsidence, or volcanic activity of such a magnitude that large-scale surface water impoundments could be created that could affect the performance of the geologic repository through changes in the regional groundwater flow.

(8) Expected climatic changes that would have an adverse effect on the geologic, geochemical, or hydrologic characteristics.

(b) Adverse conditions in the disturbed zone.

For the purpose of determining the presence of the following conditions[~~,~~] within the disturbed zone, investigations shall [~~is-assumed-to~~] extend to the greater of either its calculated extent or a horizontal distance of 2 km from the limits of the underground facility and from the surface to a depth of 500 meters below the limits of the repository excavation.

(1) Evidence of subsurface mining for resources.

(2) Evidence of drilling for any purpose.

(3) Resources that have either greater gross value, net value, or commercial potential than the average for other representative areas of similar size that are representative of and located in the geologic setting.

(4) Evidence of extreme erosion during the Quaternary Period.

(5) Evidence of dissolutioning of soluble rocks.

(6) The existence of a fault that has been active during the Quaternary Period.

(7) Potential for creating new pathways for radionuclide migration due to presence of a fault or fracture zone irrespective of the age of last movement.

(8) Structural deformation such as uplift, subsidence, folding, and fracturing during the Quaternary Period.

(9) More frequent occurrence of earthquakes or earthquakes of higher magnitude than is typical of the area in which the geologic setting is located.

(10) Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or magnitude of earthquakes may increase.

(11) Evidence of igneous activity since the start of the Quaternary Period.

(12) Potential for changes in hydrologic conditions that would significantly affect the migration of radionuclides to the accessible environment including but not limited to changes in hydraulic gradient, average interstitial velocity, storage coefficient, hydraulic conductivity, natural recharge, potentiometric levels, and discharge points.

(13) Conditions in the host rock that are not reducing conditions.

(14) Groundwater conditions in the host rock, including but not limited to high ionic strength or ranges of Eh-pH, that could affect the solubility and chemical reactivity of the engineered systems.

(15) Processes that would reduce sorption, result in degradation of the rock strength, or adversely affect the performance of the engineered system.

(16) Rock or groundwater conditions that would require complex engineering measures in the design and construction of the underground facility or in the sealing of boreholes and shafts.

(17) Geomechanical properties that do not [~~provide stability of~~] <u>permit design of stable</u> underground openings during construction, waste emplacement, or retrieval operations.

§60.124 Rebuttal of presumption that the geologic repository will not meet the performance objectives.

The presumption that the geologic repository will not meet the performance objectives can be rebutted upon showing that a potentially adverse condition or combination of conditions cited in §60.123 of this subpart will not significantly affect the ability of the geologic repository to isolate the radioactive waste. In order to make this showing, the following must be demonstrated:

(a) The potentially adverse human activity or natural condition has been adequately characterized, including the extent to which the condition may be present and still be undetected taking into account the degree of resolution achieved by the investigations.

(b) The effect of the potentially adverse human activity or natural condition on the geologic setting has been adequately evaluated using conservative analyses and assumptions, and the evaluation used is sensitive to the adverse human activity or natural condition.

(c)(i) The potentially adverse human activity or natural condition is shown by analysis in (b) above to not significantly affect the ability of the geologic setting to isolate waste, or

(ii) The effect of the potentially adverse human activity or natural condition is compensated by the presence of a combination of the favorable characteristics cited in §60.122 of this subpart, or

(iii) The potentially adverse human activity or natural condition can be remedied.

DESIGN AND CONSTRUCTION REQUIREMENTS

§60.130 General design requirements for the geologic repository operations areas.

(a) Sections 60.130 through 60.134 specify minimum requirements for the design of, and construction specifications for, the geologic repository operations area. Requirements for design contained in sections 60.131 through 60.133 of this subpart must be considered in conjunction with the requirements for contruction in §60.134 of this subpart. All design and construction criteria must be consistent with the results of site characterization activities.

(b) Systems, structures, and components of the geologic repository operations area shall satisfy the following:

(1) Radiological protection.

As required to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter, [~~and-as-low-as-is-reasonably-achievable;~~] structures, systems, and components located within such restricted areas shall be designed to include--

(i) Means to limit concentrations of radioactive material in air;

(ii) Means to limit the time required to perform work in the vicinity of radioactive materials, including, as appropriate, designing equipment for ease of repair and replacement and providing adequate space for ease of operation;

(iii) Suitable shielding;

(iv) Means to monitor and control the dispersal of radioactive contamination;

(v) Means to control access to high radiation areas or airborne radioactivity areas; and

(vi) A radiation alarm system to warn of increases in radiation levels, concentrations of radioactive material in air, and of increased radioactivity released in effluents. The alarm system shall be designed with redundancy and in situ testing capability.

