

UNITED STATES OF AMERICA
NUCLEAR WASTE TECHNICAL REVIEW BOARD

FULL BOARD MEETING

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Meeting Room - James
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The above-entitled proceedings commenced at 9:07 O'clock a.m., pursuant to notice, Dr. Don U. Deere, Chairman of the NWTRB, presiding.

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PROCEEDINGS

[9:07 a.m.]

WELCOME

DR. DEERE: Good morning. Good morning, ladies and gentlemen.

This is the second day of the Nuclear Waste Technical Review Board Summer Meeting. I am Don U. Deere, Board Chairman.

This morning we will hear from representatives of the EPA and the NRC on the EPA Standard and the NRC Regulations relating to high-level radioactive waste disposal.

After lunch, we will hear presentations of the DOE Site Selection Criteria, and receive an update on the DOE's efforts to evaluate early site suitability.

These are subjects that are extremely important to the Board's review of the DOE program, and we look forward to all the presentations today with great interest.

At this time, I would like to introduce Dr. Melvin W. Carter, Chair of the Board's Panel on Environment and Public Health, who will preside over this morning's session.

Dr. Carter is Neeley Professor Emeritus in Nuclear Engineering and Health Physics at the Georgia Institute of Technology, and an international consultant on radiation protection.

He has experience in a broad range of issues related to radioactive waste management.

Dr. Carter serves as a consultant to the NRC's Advisory Committee on Nuclear Waste and its Advisory Committee on Reactor Safeguards, and has been on hearing boards for both the NRC and DOE.

Dr. Carter has also been a consultant to almost two dozen Federal and State Government agencies and private companies, and has served in many administrative posts.

Mel, at this time, I will turn the morning session over to you.

INTRODUCTORY REMARKS

DR. CARTER: Thank you very much, Don.

What we would like to do now is have the two discussions this morning. And we are pleased to have representatives, of course, from EPA and from the NRC, to discuss 40 CFR 191 and 10 CFR 60.

The prime purpose, of course, is for the Board to be made aware, on pretty much of a direct basis, of the processes whereby the regulations have been developed, the rationale which supports the limits and the requirements, the current status of the regulations, and future plans, if any.

What I would like to do is introduce the first speaker, Ray Clark. He will address 40 CFR 191.

He is responsible for the High-Level Spent Nuclear Fuel Standards. He is also responsible, as far as the EPA is concerned, for the transportation issues as they relate to EPA's responsibilities.

I would hope that during his discussion perhaps he would address the 10,000-year requirement in the regulations, and perhaps discuss also Carbon-14, which is a special nuclide, now that we have a repository in the non-saturated zone. So at least those two points, and I'm sure other things will come up.

I'm very pleased to have Mr. Clark with us. He also, by the way is a rambling wreck. So we're pleased to have you with us.

Ray.

PRESENTATION ON
ENVIRONMENTAL PROTECTION AGENCY (EPA) STANDARD 40 CFR 191

[Slide.]

MR. CLARK: Thank you, Dr. Carter.

It's a pleasure to be here, I guess.

The alternative I had, that I could have been doing about this time, I'm in the middle of an exercise, joint exercise with the Coast Guard and Army, which I'll be going to after I leave here. Right about now I'd probably be a mile off the New Jersey shore in the Atlantic Ocean, being picked up by a Coast Guard helicopter.

So I don't know which is more dangerous, coming here, or being there.

[Laughter.]

MR. CLARK: But, at any rate, I'm here.

As Dr. Carter said, this is 40 CFR 191, EPA's Radiation Protection Standards for Spent Fuel, High-Level and Transuranic Radioactive Wastes. I am the Project Leader for that effort.

[Slide.]

MR. CLARK: I have addressed Dr. Carter's panel before, but I don't believe I have had the pleasure of the entire Board. So I was going to go back a little through the history, very quickly, and the organization of the rule, then get into some of the specific issues, and then go through some of the changes that have occurred in our latest working draft, as opposed to the '85 Standards which were promulgated.

This whole effort started out, I say here, in '76. It was roughly that. It is authorized, or we get our authority from, the Atomic Energy Act and the Reorganization Plan Number 3.

We have also been given the added impetus, or had been, of the Nuclear Waste Policy Act. We have met that deadline, and the rule got sent back to us, which I cover here in a minute. We did promulgate it, under a Court Order, in August of '85.

We were sued by several states and environmental groups, notably the Natural Resources Defense Council. They led the arguments in front of the Circuit Court. The Court did vacate and remand the rule, as you see, in July of '87, on appeal.

It did reinstate Subpart A, which, for those of you not familiar with it, is the management and storage section of the rule, as opposed to the disposal section.

[Slide.]

MR. CLARK: Speaking of which, in working draft three, you will see some changes, if you're familiar with the '85 standard. Subpart A remains the same, management and storage. Subpart B has been changed around a bit. The old section 13 is now section 12, the containment requirements. The assurance requirements moved up a section as well, although they're still both pretty much the same, at this point, content wise.

Section 14 was the old section 15, in sequence. The new parts, 15 and 16, are -- as I say, are new. Fifteen is a demonstration of capability to comply, which gives the timing for meeting the standard, and 16 is a section which will allow for experimental emplacements, if necessary. I'm going to cover these in a little more detail later.

Subpart C is a brand new subpart. As you can see, it's ground water protection. That was formerly in Subpart B. It's now been made its own subpart, completely changed the basis of it. It also now covers Subpart A, which it did not before.

The three appendices -- Appendix A is new. We just go through a basic health physics

calculation of committed and effective dose equivalent. Appendices B and C are still essentially the same, as far as form and basic content goes.

[Slide.]

MR. CLARK: Over the years, there's been a lot of myth, rumor and other discussions of how we arrived at our basic level of protection. The way it all started out was we just wanted some kind of a rough estimate of how various geologic media would perform, in the sense of containing the wastes. We developed a very -- certainly compared to current computer programs, fairly simplistic computer program and model.

As I say, just for the purpose of arriving at generic environmental standards, that's all we're allowed to do, is generic standards. We just don't have the authority to do site-specific or even waste -- well, I'll take that back. We don't have the authority to do site-specific regulation.

We employed four media, which we thought were fairly representative of the program, at that time. This was back in the times preceding and up to the Nuclear Waste Policy Act. So we still had several different media that were under consideration.

As you can see, the four we used were granite; bedded salt; tuff, very roughly tuff, there was not a lot of data available, and it was just being discussed as a potential geology; and basalt. We, through contractors and in-house efforts, developed geochemical parameters and values. Estimated probabilities for various disruptions, such as faulting, human intrusion, piping formation, volcanoes, those sorts of events.

It may be worth noting, on the geochemical parameter values, that our Science Advisory Board reviewed, those were reviewed and adjusted, to some extent, when we had that review.

Then, using the computer program I referred to before, which is fairly simple, we went through and did calculations on consequences.

[Slide.]

MR. CLARK: The results of that were basically what you see here. The Palo Duro and Paradox bedded salt formations, along with the tuff, were obviously very low. The basalt, at first, in our first round, was fairly high. It was -- well, I've forgotten the exact number, but it was certainly above a thousand potential health effects. Granite is obviously the highest one here.

What brought some of those numbers down was, again, the Science Advisory Board Review, where a lot of the environmental parameters, which they felt were too conservative, we did scale them back a little bit, and came up with lower-potential impact.

At any rate, from this, the number 1,000 was developed, as it's obviously higher than the roughly 200 of granite; but considering uncertainties and just wanting to keep an order of magnitude level, it was set at a thousand, based on this sort of analysis.

[Slide.]

MR. CLARK: The second area where there's been a lot of misinterpretation and a lot of effort, on our part, to try to explain what went on -- I think part of it was just an unfortunate wording in the preamble, which I'm going to try to work on -- was the famed and dreaded Uranium Ore Body Study.

Here, the two questions we're trying to address were intergenerational risk. That came up -- well, it was always there, but it surfaced more between the proposed rule, in '82 and the public comment period that followed. We knew you couldn't -- just technologically, you couldn't pass zero risk on to the future. So despite some of our critics, we do realize things like that.

But we needed some kind of handle on what might be reasonable to pass on. We also wanted just a perspective on -- you know, we picked this thousand, based on this simple model; is that a reasonable place to put it? So we went out -- no, we didn't go out, I'm sorry. This was

an in-house study. We got some rough data from several uranium ore bodies around the country, ran it through the same types of models that we used for the other generic repository, and came out, once again, after the SAB review, these numbers were lowered; but it ended up we were between 10 and 100,000 potential health effects.

The reasons there are ore bodies of different sizes is that the ground water flux, chemistry, release rate, all sorts of factors are different, uncertainties are different, I am sure.

At any rate, we came to accept that range as some kind of an indication of what would happen. I guess it's kind of the best natural analog that we have as well, at least for our standard. It showed, as you can see here, a thousand, and that almost looks doctored; it wasn't really intended that way, because a thousand was first. The thousand, logarithmically, falls in mid-range of that range. Therefore, we felt that it was an indication that that was a reasonable level to set the standard at.

This last bullet here is just to emphasize that this was a comparison, it wasn't the basis of the standard -- the level.

This study was done first and this came along after it, so it was just a comparison.

[Slide.]

MR. CLARK: One of Dr. Carter's questions when he introduced me was, why 10,000 years? There's nothing particularly magic about 10,000 years, other than we felt a thousand years was not long enough to show any differences in site containment capabilities. The ground water travel time, even at the poor sites, looked like it was going to be more than a thousand years.

That, put together with retardation, of course, --if you won't get anything out at all, so why are you comparing anything? More than 10,000 years, we were concerned about the growing uncertainty past that point, and we also realized that that could get you into like ice ages or other potential environmental changes and their attendant uncertainty. If you had an ice age, that could obviously just overwhelm any analysis. As they say with lot of things, you'd probably have more to worry about than this repository if you were buried under a sheet of ice.

Those were the major reasons why we arrived at 10,000. I'll hit it again a little later, but maybe I'll point out here, since you asked, Dr. Carter, we have added a potential assurance requirement for a look at 100,000 years, not on the quantitative basis of the standard performance assessment, but on a more qualitative basis which may address some of the concern about what some people see as too short a time period.

Others, as I'm sure you are aware, think 10,000 is way too long to go.

[Slide.]

MR. CLARK: When we proposed the standard in 1982, we only had the release limits. We got criticized on that by -- there are probably others, but the ones that come to mind are the National Academy of Science and several of the states asked for ground water protection. So now we've -- well, in '85, and we've continued that -- we include both individual protection requirements and release limits.

The point I want to make on this slide is the release limits are meant to control population exposures, avoid the -- I'm trying to remember the phrase -- dilution is the solution to pollution. That is not one of our mottos above the door as we go in. We think that if you had just an individual requirement, that could be a result of that.

It also provides a measure for how well your repository may or will perform. The individual ground water protection limits, on the other hand, is -- as I say, it was requested by several parties -- is meant to limit annual doses to people in the vicinity of the facility, as well as

protect the integrity of the ground water outside of the controlled area.

Since we have an hour and a half here, I'll just make note of that last section, that last point. The federal court did validate our approach on that; that, indeed, controlled area, the lithography around the repository, could, indeed, be contaminated. They felt that Congress had said that that was okay, so they did validate that approach.

Of course, the moral of this story on this slide is that the two types of limits weren't developed in conjunction. They were intended to be. They're protecting two different segments of the environment or the population. Therefore, to try to connect them is not what was intended.

In some cases, one might be limiting, in other cases of other specific sites, the other may be limiting.

[Slide.]

MR. CLARK: The last of my specific issues here nicely coincides with Dr. Carter's other question earlier. We don't refer to it as a Carbon-14 problem. We're referring to it a little more generically as a gaseous release problem. Carbon-14 has kind of come up as a problem recently and suddenly, so we don't want to kind of pin ourselves down to just Carbon-14. Who knows, maybe something else will pop up, not that we know of at this point, but we are doing some work to look into that possibility.

Back when we were developing the standards, meaning back in the mid-70's on, nobody considered gaseous release from a repository under undisturbed conditions. Obviously, if you have a volcano blow through your repository, or some such violent event, an atmospheric release such as that, that was taken into consideration. But under undisturbed circumstances such as you may have at Yucca Mountain, nobody foresaw that pathway, or if they did, didn't suggest it to us.

The current Carbon-14 release limit is based on the same thousand health effects that all the other release limits are. The way it was done, it's released, but nobody had a good handle on environmental pathways since Carbon-14 is incorporated in practically everything. It's a lot different than trying to model, say, plutonium or strontium or some of the -- well, most of the other nuclides.

Therefore, we put a -- it was released from the repository in this model, but we used the Killough model which -- it's been a while since I've looked at it, but as I recall, it's a mixing model from the atmosphere to the oceans, deep ocean sinks, those sorts of things. We used that model to spread, as it were, the Carbon-14 around.

Using the thousand health effects, we came up with a release limit based on that model. We are currently, as I said earlier, reevaluating the appropriateness of that approach and we're also trying to see if there are any technical or geochemical fixes or retardations or holdups or anything that may, indeed, reduce the releases from unsaturated zones.

So far, we haven't been able to come up with any or very much work that's been done in that area. We certainly aren't doing any research, laboratory work or such. This is a literature search, essentially. So if anybody has any good ideas, send your cards and letters.

[Slide.]

MR. CLARK: Leaving that and going into more detail on Working Draft 3 as compared to the original '85 standards, in '85, we used the -- well, certainly in Subpart A, we used the critical organ dose approach, which is the old, I believe, ICRP-2 approach.

The reason that was done was in Subpart A, we have a division between NRC and DOE. The NRC standards, the standards applicable to NRC, are a continuation of our old 190

standards which were put out, again, back in the mid '70s, and they used that approach. This part of 191 was an attempt to just finish off the fuel cycle; so we just continued on with that.

The DOE half of that, as I recall, and my recall is not good, was intended to be effective dose equivalent, but we didn't state that, and it has been interpreted as being critical organ dose approach. So this time, we're making it perfectly clear that we're switching over to the new system.

The '85 standards also -- here again, this is all Subpart A -- said that all you had to have was a reasonable assurance, a reasonable expectation, and I've forgot which -- probably expectation, actually -- that the dose levels will be met, and here we have, looking back on it, we have an operational facility. This is almost like any currently operating facility. In just rethinking it, we saw no reason to have what looked like a predictive standard for an operating facility; so we've changed that over to what appears or what is a more common operating standard, and now we just say, "You will meet such-and-such dose level."

Speaking of such-and-such dose level, these were the old standards, here again based on the split between NRC and DOE. We still intend, at least for now, to keep that split between NRC and DOE, but we're going to have the same dose levels. As you can see, there are some slight differences here. But we have put in options for 10 and 25 millirems. The 25 millirem -- we're talking about whole body doses -- is the same risk level as the 25 millirem over here.