(2) Protection against natural phenomena and environmental conditions.

(i) The structures, systems, and components important to safety shall be designed to be compatible with anticipated site characteristics and to accommodate the effects of environmental conditions, so as to prevent interference with normal operation, maintenance and testing during the entire period of construction and operations.

(ii) The structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions anticipated at the site will not result, in any relevant time period, in failure to achieve the performance objectives.

(3) Protection against dynamic effects of equipment failure and similar events.

The structures, systems and components important to safety shall be designed to resist dynamic effects that could result from equipment failure, missile impacts, and similar events and conditions that could lead to loss of their safety functions.

(4) Protection against fires and explosions.

(i) The structures, systems, and components important to safety shall be designed to reduce the potential for impairment of their ability to perform their safety functions during and after fires or explosions in the geologic repository operations area.

(ii) To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials.

(iii) The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety.

(iv) The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems.

(5) Emergency capability.

(i) The structures, systems, and components important to safety shall be designed to maintain control of radioactive waste, and permit prompt termination of operations and evacuation of personnel during an emergency.

(ii) The geologic repository operations area shall be designed to include onsite facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available offsite services (such as fire, police, medical and ambulance service) that may aid in recovery from emergencies.

(6) Utility services.

(i) Each utility service system shall be designed so that essential safety functions can be performed under both normal and emergency conditions.

(ii) The utility services important to safety shall include redundant systems to the extent necessary to maintain, with adequate capacity, the ability to perform their safety functions.

(iii) The emergency utility services shall be designed to permit testing of their functional operability and capacity. This will include the full operational sequence of each system when transferring between normal and emergency supply sources, as well as the operation of associated safety systems.

(iv) Provisions shall be made so that, if there is a loss of the primary electric power source or circuit, reliable and continued emergency power is provided to instruments, utility service systems, and operating systems, including alarm systems. This emergency power shall be sufficient to allow safe conditions to be maintained. All systems important to safety shall be designed to permit them to be maintained at all times in a functional mode.

(7) Inspection, testing, and maintenance. The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness.

(8) Criticality control. All systems for processing, transporting, handling, storage, retrieval, emplacement, and isolation of radioactive waste shall be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Each system shall be designed for criticality safety under normal and accident conditions. The calculated effective multiplication factor (k_{eff}) must be sufficiently below unity to show at least a 5% margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation.

(9) Instrumentation and control systems. Instrumentation and control systems shall be designed to monitor and control the behavior of engineered

systems important to safety over anticipated ranges for normal operation and for accident conditions. The systems shall be designed with sufficient redundancy to ensure that adequate margins of safety are maintained.

(10) Compliance with mining regulations. To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977, as to the construction and operation of the geologic repository operations area, the design of the geologic repository operations area shall nevertheless include such provisions for worker protection as may be necessary to provide reasonable assurance that all structures, systems, and components important to safety can perform their intended functions. Any deviation from relevant design requirements in Title 30, Chapter I, Subchapters D, E, and N will give rise to a rebuttable presumption that this requirement has not been met.

§60.131 Additional design requirements for surface facilities in the geologic repository operations area.

(a) Facilities for receipt and retrieval of waste. Surface facilities in the geologic repository operations area shall be designed to allow safe handling and storage of wastes at the site, whether such wastes are on the surface prior to emplacement or as a result of retrieval from the underground facility. The surface facilities shall be designed so as to permit inspection, repair, and decontamination of such wastes and their containers. Surface storage capacity for all emplaced waste is not required.

(b) Surface Facility Ventilation. Surface facility ventilation systems supporting waste transfer, inspection, decontamination, processing, or packaging shall be designed to provide protection against radiation exposures and offsite releases as provided in §60.111.

(c) Radiation control and monitoring.

(1) Effluent control. The surface facilities shall be designed to control the release of radioactive materials in effluents during normal and emergency operations. The facilities shall be designed to provide protection against radiation exposures and offsite releases as provided in §60.111.

(2) Effluent monitoring. The effluent monitoring systems shall be designed to measure the amount and concentration of radionuclides in any effluent with sufficient precision to determine whether releases conform to the design requirement for effluent control. The monitoring systems shall be designed to include alarms that can be periodically tested.

(d) Waste treatment. Radioactive waste treatment facilities shall be designed to process any radioactive wastes generated at the geologic repository operations area into a form suitable to permit safe disposal at the geologic repository operations area or to permit safe transportation and conversion to a form suitable for disposal at an alternative site in accordance with any regulations that are applicable.

(e) Consideration of decommissioning. The surface facility shall be designed to facilitate decommissioning.

§60.132 Additional design requirements for the underground facility.

(a) General criteria for the underground facility.

(1) The underground facility shall be designed so as to take into account interactions among the geologic setting, the underground facility, and the waste package.

(2) The underground facility shall be designed to provide for structural stability, control of groundwater movement and control of radionuclide releases, as necessary to comply with the performance objectives of §60.111.

(3) The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall enhance containment and isolation of radionuclides to the extent practicable at the site.

(4) The underground facility shall be designed so that the effects of disruptive events such as intrusions of gas, or water, or explosions, will not propagate through the facility.

(b) Flexibility of Design. The underground facility shall be designed with sufficient flexibility to allow adjustments, where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

(c) Separation of excavation and waste emplacement (modular concept). If concurrent excavation and emplacement of wastes are planned, then:

(1) The design shall provide for such separation of activities into discrete areas (modules) as may be necessary to assure that excavation does not impair waste emplacement or retrieval operations.

(2) Each module shall be designed to permit insulation from other modules if an accident occurs.

(d) Design for retrieval of waste. The underground facility shall be designed to--

(1) Permit retrieval of waste in accordance with the performance objectives (§60.111);

(2) Ensure sufficient structural stability of openings and control of groundwater to permit the safe conduct of waste retrieval operations; and

(3) Allow removal of any waste packages that may be damaged or require inspection without compromising the ability of the geologic repository to meet the performance objectives (§60.111).

(e) Design of subsurface openings.

(1) Subsurface openings shall be designed to maintain stability throughout the construction and operation periods. If structural support is required for stability, it shall be designed to be compatible with long-term deformation, hydrologic, geochemical, and thermomechanical characteristics of the rock and to allow subsequent placement of backfill.

(2) Structures required for temporary support of zones of weak or highly fractured rock shall be designed so as not to impair the placement of permanent structures or the capability to seal excavated areas used for the containment of wastes.

(3) Subsurface openings shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock over the long term. The size, shape, orientation, and spacing of openings and the design of engineered support systems shall take the following conditions into considerations--

(i) natural stress conditions;

(ii) deformation characteristics of the host rock under normal conditions and thermal loading;

(iii) the kinds of weaknesses or structural discontinuities found at various locations in the geologic repository;

(iv) equipment requirements; and

(v) the ability to construct the underground facility as designed so that stability of the rock is enhanced.

(f) Rock excavation. The design of the underground facility shall [~~be based on the selection of~~] incorporate excavation methods that will limit damage to and fracturing of rock.

(g) Control of water and gas.

(1) Water and gas control systems shall be designed to be of sufficient capability and capacity to reduce the potentially adverse effects of groundwater intrusion, service water intrusion, or gas inflow into the underground facility.

(2) Water and gas control systems shall be designed to [~~monitor the composition of and~~] control the quantity of water or gas flowing into or from the underground facility, monitor the composition of gases and permit sampling of liquids.

(3) Systems shall be designed to provide control of water and gas in both waste emplacement areas and excavation areas.

(4) Water control systems shall be designed to include storage capability and modular layouts that ensure that unexpected inrush or flooding can be controlled and contained.

(5) If the intersection of aquifers or water-bearing geologic structures is anticipated during construction, the design of the underground facility shall include plans for cutoff or control of water in advance of the excavation.

(6) If linings are required, the contact between the lining and the rock surrounding subsurface excavations shall be designed so as to avoid the creation of any preferential pathway for groundwater or radionuclide migration.

(h) Subsurface ventilation.

The ventilation system shall be designed to--

(1) Control the transport of radioactive particulates and gases within and releases from the subsurface facility in accordance with the performance objectives (§60.111);

(2) Permit continuous occupancy of all excavated areas during normal operations through permanent closure;

(3) Accommodate changes in operating conditions such as variations in temperature and humidity in the underground facility;

(4) Include such redundant equipment and fail safe control systems as may be needed to assure continued function under normal and emergency conditions; and

(5) Separate the ventilation of excavation and waste emplacement areas.