The 10 millirem is going toward the goal where the agency likes to be on its risk level. It's also what's been put out in a recent Clean Air Act standard. We decided that it would be good to put this out for public comment to see how the world feels about such options, and that's what we intend to do now. Our list could change when we get to final, but in Working Draft 3, that was our thought.

Back in '85, the old section -- I think it was 04 -- was an alternative standards section which applied only to the department. It allowed the Department -- here again, this was based on Clean Air Act regs -- it allowed the Department to come in and ask for variations on our dose levels here that went up as high as 500 millirem a year.

As we've gone back through this, here again, nobody sees the need anymore -- forgive me if I say this wrong, but I don't think the Department even sees the need for that section. So therefore, for this go-around, we will propose to just delete that section.

[Slide.]

MR. CLARK: Here again, just highlighting the differences. I'm not going clear through Subpart B. I mentioned this earlier. We did add this 100,000-year qualitative projection of performance. Back in '85, we thought about such a thing, but in the development of that and working with DOE, they decided to put a similar requirement in their siting guidelines in Part 960. Therefore, we decided, well, since that's there, we really don't need to add such a requirement, and the result was we didn't add that.

Obviously, with the current situation, not realizing that one sited the -- you know, the long finger of Congress pointed at just one site, as well as for other sites, not just Yucca Mountain. But even on a generic basis, if this happens in the future, we feel it would be good to have a little longer look so you're not falling off the edges or have events occur that have a greater likelihood after 10,000 that would be large, horrendous events, or some such. You know, this is qualitative, and I certainly don't want my adjectives to be on the record as changing anything, but the idea is to get a good feel, or at least a feel, for future performance and future containment capability.

Here again, we went through the effective dose equivalent, and, here again, we have

options of 10 and 25 millirem in the individual protection sections.

One added feature here is, in the '85 standards, those limits were applicable for 1,000 years. A lot of people have interpreted the court ruling as saying, "Why didn't you go to 10,000 years?" They did at least want an explanation as to why we didn't. They felt we didn't have enough public record as to why we chose 1,000 over any other particular number.

So therefore -- well, we do realize, here again, you go to 10,000, you're increasing your uncertainties. Is that going to be a problem at a site? You have to find your release pathway; you have to hypothesize an individual somewhere; you have to do all your environmental pathway work. Is that just too much to ask, to go out 10,000 years with that analysis? So therefore, we here again will likely put that out for comment, and whatever wisdom that can be transported to us or given to us, we would appreciate.

As I mentioned back in the beginning earlier, the new Subpart C is a change from the old standards. The old standards were based on a somewhat complex set of ground water classifications. You had a Class 1, a Class 2A, a Class 2B, a Class 3. We had a special source of drinking water, a significant source.

That's all been put aside now, and we have rewritten a nice clean streamlined Subpart C, which essentially agrees with the Safe Drinking Water Act, which means, leaving aside concentrations of various nuclides, 4 millirems per year effective dose equivalent.

The one thing here that I want to emphasize is that part of the Safe Drinking Water Act is the underground injection control program. At this point, it's our intention -- let me back up a step. One of the big reasons the court remanded our standard was because, with our 25 millirem limit and the admission that most, if not all, of the dose would go through a ground-water pathway -- so we thought at the time -- that we were allowing endangerment of ground water.

This was based on a series of interpretations that a repository -- interpretations of definition and legislative history -- that a repository was an underground injection well, which was a big surprise to most of us who think about underground injection. But the court did find that it was most likely an underground injection well, and asked EPA to either bring its standard in line with the Safe Drinking Water Act level, or explain why this was such a special case that you couldn't do that, that you could endanger ground water.

Therefore, the approach we've decided, at least at this point, to take is put our protection level at the same level as the Safe Drinking Water Act, and argue the other way that it is not a form of underground injection, in our opinion. How far that'll go, we'll see, but it's our intent right now. As I mentioned earlier, this does now apply to the management and operations, which it didn't before.

[Slide.]

MR. CLARK: These are the two new sections that we've added. We found a lot of, here again, mis-rumor and discussion about when you're supposed to apply these standards, or show compliance with them.

We've added Section 15 -- forgive me; I'm used to the old sections myself. It's not easy to switch this old horse here.

We've added a section which now says: You've got to show compliance before you put any waste into a system whatsoever. Just clean cut: before waste goes in, show compliance with Part 191.

Now, realizing there may be a need for experimental emplacements -- obviously WIPP comes to mind, but there may be other facilities -- and this was also recognized in the Nuclear Waste Policy Act, where the Commission can authorize a test facility at a high-level waste

repository, and we did write a section which we felt was at least parallel to that, which allows temporary emplacements, provided you meet certain requirements. And in the case of the Department, this would require an Administrator's concurrence that the requirements have been met and this was a necessary activity.

The Commission, as I said, has that authority under the Nuclear Waste Policy Act, and therefore, this wouldn't be applicable to them at any rate.

[Slide.]

MR. CLARK: I think this is the final slide on the differences. We're now back to -- this is the Appendix B bullet. The first and the last two are Appendix C, Guidance.

Appendix B is the appendix that contains the release limit table and several notes that say how to apply various factors to arrive at your final release limit. We have gotten some comments orally over the last couple of years and more recently in writing saying that they're a little too permissible on the transuranic waste limits as compared to the high-level waste releases. The suggested value that was in that comment was three to four megacuries as opposed to one megacurie.

For those of you who aren't familiar with how these release limits work, you take what you think is going to be your source term in the repository in curies -- in this case, transuranic waste -- and divide that by that sort of number, one or three or whatever the number would come out there that is set in the notes. So therefore, it's a straight linear operation. If you set three instead of one, you effectively divide your release limit by three.

Where the three comes from is, according to our analysis and the analysis that was sent to us, that's roughly the number of transuranic curies in a metric ton of high-level waste or spent fuel a year after discharge. That all changes -- I won't get into the details -- after that, but that's where that number comes from.

In the Guidance, we've added sections which suggest that implementing agencies do iterative performance assessments. Early on, so you can identify where your weaknesses are, where you might want to put a little more research or you might want to reduce your uncertainties mainly, you continue that on some sort of periodic basis throughout your operation, and, of course, you have a final one before you close the facility and button it up.

And we added a little more information on what we meant by undisturbed performance. Essentially it boils down to undisturbed inclusion in either gradual events that may affect the repository, normal ground water flow, chemical and geological changes that might be brought on by the presence of the waste, chemical interactions within the repository, as opposed to disruptive events such as faulting, volcanos, those sorts of things. The '85 standards, obviously we didn't have those sections.

[Slide.]

MR. CLARK: For those of you who are lucky enough to receive one of our packages of Working Draft #3, you found a little two-page thing added onto that, which was not incorporated into the standard but was a separate document of its own, which has been termed a Three Bucket Proposal, and I hope I don't misinterpret this or misdescribe it. If I do, feel free, Dan.

But the origin of this was from the NRC Staff. Now, we've changed it around a little bit and have to take some of the blame for that. It wasn't all them.

But essentially what it is, is the '85 standards require a performance assessment, which boils down to a probabilistic assessment of all the processes and events which seem to occur with a frequency greater than one in a thousand. These are then compared to two different levels of the release limits.

And in an attempt to make it a little less necessary to identify specific probabilities for specific scenarios and have to defend those, which obviously is a very uncertain sort of number, it was suggested that you have three buckets. Actually only one bucket has a new feature to it.

But the first bucket is for scenarios of a likelihood greater than one chance in ten, and here you do the same thing as you do under the '85 standards: you identify your scenarios; you identify their probabilities, their consequences; you do your analysis from that. I should say you do a cumulative probabilistic analysis. I'm trying to stay away from the term "complementary cumulative distribution function", but all right, I'll say it.

[Laughter.]

The second -- well, let me go to the third bucket, which is not new either. It says for scenarios less than one chance in 10,000, you don't need to look at them. You're getting so incredibly small a probability at that point that the uncertainty in trying to estimate those probabilities, we don't think is worthwhile doing; therefore, you can drop those out.

Now, the difference, as I say, comes in Bucket Two, which is between one and ten, and as we put it out to a 10,000 probability. What you do here is, you would look at individual scenarios, do a deterministic analysis in this case, and compare that to ten times the release limit.

Now, in all fairness, the second bucket under the '85 standards, as it were, allows you to compare to ten times the release limit. The main difference is you're not doing your distribution function.

[Slide.]

MR. CLARK: Finally, our schedule which is always a hot topic of conversation. I didn't put this as a bullet. I probably should have, looking back on it, especially for the group I'm talking to. Largely because of a letter from your Board, we've looked into a negotiated rulemaking. We ran a -- we had a contractor, I should say -- we had a contractor go around and interview several parties in the D.C. area, just to assess the feasibility of proceeding further with such an effort, if it appeared advisable.

The results of that we don't have in a written report yet, but we do have it verbally. It appeared that none of the players wanted to play. The environmental side didn't; the Government side didn't and the industry side didn't.

That's a little blunt. There were certain conditions for certain of those parties where they might take a limited role in some form or another. But basically it looks like a negotiated rulemaking just isn't feasible. We didn't even proceed on with our second phase where we would have talked to states and other environmental groups. As you will recall or may recall from hearing in the grapevine or something, we had also talked about a series of technical meetings or seminars or some forum.

Based on this same series of interviews, that doesn't even look likely now. Here again, I don't think that's a final decision, but it's unlikely. The most likely path we see, probably at this point, is to just proceed like a standard rulemaking would in EPA.

As you can see here, we talk about uncertainties, but we hope to propose, no later than early '92 -- we're going to push to try to do it sooner than that, but that's our goal at the moment -- public hearings, and then following that, the usual procedure. Sometime in early '93, put out the final.

Now, there are several -- maybe several isn't correct -- one or two or whatever at this point, Congressional bills floating around. They have deadlines in them in the range of 9 months to 2 years. If any of those pass, then, of course, that changes whatever we're doing. At this point, none of that's final, and that's our schedule we're looking at.

With that, bring on the Coast Guard or something and I'll come under fire.

DR. CARTER: Any questions from Board members?

DR. LANGMUIR: Could you go back to Overhead No. 3? It's the one in which a decision was made that from repository analysis, presumably that the thousand fatalities was consistent with releases. I'd like to know what kind of basis it is upon which the 194 figure for granite and the 125 figure for basalt were derived? What kind of analysis of repository performance was used to determine those numbers?

That's the one there, the basalt and granite figures. You went rather quickly over those numbers and I was curious where they came from.

MR. CLARK: The basis?

DR. LANGMUIR: For deciding that the risks were those risks for those repository types?

MR. CLARK: That analysis -- and I don't want to cop out here -- that analysis was done well before my watch, but basically, what happened was the same process was used for all five that you see here. Those two weren't picked on particularly.

There were three granite sets of data used. This was a site where there was fast-moving water, plentiful water. The basalt site was based on what we like to call generic data, but, of course, most of that data came from the state of Washington, as I recall.

Probabilities were developed inhouse for the disruptive events, using a contractor and discussions with him. I have to admit, right off the top, that I don't know what the basis of their considerations were. I just know that that's where those numbers came from. Not that I want to throw it to him, but my supervisor, Floyd Galpin, is in the audience and he was around back then. I don't know if he recalls any further details or not.

MR. GALPIN: I certainly don't recall the details of the numbers for each of the analyses, but the pathway was considered the same in each case, and that was basically a release to ground water, either by a disruptive event that occurred and appeared reasonable relative to these kinds of facilities, or through some interaction that was what you might call an undisturbed interaction to ground water to a stream, a surface stream and then an interaction of that surface stream with people, which was done on a generic basis of a ratio of how many people could be served by a river.

So the same basic model was carried through for all five of these facilities and also in terms of developing the release limits.

MR. CLARK: You still look confused.

DR. LANGMUIR: I had one other one for you. I may be incorrect, but my understanding has been that the Carbon-14 release limits that you set represents figures which are around or below background levels for Carbon-14 at Yucca Mountain. I may be wrong on this, but is that your understanding as well?

MR. CLARK: Yes. There have been a lot of comparisons thrown around and right now, as I say, we are doing a little more contract work on that. If you try to take the release limit and boil that down to an individual dose, you get a real small dose; that's correct.

As I tried to point out on one of my slides, that was never our intent to do that. It was never intended at that consistency. On the other hand, as I said, we used this Killough Model and spread it around. We're not sure that's the correct approach anymore, realizing that that's -- well, a similar pathway, but we really want to look at that again to see if that's the correct approach or not.

We also want to look at, as I think I, once again, said earlier, if there are any geologic or

geochemical mechanisms which aren't being seen, up till now, all the estimates I've seen anyway, just assume everything gets out, maybe with some retardation, but it all gets out within 10,000 years. We're not sure that's the case. Maybe you're not getting all that out. Maybe you could do better than that or maybe you could have a technological fix of some sort so you're not releasing everything.

I don't see why you have to assume everything gets out if there's some kind of fix that can be done. But so far, we don't know of much work that's been done in that area. So maybe there's a way to fix it to meet those limits, rather than changing the limit. We're open and looking at both sides.

DR. DOMENICO: In the old standards, you had -- it was a mass standard and you had certain tables in terms of mass release for each of the nuclides. I keep hearing the term "dose" thrown around now. Does this mean that you have to have models to predict concentrations and convert those to doses, or do we still have the simple, old calculation like we had in the old days where you just looked at the mass instead of concentrations?

In other words, have the old tables survived the new appendix?

MR. CLARK: The release limit tables?

DR. DOMENICO: Yes. Mass, curies per metric ton, I believe they were. Do those still survive?

MR. CLARK: Yes.

DR. DOMENICO: Those are still the basis of much of the calculations?

MR. CLARK: Yes. That's the basis of probabilistic performance assessment sections.

DR. DOMENICO: Let me ask you another question. If you're interested in setting a health standard, why would you be concerned about how much is retarded or what's getting out? Why would that influence your choice of a health standard? That is a loaded question; that is a bad question.

MR. CLARK: I will give you a brief answer, which I think I meant to say a minute ago.

We've had a lot of comment that you should increase that limit -- when there's something wrong here, the site might not work based on this one release pathway, this one nuclide, which may or may not be a problem. Nobody really knows at this point, a lot of assumptions.

If there was a way to fix the waste or a way to reduce the source term, why not? Why do you change that?

DR. DOMENICO: The question was: How does it affect your health standard.

MR. CLARK: It wouldn't in that case. It's just if we really do have an errant approach in looking at the dose because we didn't treat that differently than we did all of the other nuclides. That's why.