(i) Engineered barriers.

(1) Barriers shall be located where shafts could allow access for groundwater to enter or leave the underground facility.

(2) Barriers shall create a waste package environment which favorably controls chemical reactions affecting the performance of the waste package.

(3) Backfill placed in the underground facility shall be designed as a barrier.

(i) Backfill placed in the underground facility shall be compatible with anticipated changes in the geologic setting.

(ii) Backfill placed in the underground facility shall serve the following functions:

(A) It shall provide a barrier to groundwater movement into and from the underground facility.

(B) It shall reduce creep deformation of the host rock that may adversely affect (1) waste package performance or (2) the local hydrological system.

(C) It shall reduce and control groundwater movement within the underground facility.

(D) It shall retard radionuclide migration.

(iii) Backfill placed in the underground facility shall be selected to allow for adequate placement and compaction in underground openings.

(j) Waste handling and emplacement.

(1) The systems used for handling, transporting, and emplacing radioactive wastes shall be designed to have positive, fail-safe designs to protect workers and to prevent damage to waste packages.

(2) The handling systems for emplacement and retrieval operations shall be designed to minimize the potential for operator error.

(k) Design for thermal loads.

(1) The underground facility shall be designed so that the predicted thermal and thermomechanical response of the rock will not degrade significantly the performance of the repository or the ability of the natural or engineered barriers to retard radionuclide migration.

(2) The design of waste loading and waste spacings shall take into consideration--

(i) Effects of the design of the underground facility on the thermal and thermomechanical response of the host rock and the groundwater system;

(ii) Features of the host rock and geologic setting that affect the thermomechanical response of the underground facility and barriers, including but not limited to, behavior and deformational characteristics of the host rock, the presence of insulating layers, aquifers, faults, orientation of bedding planes, and the presence of discontinuities in the host rock; and

(iii) The extent to which fracturing of the host rock is influenced by cycles of temperature increase and decrease.

§60.133 Design of shafts and seals for shafts and boreholes.

(a) Shaft design. Shafts shall be designed so as not to create a preferential pathway for migration of groundwater and so as not to increase the potential for migration through existing pathways.

(b) Shaft and borehole seals.

Shaft and borehole seals shall be designed so that:

(i) Shafts and boreholes will be sealed [along-their-entire-length] as soon as possible after they have served their operational purpose.

(ii) At the time of permanent closure, sealed shafts and boreholes will inhibit transport of radionuclides to at least the same degree as the undisturbed units of rock through which the shafts or boreholes pass. In the case of soluble rocks, the borehole and shaft seals shall also be designed to prevent groundwater circulation that would result in dissolution.

(iii) Contact between shaft and borehole seals and the adjacent rock does not become a preferential pathway for water.

(iv) Shaft and borehole seals can accommodate potential variations of stress, temperature, and moisture.

(v) The materials used to construct the seals are appropriate in view of the geochemistry of the rock and groundwater system, anticipated deformations of the rock, and other in situ conditions.

(c) Shaft conveyances used in radioactive waste handling.

(1) Shaft conveyances used to transport radioactive materials shall be designed to satisfy the requirements as set forth in §60.130 of this subpart for systems, structures, and components important to safety.

(2) Hoists important to safety shall be designed to preclude cage free fall.

(3) Hoists important to safety shall be designed with a reliable cage location system.

(4) Hoist loading and unloading systems shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

(5) Hoists important to safety shall be designed to include two independent indicators to indicate when waste packages are in place, grappled, and ready for transfer.

§60.134 Construction specifications for surface and subsurface facilities.

(a) General requirement. Specifications for construction shall conform to the objectives and technical requirements of Sections 60.130 through 60.133 of this subpart.

(b) Construction management program. The construction specifications shall facilitate the conduct of a construction management program that will ensure that construction activities do not adversely affect the suitability of the site to isolate the waste or jeopardize the isolation capabilities of the underground facility, boreholes, shaft, and seals, and that the underground facility is constructed as designed.

(c) Construction records. The construction specifications shall include requirements for the development of a complete documented history of repository construction. Such documented history shall include at least the following--

(1) Surveys of underground excavations and shafts located via readily identifiable surface features or monuments;

(2) Materials encountered;

(3) Geclogic maps and geologic cross sections;

(4) Locations and amount of seepage;

(5) Details of equipment, methods, progress, and sequence of work;

(6) Construction problems;

(7) Anomalous conditions encountered;

(8) Instrument locations, readings, and analysis;

(9) Location and description of structural support systems;

(10) Location and description of dewatering systems; and

(11) Details, methods of emplacement, and location of seals used.

(d) Rock excavation. The methods used for excavation shall be selected to reduce to the extent practicable the potential to create a preferential pathway for groundwater or radioactive waste migration or increase migration through existing pathways.

(e) Control of explosives. If explosives are used, the provisions of §57.6 (Explosives) of Title 30 of the Code of Federal Regulations, Chapter I, Mine Safety and Health Administration, Department of Labor, shall be met, as minimum safety requirements for storage, use and transport at the geologic repository operations area.

(f) Water control. The construction specifications shall provide that water encountered in excavations shall be removed to the surface and controlled in accordance with design requirements for radiation control and monitoring (§60.131(c) of this subpart).

(g) Waste handling and emplacement. The construction specifications shall provide for demonstration of the effectiveness of handling equipment and systems for emplacement and retrieval operations, under operating conditions.

§60.135 *Requirements for the waste package and its components.*

(a) General requirements of design.

The design of the waste package shall include the following elements:

(1) Effect of the site on the waste package. The waste package shall be designed so that the in situ chemical, physical, and nuclear properties of the waste package and its interactions with the emplacement environment do not compromise the function of the waste packages. The design shall include but not be limited to consideration of the following factors: solubility, oxidation/reduction reactions, corrosion, hydriding, gas generation, thermal effects, mechanical strength, mechanical stress, radiolysis, radiation damage, radionuclide retardation, leaching, fire and explosion hazards, thermal loads, and synergistic interactions.

(2) Effect of the waste package on the underground facility and the natural barriers of the geologic setting. The waste package shall be designed so that the in situ chemical, physical, and nuclear properties of the waste package and its interactions with the emplacement environment do not compromise the performance of the underground facility or the geologic setting. The design shall include but not be limited to consideration of the following factors: solubility, oxidation/reduction reactions, corrosion, hydriding, gas generation, thermal effects, mechanical strength, mechanical stress, radiolysis, radiation damage, radionuclide retardation, leaching, fire and explosion hazards, thermal loads, and synergistic interactions.

(b) Waste form requirements.

Radioactive waste that is emplaced in the underground facility shall meet the following requirements:

(1) Solidification. All such radioactive wastes shall be in solid form and placed in sealed containers.

(2) Consolidation. Particulate waste forms shall have been consolidated (for example, by incorporation into an encapsulating matrix) to limit the availability and generation of particulates.

(3) Combustibles. All combustible radioactive wastes must have been reduced to a noncombustible form unless it can be demonstrated that a fire involving a single package will neither compromise the integrity of other packages, nor adversely affect any safety-related structures, systems, or components.

(c) Waste package requirements.

The waste package design shall meet the following requirements:

(1) Explosive, pyrophoric, and chemically reactive materials. The waste package shall not contain explosive or pyrophoric materials or chemically reactive materials that could interfere with operations in the underground facility or compromise the ability of the geologic repository to satisfy the performance objectives.

(2) Free liquids. The waste package shall not contain free liquids in an amount that could impair the structural integrity of waste package components (because of chemical interactions or formation of pressurized vapor) or result in spillage and spread of contamination in the event of package perforation.

(3) Handling. Waste packages shall be designed to maintain waste containment during transportation, emplacement, and retrieval.

(4) Unique identification. A label or other means of identification shall be provided for each package. The identification shall not impair the integrity of the package and shall be applied in such a way that the information shall be legible at least to the end of the retrievable storage period. Each package identification shall be consistent with the package's permanent written records.

§60.137 General requirements for performance confirmation.

The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of subpart F of this part.

SUBPART F - PERFORMANCE CONFIRMATION

§60.140 General requirements.

(a) The performance confirmation program shall ascertain whether--

(1) Actual subsurface conditions encountered and changes in those conditions during construction and waste emplacement operations are [those] within the limits assumed in the licensing review; and

(2) Natural and engineered systems and components required for repository operation, or which are designed or assumed to operate as barriers after permanent closure are functioning as intended and anticipated.

(b) The program shall have been started during site characterization and it will continue until permanent closure.

(c) The program will include in situ monitoring, laboratory and field testing, and in situ experiments, as may be appropriate to accomplish the objective as stated above.