DR. DOMENICO: Just to follow up, but again this, I'm curious about this because calculating concentrations in these predictive models is a lot more difficult than counting, than the mass balance. It takes a little bit more hydrologic information that is highly uncertain.

What I am hearing is that the standard has retained the more or less mass release.

MR. CLARK: Yes, that's correct, but there are also, as there were in the '85 standards, we had individual protection requirements. Those are only under undisturbed performance and in '85 they were just for 1000 years, not for 10,000.

But, yes, you do have to do that, the pathway analysis, to find out those numbers. We agree.

There have been comments made why don't you throw out the release limits, just do individual dose. That's one reason that we lean away from that at this point.

DR. DOMENICO: One more. Does any of this work affect the safe drinking water standards that were established for radionuclides several years ago, that those remain the same? The alpha-emitting and beta-emitting standards are more or less the same, the EPA standards?

MR. CLARK: They are in the process of changing those now.

DR. DOMENICO: Those will be changed?

MR. CLARK: But it is not because of us. It's because of their own efforts.

DR. DOMENICO: Oh, okay.

DR. CANTLON: Cantlon. In connection with some of the definitions in the rewrite, third revision, you talk about releases to the accessible environment and define various aspects of it, but nowhere in there do you mention presence in the biosphere.

You talk about the lithosphere, the hydrosphere, water and so on. Many of the pathways undoubtedly are going to be biospheric pathways out of that system.

For instance, tritium is pulled out of the test site and released via transpiration but it also gets picked up by animals eating it and carrying it away, so I was puzzled at the total absence of anywhere in the articulation of that, of biospheric pathways, which the Europeans put great emphasis on.

MR. CLARK: The only answer that comes to mind immediately is in our individual dose requirements that says all pathways.

DR. CANTLON: But why isn't it in the definitions?

MR. CLARK: Oh, in the definitions?

DR. CANTLON: It is not there as you look at accessible environment. Getting it into the biosphere seems to me a very critical one because of biospheric pathways, which are quite different than hydrospheric pathways or atmospheric pathways because of the food chain relationships.

MR. CLARK: I guess I'd have to know a little more specifically as to what you mean.

Certainly it's not intended to be left out, if it is. I know what you're saying, I think.

DR. CANTLON: It isn't there. Visualize this model. You have a fractured rock surface there with deeply rooted desert shrubs that are going to be the closest biospheric contact with all of these materials and they are going to pull it up and it is going to move into animals, birds, and so on, and get moved from the site. There is no evidence that that was given any consideration at all.

MR. CLARK: That's not -- we went through environmental pathways to arrive at our limits.

DR. CANTLON: Assumed you did, yes.

MR. CLARK: We did. We did irrigation. We had a release through the aquifer to a river. Down the river you had irrigation. You had people drinking it, people eating fish. You had re-suspension, all the classic pathways of environmental analyses, out into the ocean.

I guess I am not seeing --

DR. CANTLON: I see the presumption is that the only way it can get out of the system is to get into the water flow line, which means ground water movement, and what you are omitting is the tapping of very deep ground water in the fractured rock surfaces which is characteristic in desert vegetation where they can suck this material right up and put it out when there is no water pathway directly. It gets immediately into the biosphere and moves up the food chain.

MR. CLARK: I see what you are saying.

DR. CANTLON: What you need, really, is the word "biosphere" in your description of

accessible environment. That's all I'm saying.

MR. CLARK: Okay. If we could get a specific written comment on that, I would appreciate it.

DR. NORTH: Let me start with a question on your fifth slide. This is the one that is labelled "Why 10,000 years?"

The question really is related to what are you doing in the present as opposed to what you described to us, the historical background on this question.

What have you done about the projection of climate change given all of the work that EPA has done in the last few years looking at the greenhouse issue and looking at the analysis of impacts on climate of greenhouse gases?

My concern here is that I am not sure 10,000 years stands up very well as a magic number where the uncertainty becomes considerably greater after that time than before that time, if we consider that alterations in the atmosphere that are projected over a time scale of 100 years or so may make the future considerably different from the past on which we have geologic records.

MR. CLARK: How are we --

DR. NORTH: My question focuses to what are your plans in this area.

MR. CLARK: Well, honestly we don't have -- I mean we have looked into the climate change question. In our own analyses we've done some sensitivity analysis. I don't think we plan to change from 10,000 years, if that's part of the question.

We still think that's valid. We are not saying at 1001 you suddenly have nine orders of magnitude more uncertainty. We realize it is a gradual increase in uncertainty.

DR. NORTH: My recommendation to you would be to have a careful review of this issue with the parts of EPA that have been studying it.

My own impression based on my involvement in this issue through the Science Advisory Board of EPA several years ago is your argument in Bullet 1 regarding ground water travel time seems a lot stronger than your argument in Bullet 2 with regard to climate change, and maybe you want a different rationale for 10,000 years than hanging it on Bullet 2 as you have got it stated.

I am not disagreeing with you about the 10,000 years. It just strikes me that your arguments supporting it in Bullet 2 isn't as strong as it perhaps could be.

Going on to another comment on -- this is on your Slide 4-A, about five or six further on -- I would like to commend you for endorsing the iterative use of performance assessment.

I think as you have stated it in this new section, it is an excellent idea. I would like to put the comment on the record that I don't think this is any reason for not encouraging iterative use of performance assessment well before the licensing process at which your consideration would start.

MR. CLARK: Not having the full text here in front of you, I can see where you'd think that. No, that's not what we meant. We meant even before licensing.

DR. NORTH: Okay. I think if you could make that explicit, it would be useful.

MR. CLARK: If you saw the entire language --

DR. NORTH: Yes, I am commenting on the language on your slide as opposed to having the full language in front of me.

MR. CLARK: That's what I assumed. Okay.

DR. NORTH: The final comment I would like to make is with regard to the three-bucket proposal. I haven't had a chance to study this and think about it extensively, but I would like to

commend you for putting this proposal forth for discussion, and I would hope that it would get a lot of very serious consideration by the interested and affected parties. If they're not interested in participating in a formal or negotiated rulemaking, I would hope at least this would be an area on which many parties would be willing to give it some serious consideration and provide EPA with their written comments.

I think the performance assessment community also ought to be encouraged to think about this and provide comment. What will compliance with this kind of a proposal entail? I have mixed reactions to it, myself, as somebody in the risk analysis fraternity. On the one hand, I'm very sensitive to the difficulty of assessing probabilities, once you get below one chance in 10. These are often going to be derived primarily from judgment as opposed to from data: such issues as what is the infiltration rate going to be as we look into the future, the probability of a volcanic eruption, et cetera. It's going to be hard to get that, on the basis of any kind of statistical analysis.

The assumptions underpinning such determinations are going to be matters for judgment, and we can expect, at least in some cases, considerable scientific debate. So trying to get exact probabilities on which everyone is going to agree seems to me a very definite problem.

On the other hand, I'm worried about going to the other extreme, were we look at a scenario and say, "Well, that goes in bucket two," and don't go any further in attempting to distinguish between events whose probability might be in the range of slightly over one and 10 and events whose probability might be approaching one in 10,000.

I would like to see the regulations such as to encourage a serious effort to get a numerical assessment, rather than simply placing that scenario in bucket two. In particular, if you don't do that, I think you have the potential that the regulation in practice could mean, if the probability is greater than one in 10,000 and the consequences are 10 times the level in Appendix B, then the site cannot be licensed. I'm not really sure you intended to do that. So it seems to me, this is an area where the language and the implementation, on the three-bucket proposal becomes quite critical.

MR. CLARK: I have no comment, other than to agree with you. We don't want to get locked into a particular bucket either, if it can be avoided.

DR. PRICE: On Subpart B, page two, you have the comment, "demonstrate compliance before emplacing waste into the facility." Could you expand on what that means? What is necessary to demonstrate compliance, particularly since you use the word demonstrate?

MR. CLARK: I am trying to figure out if this is a loaded question or not.

[Laughter.]

MR. CLARK: My immediate answer is that that's up to the implementing agency, quite literally. If you're asking me what quastile or whatever term you want to use that a CCDF has to fall in, we haven't determined that and we may not determine that. Right now, we leave it to the implementing agency to determine that.

If you're strictly asking for an explanation of what that means, that means, "Just go through whatever procedure your implementing agency has set up and you've convinced them that you can then proceed with waste emplacement."

Have either of those answered your question --realizing the implementing agency for high-level waste is NRC, and the implementing agency for transuranics or defense transuranics is the Department.

DR. PRICE: I want to think on that.

MR. CLARK: All right.

DR. CARTER: Any other questions from Board Members?

[No response.]

DR. CARTER: Let me ask you a couple, Ray. I believe that the EPA uses a range of risk to members of the public, as far as the things that they regulate in the environment; is that essentially true? Furthermore, I guess, I'd add that it ranges, as I recall, from along the order of 10 to the minus 6, to 10 to the minus 4.

MR. CLARK: Right. That's a goal.

DR. CARTER: So it depends on the circumstances and so forth. The question, then, specifically is: How does the thousand health effects of 10,000 years for 100,000 metric tons of heavy metal compare to that?

MR. CLARK: That's where I was trying to make the point on the slide, where we never intended to compare that. That falls more in our individual protection requirement section, where that comes into play.

DR. CARTER: So even though you have this range of the agency, you don't necessarily have to fit in that range, as far as risk level is concerned?

MR. CLARK: Actually, we're above that risk level, in our individual protection requirements.

DR. CARTER: What about the containment side of it?

MR. CLARK: We didn't intend that, as I've said. We didn't intend that to be an individual risk number. That's strictly a release limit, based on these generic analyses.

DR. CARTER: You're not going to argue then that your average -- you're above on one and below on the other, in terms of either individual protection of the containment requirements?

MR. CLARK: Individual, we're -- if we stay at 25 or above, I think we're at seven times 10 to the minus fourth, if I recall correctly, per individual, which means to get down to 10 to the minus fourth, we'd have to go to three millirem, which probably wouldn't excite people a lot. But that is a possibility. There is some talk about that.

DR. CARTER: The same question occurs -- would apply to the safe drinking water number of four millirem per year, which is, of course, based on radium considerations. I guess that, as far as I can tell, is a risk level of on the order of 10 to the minus seven 10 to the minus six, something like that.

MR. CLARK: Not our number. We show that at around 10 to the minus four, at least the factors we used in the Office of Radiation Programs.

DR. CARTER: The NCRP, for example, uses a one millirem as a risk level of 10 to the minus seven, so I'm sort of pegging it to that.

MR. CLARK: He pointed out that there might be lifetime versus annual risk. There's a factor of about two difference here.

DR. CARTER: Okay. The main point is, I guess, that the Agency, even though they use this level, you don't necessarily have to be within that for individual programs or individual radionuclides in this case?

MR. CLARK: Well, I can't speak for the Administrator, of course, but from my experience, no, it's not a hard and fast rule. It is a goal.

DR. CARTER: Okay. The other question I had relates to Carbon-14, I guess, and there is at least apparently inconsistency, for example, between the standard proposed for the repository and the standards of the NRC as far as release levels of Carbon-14 from reactors, for example.

I think if you calculate, taking a look at the repository as far as EPA is concerned, there's

something like an admissible release of a curie per year, and I guess if you calculate exposure, then you come out, you know, with a fraction of a millirem to someone that would be very close.

On the other hand, the default values for Carbon-14 looked at by the NRC in this case, the default value is 10 curies per year per reactor, and if we've got roughly 100, that comes out to 1000 curies per year. It would be legally permissible; in fact, something more than that, since we've got over 100 reactors. And if you compare that to one curie per year per repository, it certainly looks like there's an inconsistency in this.

It may be preferable to wait until Dan Fehringer talks, and we can have some discussion of this.

MR. CLARK: Well, the only comment I have now is --

DR. CARTER: Yes.

MR. CLARK: -- the lack of pathway consideration before. Second of all, you're probably not going to have this thing dribbling out at one curie per year. It's going to sit there and do nothing for awhile at least, and you're liable to have, you know, a larger amount than one curie per year.

But as I say, we're looking at that. You're right. I mean, at this point in time, there are several arguments that appear to be feasible and valid.

DR. CARTER: The other question -- and it's not the subject of today's meeting, but I just wondered if you had an opinion or a comment on it -- and that's the possibility now of having EPA implement 40 CFR 191 as far as the waste isolation pilot plant is concerned.

MR. CLARK: I'm sorry. The possibility of?

DR. CARTER: Yes. I guess there's been some discussion on that. Maybe not by EPA. [Laughter.]

MR. CLARK: Yes. That's part of what I -- on my last slide when I was talking about schedule, that's, of course, what I meant, the piece of legislation. We're willing and prepared if it's signed, but we're just waiting for Congressional action.

DR. CARTER: Okay. Any questions from the Staff?

[No response.]

DR. CARTER: How about members of the audience? Floyd Galpin. Please use the mike.

MR. GALPIN: Floyd Galpin at EPA. I just want to make a plea in terms of we really do want comment and response from not just the Board, but from all those interested parties here, and especially on all those issues in which we have indicated options or alternatives.

And I just want to say one thing more about the comments we get. What we've been finding is, there have been two kinds of comments that we've been having difficulty dealing with inside the bureaucracy.

One of those kinds of comments is the stated opinion without any backup. And what we get from our management is: Oh, that's nice; that's what that guy thinks. So where you've got a point, we hope that somebody -- that you can support it with whatever analysis there is, whatever references there are to support you, rather than just opinion.

The second kind of comment we've had difficulty with is where it is just a quoted opinion of even an expert body, be it IAEA, ICRP, whatever, and what we sometimes get confronted with there is, the Administrator or his Assistant Administrators say: Gee, I thought the Congress charged me with using my judgment and my opinion. You know, what do these people have that undergird their opinion. And so just having an opinion of an even august body doesn't always sell.

So I would just raise those two issues when you prepare comments for us. Thank you.

DR. CARTER: Thanks, Floyd.

MR. ERIKSSON: Leif Eriksson. And I would like to take a step back and ask you two general questions.

The first one pertains to the status of 40 CFR 191, and I would appreciate if you can clarify to me what applies today to the Yucca Mountain site? Is it the old 40 CFR 191? Is it portions thereof? Or are they working in a vacuum with the site suitability assessment, for example?

MR. CLARK: For 191, the way it stands now, Subpart A, the management and storage part, is in effect, legally binding. It was reinstated by the Court after the original remand, several months are.

Subpart B, however, is not legally in existence. That's not to say that nobody is following it. I think certainly at WIPP there are written agreements with the State that they will follow that until there's a new one. At least that's my understanding. And I believe with the Yucca Mountain project, they've said they'll follow that as a basis to proceed until there's a new one. But the legal status is, nothing there.

MR. ERIKSSON: Subpart A applies though?

MR. CLARK: It's the only part of the two that exists, yes.

MR. ERIKSSON: My second question pertains to international involvement. Your Tom Isaacs gave a very good overview yesterday of the various activities going on internationally with IAEA, NEA, and the CEC. And he referred frequently to NRC and DOE having active involvement in those organizations.

Permanent disposal of high-level waste is sort of a global problem, and maybe that's where you can find a solution.

To what extent has EPA been involved in those international activities, and to what extent are you planning to seek involvement, because you are, in fact, developing the overall performance standards for the repository?

MR. CLARK: Here I stand to be corrected, because I don't have the overall view of the Agency that some people do. Floyd might better respond to that question.

We have been involved in some of the modeling efforts -- and here, forgive my lack of knowledge -- Hydrocoin and those programs, INTRAVAL. We are involved there.

Oftentimes like standards that are being written and guidance, that sort of thing, we act through either NRC or DOE, who represent the country at those meetings. On occasion, we have been able to send someone to sit in on the meeting, but more often than not, the Commission or the Department are the official representative.

MR. ERIKSSON: Now my second half of the question. Are you going to maintain that role, or are you going to seek more active involvement?

MR. CLARK: I think they'd like -- "they" being upper management or middle management -- would like a little more of an active role. I honestly don't know where those efforts stand. I know where our travel budget stands.

[Laughter.]

That pretty well rules it out. But on a policy basis, I don't think we have any problem with a more active role.

MR. ERIKSSON: Thank you.

DR. CARTER: Robby?

MR. ROBERTSON: Robby Robertson, TRW. There appear to be in your discussion of

the setting of the standards to be met on this an implication fairly clearly that the technical feasibility or the ability to meet that standard was a part of the criteria for establishing the degree of tightness of it, which is kind a de minimis type strategy: The better the site, the tighter the requirements.

To what extent is my perception correct, and if so, what is the legal policy or philosophic underpinnings of that approach?

MR. CLARK: I am not sure I completely understood. In setting the thousand health effects level? Is that it?

MR. ROBERTSON: Yes.

MR. GALPIN: I think I understood what you were saying. But by basis of using a technology assessment to set the standard, this is not unusual. This is the way many standards are set. Sometimes it's called best available technology; sometimes it's called ALARA.

What you do is, you go in, you look at the technology and you look at the cost of what it takes to get to certain levels, and come up with an evaluation.

So I don't find us having done something unusual, except to the extent that, instead of looking at all alternatives for disposal, we confined ourselves, because of a law, to deep geological disposal.

So in that respect, yes, we limited ourselves in terms of looking at alternatives.

DR. CARTER: Steve.

MR. FRISHMAN: Steve Frishman, from Nevada.

Would you think that there is, maybe, value, or it would be appropriate to use this regulation as a vehicle to announce that spent fuel is a mixed waste?

MR. CLARK: No.

MR. FRISHMAN: Because you don't think it is, or because you don't think it's the right place?

MR. CLARK: It's not the right place. Organizationally, mixed waste comes under the Office of Solid Waste, at least at this point. And we are strictly setting radiation standards under the Atomic Energy Act here. We don't have authority. I'm speaking parochially here of the Office of Radiation Programs --

MR. FRISHMAN: I understand.

MR. CLARK: -- not of the agency.

From our point of view, we don't have RCRA, we just have the Atomic Energy Act. So that's what we're basing these standards on.

I think, and I'm certainly not up to date here, I think the Office of Solid Waste is currently considering whether spent fuel is a mixed waste, let me put it that way.

MR. FRISHMAN: Because it would be nice to have it on paper someplace.

MR. CLARK: Yes. I agree. But I think you need to ask them, rather than us, on that one.

DR. CARTER: Any other questions or comments?

MR. DOBSON: Dave Dobson from Department of Energy.

I just had a couple of follow-up questions, based on some of the ones that the Board had asked earlier.

The first one follows up on a question of Dr. Price's.

You've changed some words in Working Draft 3. You have something conceptually now called demonstrated compliance. And I wanted to know, there's a whole body of information that the NRC has developed, and DOE has worked on, in terms of the concept of reasonable

assurance.

I was wondering if you could comment on how the concept of demonstrated compliance differs from that of reasonable assurance.

MR. CLARK: Unless I am missing something -- and correct me if I am -- reasonable assurance would come into play under demonstration of compliance. Demonstration of compliance means the entire process you go through: just as an example, license application, having your hearings before the board, whatever board. And the reasonable assurance part comes in that you've convinced the board that there's reasonable assurance that they'll meet our standards.

But demonstration of compliance just means the entire process of presenting your case before the board and then saying, "Okay, go ahead and proceed."

MR. DOBSON: So in your view, then, this change to the working draft would not require any revision of Part 60, for example, in terms of how we go about interacting with the Commission?

MR. CLARK: Not on the question of reasonable assurance, no. I don't know procedurally how it would affect things.

MR. DOBSON: Okay. Two more quick ones.

MR. CLARK: I'm told that it doesn't.

MR. DOBSON: Okay. You have a 100,000-year qualitative assessment. I was wondering if you could clarify what a qualitative assessment is for 100,000 years.

Does that mean it doesn't involve calculations?

MR. CLARK: Here again it's a little squishy, depending on what your implementing agency would want it to be.

The idea we're after is to get a feel for what could happen to the site if those things did happen to the site, or to the possible consequences of it, if you have an event sitting out there that for some reason is likely to happen at 30,000 years that is not very likely at 5,000 years, that could lead to a major release.

It's to give you an idea, and some assurance, that your site is not going to fall apart quickly, after 10,000 years, for whatever reason.

MR. DOBSON: I understand that philosophically, but it sounds like a consequence analysis, involves some non-qualitative judgments.

MR. CLARK: Non-qualitative, did you say? I'm sorry. I just didn't hear the word.

MR. DOBSON: It sounds to me like, what you just described sounds quantitative.

MR. CLARK: No. No. It's certainly not intended to be.

MR. DOBSON: Okay.

The final one. For the several-bucket approach, the three-bucket approach that you described for probabilities of scenarios that ranged from, I guess it's 10 to the minus 5 to 10 to the minus 9 per year. Is that right? Was one in 10 presumably over a 10,000-year period?

MR. CLARK: Yes.

MR. DOBSON: Okay.

You said that we should do a deterministic evaluation of consequences, I understood.

Is there some guidance in the revised working draft, or can you give me some idea of how I do a deterministic evaluation of an event with a probability of 10 to the minus 8?

MR. CLARK: I would defer to Dan when he talks. You might want to ask him the same thing. I'd say, you say, okay, it's going to happen, and see what the consequences are. That's my initial answer. You don't factor in the probability in that case.

MR. DOBSON: Well, I understand. But that's my point, is that an event with a probability of 10 to the minus 8 is difficult to get a single number for a consequence.

A volcanism would be a good example. How do I do a consequence analysis of a volcanic event? Or at least, how do I do it non-probabilistically? I'm not sure I understand the approach.

MR. CLARK: You would identify your scenarios, and then go from there. Maybe I'm not sure what you're asking.

MR. DOBSON: Okay. Well, I guess it's difficult for me to understand what exactly is meant by a deterministic analysis of these low-probability events. I'm not sure that it's going to be something that is as straightforward as it may sound.

MR. CLARK: It's my understanding that's the intent, is it's that straightforward. But maybe I don't know.

DR. CARTER: Any other questions or comments?

Yes, sir.

DR. PRICE: Dennis Price.

Given what appears to be some conceptual vagueness as to what would constitute the demonstration of compliance, that somewhere, somehow there is a process and an ultimate package that has to be delivered that would demonstrate compliance.

And as I understood your previous answer, the judgment as to whether compliance was demonstrated would be made by the implementing agency. Is that correct?

DR. CARTER: That's correct.

DR. PRICE: What happens, since this is a regulation originating from EPA?

And I would think, then, by imposing a requirement to demonstrate compliance, you must have some concept of what such a demonstration would be, or else why would you impose the requirement.

And if that's so, then what would happen if EPA looks at it and says we don't think that compliance has been demonstrated?

MR. CLARK: Oh, boy. Let me handle the last one first, I guess. I may have to have you repeat some of that.

At this point, it's up to the implementing agency to set those procedures that they want to follow.

If, somehow, we got WIPP implementation, it's our plan to go through a whole 'nother rulemaking to set those kind of requirements as to what demonstrating compliance means.

What we mean right now is you meet the containment requirements, you meet individual protection and ground water protection requirements. As far as we're concerned, that's showing compliance.

DR. PRICE: But the requirements involve, for example, 10,000 years. So we don't wait for 10,000 years to occur, to indicate that you in fact have demonstrated compliance, or 1,000 years.

So you know, you obviously have some things in this compliance package that are demonstrated analytically, in a variety of ways. And judgment has to enter in, whether or not this is compliance. What of the modeling, everything else that goes with it, in all of the process?

Conceivably, then, you have a pretty clear idea of what ought to be in that, and then, whether or not what is there is sufficient to render a judgment of compliance. And is there such a conceivable thing?

Do you simply default to NRC or DOD? Or is there such a situation possible that you

would be in disagreement with the decision about compliance because what you see in your package as necessary is not the same thing that the implementing agencies might see? That's really the heart of my question. And how are these guidelines going to flow in order that there is concurrence across the agencies?

MR. CLARK: The legal status is about all I can talk about, I think.

The Commission, in the case of the high-level waste repository, can say, "Yes, that's great with us. Here's your license," and then, in the public hearing process leading up to that, we can become part of the record.

We can comment. We can write letters. We can do whatever procedures are possible within the Administration, if any. However, when push comes to shove, it's the Commission that makes the decision.

In the case of defense transuranics, it will be, at this point, some organization inside the Department of Energy that will take the data from the WIPP group and make that same decision, and it's up to them.

Here again, we might become part of the record, and we're interacting with both groups continually. So hopefully, it wouldn't come to that, that there would be a disagreement.

DR. PRICE: Well, this thing is probably obvious to everybody in the room but me.

Being an academician, I'm not completely sensitive to the ins and outs, but it appears to me that if you're providing a regulation that says demonstrate compliance, that for you to judge compliance would imply that you have some criteria.

What is the demonstration part of it? That's why I mentioned underline "demonstrate." What is necessary to be in that package?

Hopefully, then, the NRC or the Department of Defense or whoever, you would be all playing on the same level field as to what is really necessary, if you implement that regulation, that there is some kind of agreement.

MR. CLARK: Let me correct one thing you said, if I may. It's not Department of Defense. It's Department of Energy.

DR. PRICE: Yes. The defense side of Department of Energy.

MR. CLARK: They would play a role in that, right.

The way the system is set up is that EPA -- stop me if I'm going over things you know here, but EPA only has the authority to set generally-applicable environmental standards. We can't go and say okay, WIPP, you have to do this; Yucca Mountain, this; GCD, this.

I guess to implement or to enforce our standards, NRC incorporates, maybe not word for word but close to that, probably, into their licensing requirements for a repository, 10 CFR 60.

In the case of the Department, they incorporate our standards into their -- I'm not as clear here, I'm afraid -- into their orders, I assume, is where that goes.

So our standards are incorporated into those agencies' licensing requirements, and then they judge -- they can add some of their own. NRC has their "subsystem requirements" and various other -- all kinds of other requirements.

But amongst those are the embodiment of our standards. Therefore, their licensing board makes the decision as to whether -- based on their regulations, which incorporate our standards, whether they've met our standards or not, and the same with the Department of Energy.

Does that help?

DR. PRICE: I think my education needs to go on in a different forum.

MR. CLARK: Okay.

DR. CARTER: Let me interrupt, then.

I think we'll draw this session to a conclusion. We'll have a break.

Before we do that, we realize that there were a limited number of viewgraphs of Mr. Clark's presentation. We've had more made, and they should either be available now or they will be available later, so that anyone that wants a set of those may pick them up.

I'd like to thank not only Ray Clark but also Floyd Galpin from EPA for being with us, the Office of Radiation Programs, and we're glad that Ray came, instead of running a low probability of risk of getting wet in the Atlantic. We appreciate it very much.

We'll now break until 11:05.

[Brief recess.]

DR. CARTER: I would like to call the meeting back together, please.

We'd like to continue the discussion now of the rules and regulations as far as the repository is concerned, and we will now hear from the NRC as far as 10 CFR 60 is concerned, and our speaker will be Dr. Daniel Fehringer.

He's a Systems Performance Analyst with the Geosciences and Sciences Performance Branch of the NRC's Division of High-Level Waste Management.

His responsibilities have included interactions with the EPA on the development of safety standards compatible with performance assessment capabilities.

He has been involved with the development of 10 CFR 60 and has a comprehensive knowledge of the technical and policy bases for both the EPA standard and the NRC high-level waste regulations.

We're pleased to have Dr. Fehringer with us.

PRESENTATION ON NUCLEAR REGULATORY COMMISSION (NRC) REGULATION 10 CFR 60

[Slide.]

DR. FEHRINGER: My presentation today will be a repetition of one that I gave in December of last year to our Advisory Committee, and at that time, they were interested in the subsystem performance objectives in Part 60, a relatively limited part of the regulation but one of the more controversial parts of our regulation.

So my prepared remarks will only cover the subsystem performance objectives, but if you have questions about other parts of the rule or, as was brought up earlier, our suggestion to EPA on an alternative format for their standards, I will be glad to field any questions that you have.

[Slide.]

DR. FEHRINGER: Let me begin about 1978, when we had Part 60 under development. At that time, the basic philosophy that we were working with was that the regulations should match the design of a repository.

In a way, it kind of sounds like wimpy regulation, and yet, that's not an unreasonable approach to regulation of a new technology, where you have no experience.

The regulator and the developer kind of negotiate the features that the facility would have, and the regulation serves to document the results of their negotiation and to allow input into that negotiation by the other parties that might be interested; specifically, the affected members of the public.

At that time, in 1978, we expected that high-level waste would consist only of reprocessing waste, and at that time, it appeared that the hazardous lifetime of such waste was

limited to only 1,000 years.

I say "only" because of today's perspective, but at that time, 1,000 years seemed like a very major problem. We were used to licensing facilities with 30-year lifetimes, and that is comparable to a human generation, and 1,000 years brought on a whole new set of problems.

At that time, in 1978, there were no concepts of having any significant waste package containment for waste.

There would be a canister into which waste would be placed, but that was primarily a device for handling the wastes and transporting from the factory where they were generated to the repository, and it was not expected that that canister would provide any significant long-term containment of wastes.

There were plans to process wastes into a glass waste form, but in some discussions, people were even questioning the need for doing that processing.