(d) The confirmation program shall be implemented so that:

(1) It does not adversely affect the natural and engineered elements of the geologic repository.

(2) It provides baseline information and analysis of that information on those parameters and natural processes pertaining to the geologic setting that may be changed by site characterization, construction, and operational activities.

(3) It monitors and analyzes changes from the baseline condition of parameters that could affect the performance of a geologic repository.

(4) It provides an established plan for feedback and analysis of data, and implementation of appropriate action.

§60.141 Confirmation of geotechnical and design parameters.

(a) During repository construction and operation, a continuing program of surveillance, measurement, testing, and geologic mapping shall be conducted to ensure that geotechnical and design parameters are confirmed and to ensure that appropriate action is taken to inform the Commission of changes needed in design to accommodate actual field conditions encountered.

(b) Subsurface conditions shall be monitored and evaluated against design assumptions.

(c) As a minimum, measurements shall be made of rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into subsurface areas, changes in groundwater conditions, rock pore water pressures including those along fractures and joints, and the thermal and thermomechanical response of the rock mass as a result of development and operations of the geologic repository.

(d) These measurements and observations shall be compared with the original design bases and assumptions. If significant differences exist between the measurements and observations and the original design bases and assumptions, the need for modifications to the design or in construction methods shall be determined and the recommended changes reported to the Commission.

(e) In situ monitoring of the thermomechanical response of the ~~[geologic-repository]~~ <u>underground facility</u> shall be conducted until permanent closure to ensure that the performance of the natural and engineering features are within design limits.

§60.142 Design testing.

(a) During the early or developmental stages of construction, a program for in situ testing of such features as borehole and shaft seals, backfill, and the thermal interaction effects of the waste packages, backfill, rock, and groundwater shall be conducted.

(b) The testing shall be initiated as early as is practicable.

(c) A backfill test section shall be constructed to test the effectiveness of backfill placement and compaction procedures against design requirements before permanent backfill placement is begun.

(d) Test sections shall be established to test the effectiveness of borehole and shaft seals before full-scale operation proceeds to seal boreholes and shafts.

§60.143 Monitoring and testing waste packages.

(a) A program shall be established at the repository for monitoring the condition of the waste packages. Packages chosen for the program shall be representative of those to be emplaced in the repository.

(b) Consistent with safe operation of the repository, the environment of the waste packages selected for the waste package monitoring program shall be representative of the emplaced wastes.

(c) The waste package monitoring program shall include laboratory experiments which focus on the internal condition of the waste packages. To the extent practical, the environment experienced by the emplaced waste packages within the repository during the waste package monitoring program shall be duplicated in the laboratory experiments.

(d) The waste package monitoring program shall continue as long as practical up to the time of permanent closure.

SUBPART G - QUALITY ASSURANCE

§ 60.150 Scope.

As used in this part, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that the repository and its subsystems or components will perform satisfactorily in service.

Quality assurance is a multidisciplinary system of management controls which address safety, reliability, maintainability, performance, and other technical disciplines.

§ 60.151 Applicability.

The quality assurance program shall apply to all [items] systems, structures and components important to safety and to activities which would prevent or mitigate events that could cause an undue risk to the health and safety of the public. These activities include: exploring, site selecting, designing, fabricating, purchasing, handling, shipping, storing, cleaning, erecting, installing, emplacing, inspecting, testing, operating, maintaining, monitoring, repairing, modifying, and decommissioning.

§ 60.152 Implementation.

DOE shall implement a quality assurance program based on the criteria of Appendix B of 10 CFR Part 50 as applicable, and appropriately supplemented by additional criteria as required by § 60.151.

§ 60.153 Quality assurance for performance confirmation.

The quality assurance program shall include the program of tests, experiments and analyses essential to achieving adequate confidence that the emplaced wastes will remain isolated from the accessible environment.

SUBPART H - TRAINING AND CERTIFICATION OF PERSONNEL

§ 60.160 General requirements.

Operations that have been identified as important to safety in the Safety Analysis Report and in the license shall be performed only by trained and certified personnel or by personnel under the direct visual supervision of an individual with training and certification in such operation. Supervisory personnel who direct operations that are important to safety must also be certified in such operations.

§60.161 Training and certification program.

The DOE shall establish a program for training, proficiency testing, certification and requalification of operating and supervisory personnel.

§60.162 Physical requirements.