There was some thought that perhaps a calcine or some moderate improvement to a calcine waste form would be adequate and that the expense of processing waste into glass was unnecessary.

So that left us with a situation, at that time, where there were really no engineered barriers being relied upon to provide a substantial degree of waste isolation. Instead, the site was being relied upon as the principle way to achieve isolation of waste in the biosphere.

[Slide.]

DR. FEHRINGER: In 1979, we had a change of management in the Waste Management Division at the NRC, and that brought a change in the basic philosophy that we were working with. Our new Director's philosophy was that the design of the facility should meet preestablished regulatory objectives, rather than the other way around.

Instead of conforming the regulation to a facility, the facility should conform to the regulation, and a staff goal was set. We wanted to have three-way redundancy in the design of a facility.

This was borrowing from the defense-in-depth concept that had been used to design nuclear power plants, where the waste cladding provides essentially complete containment of wastes.

If the cladding should fail, the primary coolant system boundary provides essentially complete containment of wastes, and if, for some reason, both of those should fail, then there is a large concrete-and-steel containment structure surrounding the whole facility that serves as a third barrier to release of radionuclides.

We tried to develop an analogous concept for a repository which would have 1,000 years of containment by waste canisters; if the canisters should fail, 1,000 years of containment by the repository or what we would now call the underground facility; and if both of those should fail, the site would then provide 1,000 years of containment.

Remember that we were still viewing this as a 1,000-year problem.

With reprocessing wastes, the inventory of longer-lived nuclides was small enough and the dosimetry of the time showed that the comparability of uranium ore was reached within 1,000 years, and so we thought that that was a long-enough period of time to be concerned as regulators.

[Slide.]

DR. FEHRINGER: In 1980, we published an advance notice of proposed rulemaking, and by 1980, we had begun to realize that reprocessing was probably not going to occur, at least not for the initial disposal of wastes.

The Carter Administration had announced its deferral policy for reprocessing. The uranium cartel had collapsed, and uranium prices had fallen, and there seemed to be no economic incentive, at least in the short term, for reprocessing.

So we began to think that spent fuel would be the waste form.

At the same time, some of the assumptions involved in radiation dosimetry had changed, causing a different perspective on when radioactive wastes and uranium ore deposits would reach a comparison on a toxicity comparison basis.

It seemed that that equivalence was not reached until about 10,000 years of decay if spent fuel was the waste form. So that caused problems for our 1,000-year, three-way redundancy goal.

We still stuck with a multiple-barrier concept in the advance notice, and we specified minimal levels of performance that we thought should be achieved by each of the major components of the repository.

We kept the 1,000 years of containment for the canisters and 1,000 years of containment by the underground facility if the canisters should fail.

We added a 1-part-in-100,000 annual release rate criterion for releases from the engineered barriers after the first 1,000 years, when the canister presumably would start to fail, and we proposed a 1,000-year radionuclide travel time as a measure of the isolation that was to be provided by the natural barriers of the repository system.

Significantly, the last bullet indicates that we did not try to provide any correlation between these subsystem performance objectives and the overall system criteria of the EPA standards.

We argued at the time that this type of multiple-barrier concept was important enough that it needed no justification by providing that correlation with the EPA standards, that it was just an obvious way to regulate a repository and that it had enough merit on its own that, no matter what form the EPA standards might ultimately take, that this multiple-barrier concept should be followed.

That assertion was not well received in the technical community, and we got a lot of comment that we were being unduly stringent in our proposal.

[Slide.]

DR. FEHRINGER: In 1981, when we published a proposed rule, we had some changes. We still had 1,000 years of waste package containment.

We dropped the provision for 1,000 years of containment by the underground facility, and we substituted the 10 to the minus 5th per year annual per-year release rate requirement after 1,000 years of initial containment by the waste package.

We changed from the 1,000-year radionuclide travel time to a 1,000-year ground water travel time criterion. At the time, it was thought that the radionuclide travel time criterion mixed two concepts: ground water travel time and radionuclide retardation.

The second one was thought to be particularly difficult to deal with in a regulatory sense, and we thought it made more sense to just limit the ground water travel time directly, rather than trying to work with a combination of the two.

Again, we provided no correlation with the EPA standards.

Even though comment on the advance notice had argued that there should be a correlation, we maintained our position that this multiple-barrier concept had merit on its own and there was no need for us to justify it by providing an analysis of equivalence with the EPA standard.

[Slide.]

DR. FEHRINGER: Again, we received a substantial amount of comment from the technical community disagreeing with our assertion that multiple barriers were appropriate in this case or, at least, that multiple barriers without a correlation to the EPA standard would be appropriate.

So in 1983, when we published the final rule, we did provide that kind of a demonstration. First of all, though, there were some changes in the general format of the subsystem objectives.

We kept the multiple-barrier concept, but we added an explicit provision allowing for tradeoffs among the barriers.

If, for some reason, one of the subsystem performance objectives appeared to be inappropriate, the Commission is now authorized by rule to either approve or specify some different performance objective.

The waste package containment requirement was altered to a small degree by specifying a range of containment times, 300 to 1,000 years, rather than the minimum 1,000, as had been in the proposed rule.

The 1-part-in-100,000 annual release rate provision remained unchanged, and the 1,000-year pre-emplacement ground water travel time remained unchanged.

Finally, as I mentioned, we did provide a demonstration of the relationship between these subsystem performance objectives and the containment requirements that were in a draft of the EPA standards.

The EPA standards had not been published final yet at that point, and we were working with one of the drafts that EPA was circulating.

That demonstration was documented in a report, NUREG-0804, and it shows that the subsystem objectives are beneficial in achieving compliance with the EPA standards. They're not necessary, and they're not sufficient.

The relationship is more one of a correlation, rather than a one-to-one correspondence. If you meet the subsystem performance objectives, it is more likely that you will meet the EPA standard than if you do not meet the subsystem performance objectives.

So that is the basis that we ultimately documented as our view on the relationship between the two sets of regulations.

We never tried to argue that it was necessary to meet subsystem objectives in order to meet the EPA standards, and it's not. You can find cases where one barrier alone will show compliance with EPA's release limits.

We did not argue that it was sufficient to meet the subsystem objectives. Those three provisions do not add up to compliance with the EPA standards alone. You need to have some additional help from the geochemical conditions at a site in order to achieve compliance.

[Slide.]

DR. FEHRINGER: The current status of the subsystem performance objectives is that they remain as they were promulgated in 1983.

There has been continued criticism by the Department of Energy and by the technical community. A lot of that stems from a disagreement with the basic regulatory philosophy that led us to the multiple-barrier concept in the first place.

Many people would prefer what's called an overall systems approach, where only one criterion is placed on the performance of the system, and the developer is given complete latitude to achieve that performance goal in any way that he finds appropriate.

He can use one barrier, he can use several barriers, and if he uses more than one barrier, he can adjust the levels of performance from those barriers as is appropriate in his mind or as is convenient.

Clearly, our regulatory philosophy, with multiple barriers, is different from that.

We are essentially asking for a degree of redundancy among the barriers and specifying minimum levels of performance, whether those minimum levels are strictly needed or whether an alternative way could be found to achieve compliance with the overall system goal.

There also have been problems with the specific wording of some of the performance objectives. In particular, the one that refers to substantially complete containment by waste packages has caused a lot of problem.

Interpretation of what "substantially complete" means has both us and other parties scratching our heads, and the ground water travel time objective has caused a lot of difficulty. There are phrases like fastest path of likely radionuclide travel that require interpretation.

[Slide.]

DR. FEHRINGER: Our future efforts include continued work to improve the wording of the existing subsystem objectives.

I just mentioned the two that have caused the most problem, the substantially complete containment and the pre-placement ground water travel time provisions.

We also have a provision that we call a flexibility provision. I mentioned it earlier. It allows the Commission to approve or specify alternative performance objectives, and we're looking a little bit at the wording on that.

It's been viewed as an exemption, rather than an alternative provision, and that's not what it's meant to be. It's not meant to say that DOE must come crawling to us and ask for an exemption from some objective that they find inappropriate.

It's meant to be truly an alternatives provision, where ground water travel time could be replaced with ground water flux, if that seems more appropriate for a specific site.

So we want to see if we can find better wording that will make more clear what the intent of that provision is.

[Slide.]

DR. FEHRINGER: This is not of particular interest to this group, but we are developing our own performance assessment capability, and we want to continue that development over the next several years, to do some performance assessments of the Yucca Mountain site for our own purposes, partly to develop the capability and partly to learn what we can from doing the assessments, and we want to use the results of this work, as appropriate, to continue to look at the relationship between the subsystem performance objectives and the overall standard that EPA is developing.

[Slide.]

DR. FEHRINGER: Finally, in the future, we will be developing what we call conforming amendments.

At some point, when EPA has developed their overall system performance standards, we will adopt the applicable parts of those standards, and at that time, we'll take another look at the relationship between our subsystem performance objectives and EPA's overall systems standard.

There are at least three reasons for taking another look.

EPA's release limits have already increased since the earlier analysis. When EPA's 1985 standards were published, the release limits were somewhat different and generally higher than they had been in the earlier draft that we used when we did our analysis.

EPA has added individual ground water protection requirements, and we never looked at those when we did our early assessment of subsystem objectives. They didn't exist at that time.

And there are other changes that may occur in the future. You had some discussion already this morning about the release limit for Carbon-14, and presumably, all of the release limits in EPA standards are subject to review as EPA re-issues its standards.

That's the end of my prepared remarks. If you have questions on this subject or any other, I will be glad to take them.

DR. CARTER: Okay. Questions or comments from Board members?

DR. DOMENICO: I have a few.

DR. CARTER: Yes, Pat.

DR. DOMENICO: Domenico.

The 1 part in 100,000, when you thought of this, did you consider that to be a design standard or a performance standard?

DR. FEHRINGER: These were all design standards, because one obviously cannot monitor for 10,000 years and verify that performance has been achieved. If that's the terminology you're using, then they're definitely design standards.

DR. DOMENICO: Not knowing anything about canisters and waste forms, is it possible to design such a system where it will release 1 part in 100,000?

I would think it would depend more strongly on the geochemical conditions and the things happening at the site, but you do view that as a design --

DR. FEHRINGER: Yes. At the time, we were convinced that the three subsystem objectives were technically achievable, and that was part of the basis for their development.

We thought that they were beneficial, and we also thought they were technically achievable without undue cost.

DR. DOMENICO: Have you ever noticed the coincidence, the fact that 1 part in 100,000 will empty the repository in 100,000 years, which corresponds pretty nicely with EPA's 100,000-year consideration? That's not a question; that's a comment.

The question is: Did I understand correctly that you may release some of the subsystem controls if the overall system performance can be achieved vis-a-vis EPA release records?

DR. FEHRINGER: Yes.

The regulation has a very explicit provision saying that the Commission may approve or specify alternative performance objectives, and if the Department could show that one of the performance objectives was just not appropriate or overly expensive, they could ask for an alternative performance objective, or the Commission could specify it.

DR. DOMENICO: My last question is, since you have a long history with this program, how many of these considerations came into being because at one point in time we were considering comparing nine repositories and, ultimately, three repositories, instead of dealing with just one?

Was that in any way influential in terms of setting up these subsystem performance standards?

DR. FEHRINGER: No. I don't recall that that ever was a consideration. When we developed Part 60, we always tried to make clear that we were not looking for the best repository system that could be conceived of.

Particularly if you go on a search for the best site, you will never find it. There will always be one over the horizon that might look a little better to somebody.

The comparison of alternative sites, I think, did originate in our rule, where we asked for

a comparative study of at least three sites, and at the time, we always thought that any of the three or all three could be judged acceptable, and perhaps, if more than one repository was needed, all three might ultimately be developed.

DR. DOMENICO: My question was you weren't looking at any of these subsystem performance standards to be able to judge between three, for example, which one might be "best."

DR. FEHRINGER: No.

DR. DOMENICO: No. Never. Thank you.

DR. CARTER: Let me ask you a couple of things.

I wonder if you'd clarify for us exactly what conformance means. I'm thinking particularly as far as conformance of 10 CFR, Part 60, with 40 CFR 191. What does that mean in a technical and legal sense? Is there any flexibility in it?

DR. FEHRINGER: What we have in mind with the conforming amendments is to adopt, pretty much word for word, the applicable parts of EPA's standards.

We say "conform," because we think there may be cases where we will want to change a word or two in order to conform EPA's terminology to the existing terminology in Part 60; either we adopt EPA's terminology or we change the words in their standards to the words that are already used in Part 60.

An example is "reasonable assurance," as used in Part 60, and "reasonable expectation," as used in the EPA standards. We think they mean the same, and we would not want to have two different terms in existence, implying that there might be a difference.

There are parts of the EPA standards that we think do not -- that EPA does not have the authority to issue; specifically, the assurance requirements, the new sections on demonstration of capability to comply, and so on.

We don't object to the substance of most of them, because virtually everything is already in Part 60. So we would not pick up those parts of the standards, and there are one or two parts of the standards that might not be applicable to us just because of the legal structure.

The 100,000-year comparison of alternative sites is the most obvious example. Site selection is not our business, and we would not add that particular provision to our regulations.

DR. CARTER: Well, does the Commission feel strongly enough, as far as the applicability of EPA responsibility in some of these things, to make this a legal issue, or they're just sort of complaining about it internally?

DR. FEHRINGER: Well, we have complained about it externally. We have complained to EPA for years, but we have never made a Federal case out of it, and I don't know whether the Commission will want to do so this time or not.

There is a general jurisdictional disagreement between EPA and NRC that is much broader than high-level waste, and it has been more touchy in other areas than in high-level waste.

So we're probably not going to be the ones that will precipitate a decision on how seriously we object to that type of provision.

DR. CARTER: Okay.

The other thing I might ask you -- and maybe Ray Clark would like to comment, but has either agency been beat over the head on the basis that you have dual regulations for the repository?

I'm considering your subsystem requirements, as well as the applicable provisions of 40 CFR 191.

DR. FEHRINGER: Well, as I mentioned in my presentation, there has been a lot of comment from the technical community that our subsystem performance objectives are unduly burdensome, that the Department should be given the flexibility to pick whatever levels of performance it thinks is appropriate for the components of a system.

We have not accepted that argument, obviously. We have maintained the multiple-barrier concept that is expressed in those subsystem performance objectives, and at the present time, our intent would be to continue to maintain a multiple-barrier concept.

If there is reason, we might fine-tune some of the specifics of the subsystem performance objectives.

In particular, the 10 to the minus 5th per year release rate criterion for Carbon-14 might not be as readily achievable as it would be for other nuclides and might not be as necessary as it would be for other nuclides.

So our thought at the present time is to keep the basic concept and look for what I would call more minor difficulties that could be fixed up to make the subsystem objectives workable.

DR. CARTER: Another question: As far as the differences of opinion, I guess, between the NRC staff and Commissioner Curtiss -- you might or might not want to answer the question, so I'll give that much preamble, but he is obviously concerned about the fact that there is not a close nexus between these two, and then you essentially say that, by design, they were made that way.

So I guess the question is: Is he going to educate the staff or is the staff going to educate him?

DR. FEHRINGER: We may end up agreeing to disagree on this one. We've had a number of discussions with Mr. Curtiss on this subject, and his view is more a legal one than a technical one.

His view is that DOE is faced with four criteria that they have to meet -- the overall system performance objective, the EPA standard, plus the three subsystem objectives -- and there is an opportunity for legal challenge or mischief making on each one of those four, and it makes the proof that the Department is faced with four times as difficult as it would be if there were only a single performance objective.

In at least one discussion with Commissioner Curtiss, he drew the analogy between EPA's uranium fuel cycle standards and the equivalent NRC regulations for nuclear power plants.

There we assertions that demonstrating compliance with our regulations was sufficient to show compliance with the EPA standards, and so there was no longer a need to show two separate demonstrations of compliance. There was a one-to-one correspondence.

If you showed compliance with the NRC's regulation, then that was taken to be evidence of compliance with the EPA standard, and Commissioner Curtiss implies he would like to see the same type of a relationship between the subsystem objectives of Part 60 and EPA's high-level waste standard; that if the Department shows compliance with subsystem objectives, that should be taken to be evidence of compliance with EPA's standards, and that would require some changes to the subsystem objectives as they now exist.

DR. CARTER: Another question, I suppose: Does the staff wish you had now specified a minimum carbon dioxide travel time to the accessible environment, rather than ground water travel time, or have both?

I'm not suggesting, by the way, seriously, that you add another subsystem requirement.

DR. FEHRINGER: No. And I think that probably would not be beneficial to treat that

one separately, but I think the current exemption provision is probably the way to deal with Carbon-14, to recognize that it was not foreseen.

It doesn't make good sense to try to limit the release of that radionuclide to 10 to the minus 5th. It doesn't seem to buy anything of particular safety significance.

So if the Department would ask for an alternative performance objective, I think we would look upon it probably favorably. I can't speak for the Commission, but I think the Commission would at least want to entertain an alternative.

DR. CARTER: Okay.

Any other questions or comments from the Board?

DR. DOMENICO: I have to ask one more. I need a clarification, because eventually we have to write this up, and I think you told Mel something opposite from what you told me.

The question was we have the subsystem performance standards and the EPA standard, and my question was that if it can be demonstrated to meet the EPA standard and you may be in violation of one of the subsystem standards, will this be a problem? I think you told me no, there are tradeoffs.

For example, if you find you have a very fast travel time and you want to keep it in the container a little bit longer or something of that sort, these tradeoffs are possible, whereby you do not have to specifically meet the subsystem standards if you can demonstrate to meet the overall standard.

I think you said yes to me and no to Mel.

DR. FEHRINGER: Well, I didn't mean to say yes in a very blanket way. I meant to say that the regulation allows approval or specification of alternative performance objectives. It does not say that DOE can ignore the performance objectives.

There would have to be a demonstration by the Department that it was appropriate to pursue an alternative performance objective, or the Commission would have to take the initiative and say you shall pursue this other alternative, and I think that's consistent with what I told Mel.

DR. DOMENICO: What did you just say?

DR. FEHRINGER: What did I just say? I said the rule is flexible but not without Commission action.

The Commission must approve or specify any alternative performance objectives, and the Department should not think that the performance objectives have been rescinded and they can ignore them.

DR. DOMENICO: I think, also, the problem with the Carbon-14 is not so much to 1 part in 100,000 per year. I think it's mostly that the total release in the appendices will probably be exceeded, that total number back there.

I think that is the basic problem, not so much the rate at which it's released.

DR. FEHRINGER: That's my understand, also, that there is more difficulty in projecting compliance with EPA's cumulative release limit than with the 10 to the minus 5th provision of our rule, although the 10 to the minus 5th provision has been raised as a potential problem.

DR. DOMENICO: Thank you.

DR. CARTER: Any other questions or comments from Board members?

[No response.]

DR. CARTER: How about the staff?

Dr. Parry and then Dr. Reiter.

DR. PARRY: Jack Parry of the Nuclear Waste Technical Review Board staff.

Just a clarification, Dan, about the point on flexibility: When you say "Commission,"

you mean the sitting Commissioners, don't you?

DR. FEHRINGER: The rule says Commission. I have asked our legal counsel who that is, and they think there may be an opportunity for the Commission to delegate that responsibility to a licensing board, but it's unclear as to just who is referred to by "the Commission."

DR. PARRY: But then that would require Commission action.

DR. FEHRINGER: If it is reserved to the five-member Commission, yes.

DR. PARRY: So that, for instance, if the DOE were to propose a long-lived barrier system as an option, perhaps one of several thousand years substantially complete containment, that would require, given the current understanding, action by the Commission.

DR. FEHRINGER: Yes.

DR. PARRY: Thank you.

DR. REITER: Leon Reiter from the TRB staff.

Dan, I want to take advantage of your willingness to answer some of the questions that were raised before about compliance.

There is a feeling by some that in many cases the devil is in the details here; in other words, that determining what constitutes compliance may be a really important issue.

I'd like to bring up two examples, two questions, and I wonder if you could comment on that and the general issue.

The first is with the CCDF. I was looking at the WIPP demonstration of compliance, and of course, depending on which percentile you get, it varies all over the map, and they, WIPP, has decided that their measure of compliance is the arithmetic mean.

Question: Does the staff also agree to that?

The second is -- with the questions raised before by several people -- in this second bucket, what constitutes deterministic calculations?

DR. FEHRINGER: Your first question of what numerical level of confidence constitutes reasonable assurance, we have never allowed ourselves to be pinned down on any specific number, for the reason that there is no single number.

Reasonable assurance is that degree of certainty that is reasonable in light of the decision that's being made, and in order to make the decision, you have to look at things like what happens if you're wrong?

In reactor licensing, some types of decisions involve the potential for enormous releases of radioactive material, and in that case, you want to be quite certain that your decision is a correct one.

In other cases, particularly some of our materials licensing cases, if something goes wrong, it's not a big deal. We're working with a very small amount of radioactive material; there is very little potential for serious harm.

The degree of certainty in the two cases is much different, and I think an analogy can be drawn with repository licensing. You'll need to look at what happens if your decision is wrong when deciding how certain you must be that your decision is a right one.

So that's kind of the thinking that we have on reasonable assurance. We know there is going to be a lot of uncertainty, and we know that a lot of that uncertainty cannot be quantified in any meaningful way.

You've got to look at the un-quantified uncertainties, as well as those that are reported in some percentile curve on a CCDF, and that's why we have a licensing board to examine all those factors that go into a decision.

About the question on three-bucket concept, I borrowed Ray's viewgraph just as a prop.

[Slide.]

DR. FEHRINGER: Our concept, as was described by Ray, involves continuation of a probabilistic analysis for the more likely scenarios leading to release, and as in the current situation, we would not require any analysis of those scenarios that are so unlikely that common sense says you don't worry about them.

Our only change is in the second category. As we proposed the concept to EPA, we would have had the bottom end of the category defined qualitatively, saying scenarios that are not sufficiently credible to warrant consideration, and EPA interpreted that as greater than 1 chance in 10,000.

At the time, I didn't think that was a major disruption to the fundamental concept we are proposing, but having given it more thought, I am now convinced that it is a significant disruption.

The idea is to do consequence analyses only for events in that second category and not try to estimate the numerical probabilities that those scenarios will occur.

A consequence analysis is not necessarily a deterministic analysis in the normal jargon. A consequence analysis might include an uncertainty analysis, or it might be a bounding analysis.

One might pick worst-case estimates for all the parameters that go into the release estimate and just use those as a conservative estimate.

So in the sense that an uncertainty analysis is considered probabilistic, that would be an acceptable way to address releases in the second category.

What we were trying to get away from was estimating the probabilities that those disruptive events would occur.

The reason I decided that the numerical definition on the lower end of the category is a problem is because you can't really determine whether you have complied with that without estimating all the probabilities of the events that constitute scenarios that might fall into that category.

So I think if one is to really adopt this concept and avoid numerical probability estimates, it will be necessary to have a qualitative definition of the lower bound on that second category.

DR. CARTER: Dr. Barnard.

DR. BARNARD: Bill Barnard.

I'd like to pick up on the question that Jack Parry asked.

Last year, the NRC issued a Technical Position Paper on long-lived waste packages that indicated that DOE could receive credit during the licensing proceeding for any packages that lasted beyond 1,000 years.

Are there any plans to incorporate the substance of that technical position in the regulations?

DR. FEHRINGER: I don't know. I haven't followed that particular concept that closely. I know there was a suggestion internally that we should do so, and I just don't know if a decision has been made.

DR. CARTER: Okay. Any questions or comments from members of the audience? Please identify yourselves.

MR. LUGO: Mike Lugo, SAIC.

I've got two questions.

My first one, I'd like you to clarify the answer you gave to Dr. Parry, in addition to the answer you just gave now.

My understanding is that if DOE were to come in with a proposal to have longer-than-1,000-year waste package and they were not to want to trade off another performance objective, it would not require Commission action. Is that a correct assumption?

DR. FEHRINGER: That's not the way I read the rule. The rule says alternatives must be approved or specified by the Commission. It's a legal matter for your counsel and our counsel to work out, I think.

MR. LUGO: The way I guess it's being understood lately because of the SP that was issued by the staff is that the 300 to 1,000 years is a minimum requirement, and therefore, anything about that would not be precluding.

DR. FEHRINGER: Oh. If the question is whether you can recognize a longer-lived canister when doing an overall system performance analysis, clearly you can. There is no need for Commission approval of that.

It's the question of whether you can back off on another performance objective that, I think, does require Commission attention.

MR. LUGO: Okay. That was what I was getting at.

My second question has to do with past proposals that you received for eliminating the subsystem requirements.

I know that you rejected those proposals, and I want you to comment on this proposal.

Obviously, the reason we have done that is because you feel that it's important -- and, I guess, so do I -- to maintain the multiple-barrier concept for your defense-in-depth approach.

In 113, Part 60, you already do have a requirement for a multiple-barrier concept by indicating that containment of high-level waste shall be substantially complete during the earlier phases and then, afterwards, there shall be a controlled release.

If you were to maintain that requirement by not have the numerical limits in there and maybe even consider putting the numerical limits in some kind of a regulatory guidance document, how would you feel that would work?

You would still have a multiple-barrier concept as a requirement but not the numerical limits.

DR. FEHRINGER: That is a concept that we have considered internally ourselves, at the staff level.

Some years ago, we thought it was important to write the numerical performance objectives into the regulation because of the way the repository program was developing at that time.

Remember, in one of my earlier viewgraphs, I showed that there was very little reliance on engineered barriers back in the late '70s, that the natural barriers of the site were being relied upon, almost exclusively, to provide waste isolation.

The pendulum seems to have swung the other direction now. It seems like engineered barriers are being relied upon more and more and the natural barriers of the site less and less.

So perhaps the rule has achieved what it was meant to, and maybe there is less need to keep the numerical objectives in the rule.

So that's my personal view on your proposal, and it is one of the alternatives that the staff at large is considering, and I can't predict anymore than that what the outcome might be.

MR. ERIKSSON: Lief Eriksson.

I think NRC is entitled to have their sub-criteria, but as a pragmatic technocrat, I also think that those criteria should be technically and scientifically defensible, and I refer particularly to the ground water travel time.

When that rule was implemented by NRC, the distance to the accessible environment was 10 kilometers. Subsequently, EPA has shortened that distance to half, 5 kilometers, and in simple terms, I'm used to thinking about travel time in terms of speed and distance.

What are you going to do about the change in distance to the accessible environment?

I have noted that the NRC still remains their 10 kilometers in 10 CFR 60. They haven't changed that definition of accessible environment yet, or controlled area, rather, is the definition.

DR. FEHRINGER: Let me respond to the latter part of your question first.

That distance in the definition of controlled area is one of the things that we would address in the conforming amendments. When EPA settles on their standards and gets a distance specified, then we would adopt that in Part 60 as our distance, also.

As far as any changes that might occur, if it really appears that a reduction in that distance by EPA has caused practical difficulties in achieving compliance with Part 60, then that would be a basis for us to reexamine our subsystem performance objectives, and we plan to do that.

We expect that there will be several changes -- I listed three of them -- from the 1983 draft we were working with.

Release limits have changed, individual and ground water protection requirements have been added, and there may be things like Carbon-14 release limits changed, and if a distance to the accessible environment is changed, we'll evaluate that, as well, when we decide whether any changes are appropriate for the subsystem objectives.

MR. RAMSPOT: I'm Larry Ramspot from Lawrence Livermore Lab, and I'd like to offer a hypothetical scenario and ask you how you would see it being handled in licensing for the subsystem performance objective of 1 part in 10 to the 5th per year.

That's measured yearly, obviously, and the negotiated understanding between DOE and NRC, as I understand it right now, is it will be measured at the borehole wall, and it's also measured nuclide by nuclide.

So you can come up with a scenario that, for a few years, some particular radionuclide might release at greater than 1 part in 10 to the 5th per year, one that was very highly soluble, and yet, overall, over the 9,000 years that that governs, it would release at a very low rate, maybe even 1 part in 10 to the minus 6th or 10 to the minus 7th.

So in, actually, the practical application of this, how would this be handled?

Would this have to be handled by an application to the Commission for an exemption, simply because one radionuclide for one year did not meet that requirement out of the 9,000 years, or would this be something that would be kind of averaged out or folded in, or can you answer that?

DR. FEHRINGER: Well, I can tell you a couple of possibilities for how it could be handled.

One is what you suggested, that DOE could prepare a case to submit to the Commission, saying on average, we have done what is needed to meet the intent of the objective, and even though it appears there might be a technical violation, we would like the Commission to approve what we have proposed.

Another alternative would be to identify that condition before the license application is submitted and either ask the staff to take an initiative or petition the Commission for rulemaking in order to get whatever relief is thought to be appropriate.

Particularly if it's a minor thing like a few years of technical violation, it should be relatively easy to fine-tune the wording of the subsystem objectives.

So there are at least those two routes that could be taken. I suppose there might be others.

DR. CARTER: Steve.

MR. FRISHMAN: Steve Frishman.

In thinking about the 1,000-year ground water travel time, was there any consideration -- I should know this, but I just don't recall, and I don't remember ever having seen anything about it -- was there any thought given to the possibility of saturated versus unsaturated and whether, in fact, the term "ground water" is really just a surrogate for fluid?