The physical condition and the general health of personnel certified for operations that are important to safety shall not be such as might cause operational errors that could endanger the public health and safety. Any condition which might cause impaired judgment or motor coordination must be considered in the selection of personnel for activities that are important to safety. Such conditions need not categorically disqualify a person, so long as appropriate provisions are made to accommodate such defect.

Dated at Washington, D.C. this ______________ day of ______, 1981.

For the U.S. Nuclear Regulatory Commission.

Samuel J. Chilk
Secretary of the Commission

RESOLUTION OF DOE COMMENTS ON THE MARCH 5, 1981
DRAFT OF 10 CFR PART 60 TECHNICAL CRITERIA

60.102 Concepts

60.102(b)(2) and 60.102(c)(1)

The definition of "geologic repository operations area" is defined on page 19 of Enclosure A. The term "storage" is undefined. NRC staff explained that the use of the term "storage" is consistent with its use in Section 202(3) and (4) of the Energy Reorganization Act of 1974, and believes no further definition is necessary.

60.102(c)

The concern about the title of Section 60.102(c) has been resolved in Attachment 2 by deleting the title and renumbering the Section.

It was pointed out to the DOE staff the requirement to limit the release rate from the underground facility (§60.111) allowed DOE the flexibility to rely on other engineered barriers and was not a requirement on the waste form. The containment requirement (§60.111) does not apply to TRU waste packages if they are sufficiently isolated from the high level waste (HLW) packages that the TRU wastes are not significantly affected by the heat from the HLW. It was agreed no change is needed.

60.102(f)

DOE has misinterpreted the discussion in 60.102(g) and withdrew the comment.

60.102(g)

NRC and DOE staff ~~has~~ are agreed to disagree on the definition of "isolation" and NRC will seek public comments on its approach. No change has been made.

60.111 Performance Objectives

60.111(a)(3)

DOE agrees that the intent of its requirement is clear in SECY-81-267 and no change has been made.

60.111(b)(1)

This requirement was clarified by inserting the words radiation protection to identify which generally applicable environmental standards were intended.

60.111(b)(3)

NRC and DOE staff agreed that the wording of this requirement as written in SECY-81-267 satisfies DOE's concern and no further changes were made.

60.111(b)(4)

The basis for the 1000 year groundwater travel time is contained in Enclosure J to SECY-81-267.

60.122 Requirements for the Geologic Setting*

60.122(a)(1)

NRC explained why it considered low population density in the geologic setting and emplacement at a depth of at least 300 meters to be favorable to waste isolation. Both conditions favor isolation by reducing the potential for disruption of the repository. NRC staff also explained that the limits of the geologic setting will be site specific, since it includes those systems that provide isolation. No changes were made as the result of these discussions.

*Note that this section has been restructured and renumbered in SECY-81-267.

DOE staff still consider that the "low population density" condition should be deleted. In the condition 60.122(i), the word "waste" was changed to "radionuclide" for clarity.

60.122(b)(2) now 60.123(b)

This requirement has been reworded to clarify that it applies to the extent of the investigations of the disturbed zone and is not a new definition. The third instance of the use of disturbed zone referred to in the DOE comment did not appear in SECY-81-267. The requirement 60.123(b)(9) had already been clarified in SECY-81-267.

60.122(c)(2)(xix) now 60.123(b)(17)

Revised wording is proposed in Attachment 2 to clarify the staff's intent.

60.122(b)(5)(iv) now 60.10(d)(iii)

This requirement has been moved from Subpart E to Subpart A and is now a requirement for conduct of the site characterization program. In Attachment 2 we have also proposed to insert the words "To the extent practical."

60.122(d)(2) now 60.21(c)(13)

Attachment 2 contains revised wording which resolved the DOE concern. The requirement to perform this evaluation is now contained in the Content of Application section of Subpart A.

60.122(d)(3) now 60.21(c)(1)(i)

The information requirements for subsurface exploration have been moved to the Content of Application section of Subpart A. The words "and conditions" have been inserted in the information requirements 60.21(c)(1)(i)(C) and (D).

7. <u>60.141(e)</u>

The intent was clarified by replacing the words "geologic repository" by "underground facility."

8. <u>60.151 Applicability</u>

The intent was clarified by replacing the word "items" with "systems structures and components important to safety."

9. <u>60.161 Training and Certification Program</u>

The intent was clarified by inserting the words "operating and supervisory" before personnel.