DR. FEHRINGER: Yes. That was a major consideration, and when the rule was first issued, it applied only to repositories located in the saturated zone.

Later, an amendment was made to extend the applicability to repositories in an unsaturated zone, and ground water was defined to include all water below the surface of the land, whether in a saturated zone or in the unsaturated zone, and that has some ramifications for determining what the ground water travel time is.

To my knowledge, there was no consideration, though, if using ground water was a surrogate for other fluids like air. It was meant to refer to water which would serve as a transportation medium for releasing waste from the repository to the environment.

MR. FRISHMAN: Okay. In any of your thinking now, just as, you know, EPA is having to deal with this question of, admittedly, not thinking about gaseous releases, where are you going with that?

DR. FEHRINGER: We recognize the potential for Carbon-14 to be released in a gaseous mode.

We are not aware that there is any other nuclide that has the same potential difficulty, and we haven't entertained the notion of modifying our regulations to date, other than what I mentioned earlier, to recognize that if EPA changes their overall release limit, the 10 to the minus 5th provision might technically be violated for Carbon-14, and we might need to take another look at that.

But we have no substantive effort underway to overhaul Part 60 to address gaseous releases.

MR. FRISHMAN: I'm just think that, you know, both you and EPA are slowly being moved into this situation where you're having to think about your rules in a non-generic sense.

You're having to think about them in terms of how is the potential applicant's thinking developing relative to a particular site that it's working on, and let me just give you an example of how far you can go.

You say you're not talking -- you're not really particularly thinking about gaseous releases right now, because you can't really see a situation where you would have to.

How about we go to what was being talked about the other day, the possibility of a multi-purpose container, where you have spent fuel put into some type of a unit, where that unit ultimately becomes the container that is emplaced in a repository. What about xenon and krypton?

DR. FEHRINGER: To my knowledge, xenon and krypton nuclides don't have a long-enough half-life that they're likely to be a particular problem. Iodine is the only other radionuclide that I know of that has a long-enough half-life.

MR. FRISHMAN: I'm thinking about, you know, the possibility of an early failure of one of these things in a situation where we know we have very rapid gaseous transport through a rock body.

So what I'm trying to point out is that the regulators are getting more and more thrust into a situation of having circumstances driving the thinking about regulations, where 10 years ago we all thought very hard about these regulations, and I don't think it was through ignorance that we didn't have them tuned just right to a particular application you think is coming.

DR. FEHRINGER: Let me say something that probably will not make you very happy, but I'll say it anyway.

MR. FRISHMAN: I'm sure it won't make me happy. I know what's coming.

DR. FEHRINGER: We're not convinced that gaseous releases of radionuclides have been shown to be a public health problem, and that's why we're not particularly worked up about fine-tuning our rules.

For Carbon-14, it appears that releases would be a small fraction of the existing inventory of naturally-generated Carbon-14. As pointed out this morning, it would be a small fraction of what's allowed to be released from operating power plants.

So we look at that release mode as kind of a technicality, that even though a repository might clearly meet the intent of our regulations in providing good, substantive multiple barriers and being a very robust system, there might be this potential release of one radionuclide that would technically violate our rules, and we don't think it makes sense to get all worked up over that minor violation for otherwise a very good system.

I think carbon and xenon, in the example that was given, would probably be in the same category.

I have never heard anyone argue seriously that that is a real threat to public health and safety, that a small release of the residual noble gases from spent fuel would be a real public health threat, and if there is no public health threat, I see no reason why we should try to regulate such things.

DR. CARTER: Other questions or comments?

DR. DOMENICO: I have a comment to that last one.

Would EPA go along with that last statement? Because I think it's your call, not NRC's.

MR. CLARK: Which last statement?

DR. DOMENICO: The last three-minute statement about Carbon-14 -- releases of Carbon-14 do not represent a health hazard and they are not to be concerned with. I think that was the gist of that. I say it's your call, not NRC's. I say that's the call of the EPA, not NRC.

MR. CLARK: Well, certainly, for our release limits, that's correct, and as I say, we're reexamining what we've done in the past to see whether we think it's a real health hazard or not. That's still open, in our minds.

DR. CARTER: Yes, Dr. North.

DR. NORTH: I'd like to add my voice to this discussion.

It seems to me that this problem of unresolved ambiguity and having standards such as is it a public health threat that motivate the detailed rulemaking but are not explicit in the rules themselves provides a real problem, both for the applicant and for the interested and affected parties.

It would be very good to get the rules of this game clearly set forth before enormous amounts of time are spent developing the licensing application, and I would hope the agencies, both NRC and EPA, would recognize the usefulness of getting these clarifications on gaseous releases and other items out there for purposes of making life easier for the other people in this process and hopefully making a more effective decision process possible.

DR. CARTER: Very good.

If there are no more, what I'd like to do now is certainly thank Dan Fehringer and, also, Ray Clark for being our speakers this morning.

We are a little bit ahead of schedule. So we will split the time, and assuming that Paul Gnirk will be here at 1:15, we will reconvene the session at that time.

DR. GNIRK: I will be here.

DR. CARTER: Very good.

We are now adjourned until 1:15.

[Whereupon, at 12:10 p.m., the meeting recessed for lunch, to reconvene this same day, Wednesday, July 17, 1991, at 1:15 p.m.]

AFTERNOON SESSION

[1:20 p.m.]

DR. DEERE: Good afternoon. Our first speaker this afternoon is Dr. Paul Gnirk. Dr. Gnirk is Principal Consultant with RE/SPEC, Inc. and has more than 20 years experience in many areas of the geologic disposal program. He has been involved in a number of activities relating to the program, including serving as co-leader of Sandia's decision methodology group for the ESF alternative study, and participating as a member of the DOE's technical integration group for performance assessment.

Since 1980 Dr. Gnirk has served as one of the DOE's representatives to the International OECD/NEA Stripa Project. We have invited him to give us a historical review of how the DOE site selection criteria, 10 CFR 960 were developed. Paul, welcome.

HISTORICAL OVERVIEW OF DOE SITE-SELECTION CRITERIA 10 CFR 960

DR. GNIRK: You serve with dubious honor when you get to that point in your life when you become the program historian about all this stuff. It seems like you sort of predate everybody in the room. I have been before this distinguished group on a number of occasions. In '89 I talked about performance assessment along with Jean in 1990 at an exploratory shaft facility, and now I'm talking about the guidelines from back in 1983. The analogy is that prior to my involvement in the guidelines, in April of 1983, I spent the previous three years working on performance analysis for the salt program and the NWTs program at Yucca Mountain, and also advising the various people at DOE, at Yucca Mountain on the shaft excavation techniques and the underground stability requirements at Yucca Mountain. So one wonders if I am going through like a seven-year or eight-year cycle, that I am starting again with the guidelines and going through another process and all this. One wonders over a period of time.

[Slide.]

DR. GNIRK: I am going to talk today about the history of the development and application of 10 CFR Part 960.

[Slide.]

DR. GNIRK: In particular, it's going to cover three areas: The history of the development of the rule; the structure of the rule, in particular the post-closure guidelines; the implementation guidelines and how they're applied through the siting process; and then some applications that have occurred since the development of those guidelines.

I would urge this Board, if they have questions at any time when I'm speaking, please don't hesitate to interrupt me to ask questions. That doesn't bother my presentation at all. It's easier sometimes to have the questions answered during the presentation than wait till the end.

[Slide.]

DR. GNIRK: It all began with the Nuclear Waste Policy Act of 1982, which was passed on December of 1982 and actually went into law in January of '83. In Section 112(a) of that law it says that no later than 180 days after the date of the enactment of this act, the Secretary, following consultation with the Council of Environmental Quality, Administrator of the Environmental Protection Agency, the Director of the Geological Survey, and interested Governors and the concurrence of the Commission shall issue general guidelines and recommendation of sites for repositories. That's spelled out very very clearly in 112(a). This was the emphasis that directed DOE to proceed with the development of the guidelines.

[Slide.]

DR. GNIRK: Furthermore, in Section 112(a), it gives some general framework, guidelines I guess, for framing these guidelines, in the sense of things that should be considered. These guidelines were intended to specify detailed geologic considerations that shall be the primary criteria for the selection of sites and various geologic media, and shall specify factors that both qualify and disqualify the sites for development as a repository, including factors related to mineral resources or natural resources, hydrology, geophysics, seismic activity, et cetera, et cetera, et cetera. It's all spelled out very clearly in 112(a).

Furthermore, in that section, it says: "The Secretary shall use guidelines established under this subsection in considering candidate sites for recommendation no later than January 1st, 1985 for characterization."

[Slide.]

DR. GNIRK: So with that in mind, the Department of Energy, in the middle of February -- the 24th of February or something like that, published in the Federal Register, the draft proposed guidelines. They were developed by a group of people in February, based on a number of documents -- a number of studies that have been done in the past. This included the National Waste Terminal Storage Program objectives, the system performance and site performance criteria work through a series of documents that have been developed in the program, National Academy of Science criteria that have been developed and also the International Atomic Energy Agency, and criteria that were developed at the Oak Ridge National Laboratory, by the group at Oak Ridge National Laboratory in the middle '70s, by George Brunton and the late Bill McClain.

It also was based -- the guideline draft was based on advanced information from the NRC, regarding development of 10 CFR Part 60, and the National Waste Policy Act requirements in Section 112(a).

This document came out in February, and it was sent out for review. It went to the six or seven first repository states and went to 17 of the second repository states or to those governors. The document was sent to 4,000 interested people who had written comments at various times at DOE on various parts of the program. It went to 200 consumer groups and public interest groups, with the request for comment. It was put in the various DOE libraries and so forth.

There was a 45-day comment period, which was subsequently extended to 60 days. Out of that came roughly 119 written replies, which were dissected into 2,000 comments. That process of dissecting those comments and reconstructing or trying to revise the rule began in the early part of April of 1983 when I became involved in all of this.

In addition, the Department of Energy held hearings in various states -- public hearings, as well as consultation meetings with the various states involved for the first repository.

With this large amount of information, we began to revise the rule, or tried to work in all the comments that were given to us.

At that time, I might add, it wasn't a very large group of people. This group, this task force, as it was set up by the Department of Energy, consisted of about 12 to 14 people, something like that.

The chief person at DOE who was in charge of that was Bill Bennett, but the person who carried out most of the work in management was Critz George, who is here today, and he was assisted by Carol Hanlon at DOE.

Bob Mussler, who is now at the negotiator's office, was the legal person who looked at the rule as we were revising it.

We had Tom Hunter, who started in April with some of the organization. He spent a couple of months.

Myself, I was sort of, I guess, for lack of a better word, sort of a facilitator of all this to web it all together.

Bill Hewitt represented the salt project.

Scott Sinnock, from Sandia, represented the tuff project, with the help of Bill Twenhofel.

Larry Fitch represented the basalt project, with the help of Don Carroll.

Jim Finley, from Battelle, handled socioeconomics.

Chet Bradley and Carol Borgstrom, from DOE, handled the environment, and we had the Sandia transportation group and the Battelle transportation group that provided us input on the transportation.

Felton Bingham wrote the first draft of the preamble, and Critz George handled the population end of things, and then we had everybody in the program who reviewed all of our various drafts, and we put together, then, eventually, a second draft, which was known as the alternative guidelines, which went out, I think, on or about the 27th of May.

These were called the alternative guidelines to the DOE guidelines, because they were -- as you read in the preamble, they were developed by the task force and offered as an alternative to the first issue.

In those alternative guidelines, what we had done was we had segregated the guidelines into post-closure and pre-closure, which was not done in the first set.

Secondly, we added what was known as the implementation guidelines.

So there was a process or a framework for implementing the entire set of guidelines at each stage of the selection process, site-selection and screening process, potentially-acceptable sites, sites that were nominated as suitable for characterization, recommended for characterization, and recommended for development of repository; had the rule segmented into four subparts, as I said: implementation, post-closure, pre-closure, and then an applicability section at the front with definitions.

That went out for review, with additional meetings with the interested states.

I was involved with Bill Hewitt and the DOE people when we met with the people in the salt states, including the State of Texas, which, at that time, Steve Frishman was there and was across the table and provided us with his oral comments and then, later, written comments, and the people at Nevada and in the State of Washington, DOE people and their contracts, met with the various state people, and in the Chicago office, with the second repository people.

Then we had one or more large meetings in Dallas in which Critz and Bill Bennett chaired, with all of the states, and we sat in the room and answered questions and went through all of this.

So based on the alternative guidelines, we came back to Washington, D.C., with all of this information, and at that time, we had about -- I don't know -- 57, 58 written replies, formally, as well as our meeting.

We ended up with 900 comments that we got, and we segmented them all out, and we went through another revision of the guidelines, which were issued in August of 1983.

These were submitted to DOE management for review and approval and sent to the states for their information, keeping in mind, though, that we spent, really, a lot of time looking at comments.

[Slide.]

DR. GNIRK: I would say, in defense or in support of the Department of Energy, the task

force that was working on this, the technical people, were not directed to make changes in the technical guidelines.

They were not directed by management to make changes, you know, because it was something they didn't like.

We worked on the rule. The rule was reviewed by people in the Department of Energy. They offered comments. They offered ways to change things around. We took that into consideration. We considered all this.

It was reviewed by Bob Mussler from a legal standpoint, by the environmental people. We consulted with the EPA, with the late Dan Egan.

We consulted with the NRC; we had meetings with them and the Council of Environmental Quality and all these various people, and all of this was taken into consideration.

DOE honestly gave us a very free hand in developing this from a technical point of view and offered us suggestions.

Of course, they had to concur on all this, and from the viewpoint of the implementation guidelines to implement all this, that was basically crafted by Bill Hewitt and myself, with suggestions by the DOE people, as we worked it out.

In that early, middle-summer version, we had a provision in there for the development of the methodology to pick sites, select sites, and that methodology would have included representatives from the states.

It was a decision by the Department of Energy, based on their responsibility under the law, not to include that in the final version that went, in August, to management at that point in time.

So in November of '83, the DOE submitted the final revised guidelines to the NRC for concurrence, and in December, the NRC issued a preliminary concurrence decision, and there was a meeting in January, and their concurrence decision would be based, essentially, on three things.

The siting guidelines could not be in conflict with 10 CFR, Part 60, their own rule. The siting guidelines must not contain provisions that might lead the DOE to select sites that would not be reasonable alternatives for an EIS, and thirdly, the siting guidelines should not contain provisions that are in conflict with the Act. That was their basis.

[Slide.]

DR. GNIRK: Subsequently, in March of 1985, they said that NRC issued whatever they call their documents that said that they would concur with the siting guidelines provided that DOE met seven conditions.

I have not listed all the seven, but I list one which had a lot of impact on everything.

DR. CANTLON: You said '85. It was '84.

DR. GNIRK: '84.

DR. CANTLON: Okay.

DR. GNIRK: Sorry.

The NRC requested that the DOE specify in greater detail how the guidelines would be applied at each stage of the siting process, including the site nomination and characterization; for example, specifying the implementation guidelines, which guidelines would be applied at each stage of the site screening.

This particular requirement led to the development of what is known as Appendix 3 in the siting guidelines, which has the findings, the findings at the point of nomination and recommendation and the findings at the point of site selection; that is, the recommendation of a

site for development as a repository.

It has the different findings, and the findings are all related to the various qualifying conditions, the disqualifying conditions within the rule itself.

So we began meeting -- we, the DOE, with Bill Hewitt and I as the technical consultants, began meeting with the NRC staff in March, April, and May, went through a series of six meetings in which we negotiated or revised the concerns and accommodated the concerns of the NRC, such that in June, at a meeting -- the 14th or 24th of June -- the NRC Commissioners voted unanimously to grant concurrence to the guidelines, and the guidelines were finally published in the Federal Register in December of 1984.

It took a little longer than 180 days, but we got there with the concurrence of everybody, and I might add that, in addition to the document itself which went into the Federal Register, there was documents developed on the comment resolution of all the various comments that were provided to the Department on the rule itself over the period of time it was looked at.

[Slide.]

DR. GNIRK: So what does it consist of, as I said, the rule, when you read it?

It's long. It's involved, in many cases. It covers a broad spectrum, from geology through socioeconomics, transportation, a broad spectrum of things that relate to the siting of repositories.

Subpart A has two sections, applicability and definitions.

Applicability says very specifically these guidelines are to be used in evaluating the suitability of sites for the development of repositories, straightforward, right from the Act itself, and it recognizes that the NRC has jurisdiction for resolutions of differences between the guidelines and 10 CFR, Part 60.

In the definitions, we have 102 definitions in this particular rule, and we define such things as "determination," which was to be made by the Secretary, what "evaluation" means, what "likely" means, "mitigation," "siting," to the extent practicable, and you ask why did we do this?

Well, I have to admit, I had discussions with Bob Mussler, and I wrote some definitions, and Bob said, you know, when it gets to the point that this has to be interpreted, people will like to know what you meant by these various terms; what does "likely" mean, what does "application" and what does "siting" mean?

So we wrote out the definitions so you could refer to those to see exactly what we meant in the phraseology throughout the rule itself.

[Slide.]

DR. GNIRK: Subpart B of the rule, the implementation guidelines, has essentially three sections -- a siting provision, siting process and the consultation and environmental impact section. Siting provisions covers diversity of rock type which is required by the Act, diversity of geohydrologic settings which came out of a comment from the State of Texas; regionality, which is another requirement from the Act.

Evidence for siting decisions is what we crafted to explain how you would make the evaluations and each and every guideline, what you would take into consideration, including evaluations of individual sites and comparisons between and among sites. With regard to the presentation by the representative of the EPA this morning, that particular section contains the 100,000 year provision for comparison between and among sites.

That provision came in in about March of 1984, in fact, after the meeting in January that the Commission, in which the EPA, by and large, said -- or their representative, as I recall, that if

the DOE does not include that provision somehow in the guidelines, that they would include it in 40 CFR 191. So Bill Hewitt and the DOE people worked with the late Dan Egan and their representatives in coming up with the verbiage and the provisions for the comparisons for the 100,000; 100,000 years looking at the natural barriers only, their containment and isolation capabilities for comparing between and among sites and a second provision which required looking at the total system and then looking at the results of the two and how they might compare with regard to the sites.

It continues with the siting process which is the various stages, the designation of potentially acceptable sites, the nomination and recommendation of sites for characterization of sites, which includes the content and the environmental assessment. The things that had to be considered are included within the environmental assessment, including the common Chapter 7 at that time, which was to include the comparison between and among sites that were nominated for characterization.

That, in fact, was replaced -- that Common Chapter 7 was replaced by a separate document that involved an analysis by decision theory of the comparative attributes of the various sites in 1985, I guess it was. Then it talks about the recommendation of sites for repository development, what the comprehensive basis of the statement that would go to the President with the recommendation and what must accompany that. The fact is that in the environmental impact statement, you would include how the history of the decision process and the results of the comparative evaluation.

[Slide.]

DR. GNIRK: Subpart C is known as the post-closure guidelines. There is one system guideline and nine technical guidelines. Within one system guideline and nine technical guidelines there are ten qualifying conditions; that is a qualifying condition for the system guideline and one each for the nine technical guidelines. I'll talk about that a little more later.

There are six disqualifying conditions and I'll say a little bit more about that also later. The subjects that are considered are geohydrology, geochemistry, rock characteristics, et cetera, up to natural resources. Those are all contained with individual qualifying conditions. That constitutes sort of the framework of the post-closure guidelines.

[Slide.]

DR. GNIRK: Subpart D is the preclosure guidelines. There are three system guidelines and 11 technical guidelines which have 14 qualifying conditions, 11 disqualifying conditions. The preclosure guidelines consider population, site ownership and control, meteorology. Those first three were in a group that related to radionuclide releases from the actual operations, including offsite installation operations.

A second group was environmental quality, socioeconomics and transportation. A final group was surface characteristics, rock characteristics, hydrology and tectonics. All of these, of course, had their potentially favorable conditions, potentially adverse conditions, which was something that we used -- if you wish, copied -- from the NRC Part 60 rule and how they set up for their siting criteria.

Finally, the final four appendices include the performance requirements, at that time, of the EPA and NRC, and then the siting process findings, the types of information that are required for site nomination. In fact, that last bullet there came out of the discussions with the NRC in the Spring of '84.

[Slide.]

DR. GNIRK: Okay, I'm going to talk principally about the post-closure guidelines as an

example of Subpart C. Subpart D is similar to that in the framework. The system guideline for post-closure requires that the radionuclide releases from the waste to the accessible environment meet the requirements specified by Part 191 as implemented by Part 60.112, first.

Second, it requires that the geologic setting at the site will allow for the use of engineered barriers to ensure compliance with the containment and gradual release requirements specified by Part 60.113(a)(1). It's a system guideline for post-closure.

Now, below that, we had these sets of technical guidelines dealing with the natural state, as you might say, and the disruptive state. At one time in the development of the guidelines, we had actually segmented the post-closure guidelines into two sets: expected conditions and potentially disruptive processes and events, to try to set a stage for people's thinking and to try to bring that stage into what we thought was compliance with the thinking of the NRC on their anticipated and unanticipated processes and events.

It turns out that their definition of anticipated and unanticipated did not match our definition of expected and potentially disruptive, so we eliminated that terminology from the guidelines themselves under post-closure. But we were thinking that expected conditions are what exist today, as you see it today, and what you expect will naturally happen in the next 10,000 to 100,000 years.

Potentially disruptive processes and events are as you would expect, climate, erosion, dissolution and so forth; those things that could occur which would have some probability that they would occur over the next 10,000 years.

[Slide.]

DR. GNIRK: Each of the technical guidelines within the post-closure guidelines have a qualifying condition and that qualifying condition for the expected conditions, the expected state of geohydrology, geochemistry and rock characteristics, the qualifying condition for each of those guidelines says, number one, that the site should be compatible -- the site characteristics should be compatible with the goals of waste containment and isolation and should meet the system guidelines. This is the qualifying condition.

Below that then, of course, we had the potentially adverse and unfavorable conditions.

[Slide.]

DR. GNIRK: The potentially disruptive processes and events, that's erosion, dissolution within post-closure. The qualifying conditions are stated in a way such that you would locate the site where such processes and events are not likely to lead to releases greater than those allowed by the system guidelines, and take into account those factors that must be taken into consideration when predicting the likelihood of such processes and events. This is what's contained in the qualifying conditions for the disruptive processes and events.

As you see, we tied all of the technical guidelines, the qualifying conditions, back to the qualifying condition of the system guidelines so that when you made these assessments, -- for example, in the system guidelines, you had to consider the collection of technical elements. When you made an evaluation of individual technical guidelines, be it geohydrology, be it erosion, or whatever, you had to take it in the context of a system guideline to meet the requirements of 191 and Part 60.

We had 29 favorable conditions, 26 potentially adverse conditions scattered throughout these various technical guidelines in post-closure.

[Slide.]

DR. GNIRK: The disqualifying conditions, there were six of those in the post-closure part of the rule.

The agreement with the NRC staff in the Spring of '84 was that we would have disqualifying condition for each factor that was specified in Section 112(a), Nuclear Waste Policy Act. For post-closure this amounted to geohydrology, erosion, dissolution, tectonics, human interference for both type of natural resources.

Interestingly enough, the last one on natural resources, when we did the work in 1985 on the comparative evaluation, took into consideration the potential for developing pumped hydro storage facilities in and around sites which would tend to change the hydraulic gradients and cause problems and that was one of the assessments that we made when we discussed our potential scenarios of what could happen disruptive-wise with each and every one of the projects because that was like a natural resource. The pumped hydro storage facility whether it's in hard rock or in sandstone or whether it's in salt dome is still using a natural resource in one way or another.

Some of these refer specifically to rock types more or less. Dissolution of course referred specifically to salt. When you develop a rule like this you are asked to do something that covers all types of rocks under all conditions in every state in the contiguous 48 states in the United States or maybe in all 50 states for that matter -- I assume all 50 states.

But you have to cover everything and so when we dealt with the representatives from the various states and looked at the various comments, you find that, and understandably so, the people in the various states have more site-specific, rock-specific comments and their question to us was why don't you write the qualifying conditions and the guidelines and the disqualifying condition in more specific terms dealing with tuff, salt, basalt and so forth?

Well, it was our philosophy and our thinking and the direction of course of the Department of Energy that we were writing a rule that was a generic rule that to cover the broad spectrum of everything and our instructions were to write or to prepare or to craft the verbiage such that it was applicable to whatever rock type you have because you would take these very basic fundamental considerations into mind when you made these evaluations and so that you could apply it across the board.

Admittedly in some cases you would have more specifics, like in the case of dissolution, which is essentially salt or that type evaporites.

[Slide.]

DR. GNIRK: Now how do you apply the guidelines? That was also something that was of considerable discussion during the development as well as in the discussions we had with the Nuclear Regulatory Commission, 1984, their staff.

So Section 960.3-1-5 contains all these words that we crafted and put together to try to explain how you would use the guidelines in making evaluations in one way or another, apart from the fact that evaluations of individual sites and comparisons be based on post-closure and pre-closure guidelines we state in there -- it's stated in there -- that such evaluations shall place primary significance on the post-closure guidelines in that state and I don't have it listed but it always said that within the pre-closure guidelines you place primary significance on those that involve some sort of radionuclide release, give those greater importance than those guidelines dealing with socio-economics, environment, and transportation.

The set of guidelines of least importance, relatively speaking, were those dealing with ease and cost of siting, construction, dealing with the rock characteristics, the hydrology, surface characteristics, in order of importance, and how you would look at each of the technical guidelines, evaluation of the compliance. The qualifying conditions shall be made in the context of the collection of system elements considering on balance the favorable conditions and

potentially adverse conditions.

Now this comes, say, right from Part 60, if you look under Technical Criteria. It talks about -- or I don't know if that's 1.122, 1.112, 1.113. It talks about looking on balance, the favorable condition, potentially adverse conditions and things in siting criteria in Part 60.

Comparisons between and among sites shall be based on the system guidelines to the extent practicable. That is, rather than looking at just geohydrology or just dissolution, you looked at the system when you compared Site A against Site B against Site C and you will find that when we did the evaluation, the comparative evaluation in '85, that we did indeed look at the system for post-closure, although we broke it out into the expected case and then all of the potentially disruptive scenarios but we did look at the system, as it would respond.

[Slide.]

DR. GNIRK: Well, I have already talked about this siting process. You use the guidelines as specified throughout all of these sections of 963-2, exactly which guidelines you look at or which parts and how they'll be used and so forth. That's all discussed in there.

[Slide.]

DR. GNIRK: In Appendix III, it is listed very specifically what the three decision points are in the siting process: (1) identification of potential acceptable sites; (2) nomination and recommendation of sites for characterization; and (3) recommendation of a site for repository development.

Those are the three points, principal decision points in the siting process. Then we tied to that the concept of findings on each and every one of the technical guidelines, the qualifying conditions, the system guidelines and their qualifying conditions and the disqualifying conditions themselves, the concept of findings -- findings at the first decision point, the second decision point and the final decision point.

You'll see that there is a table in Appendix III that lists that very clearly as to what findings you have to make. The findings themselves are expressed as follows.

[Slide.]

DR. GNIRK: There are the lower-level findings which you make at the point of a potential acceptable site, some of those indicating, and for sure at the point of nomination and recommendation, and this is an example that you will see that's in Appendix III.

The evidence does not support a finding that the site is disqualified, and that is based on the available evidence that you have at that time when you nominate a site as suitable for characterization.

A second one is the evidence does not support a finding that the site is not likely to meet the qualifying condition. Of course, what immediately comes to your mind, why do you have a double negative in there?

Clarence, you were wondering that, I think.

Well, that actually, I guess you would say, changes the burden of proof in part. You have to ask Bob Mussler on that, but it was his advice when we were crafting this that you write it in this fashion -- that does not support a finding that the site is not likely to meet the qualifying conditions, but we thought that was a good way to put it. You can, of course, come to that finding.

Examples of the higher-level findings, this is at the point where you are recommending a site for development as a repository. Evidence supports a finding that the site meets the qualifying condition and is likely to continue to meet the qualifying condition into the future.

What does "likely" mean? Of course you have to look at that. The definition says that

"likely" means possessing or displaying those characteristics, et cetera, that leads one to come to, forms a basis for reasonable confidence that what exists does exist or what will occur will occur, provides you a reasonable basis -- sorry, bases a reasonable confidence that indeed what you expect out there does occur or will occur or does exist.

The evidence supports a finding that the site is not disqualified on the basis of that evidence and is not likely to be disqualified. That relates specifically to disqualifying conditions. That's a finding you'd have to make. This is at the point where you make the recommendation, the Department makes a recommendation to the President for development of a site as a repository.

[Slide.]

DR. GNIRK: Okay, how have the guidelines been used in the past number of years? In 1984 they were used in the development of draft environmental assessments for the nine sites, including the Yucca Mountain sites. These were the draft EAs that came out in '84. The lower-level findings were made for the qualifying/disqualifying conditions throughout those nine environmental assessments.

There was a common Chapter 7 with a comparative evaluation of nine sites on the basis of qualifying conditions at preclosure and postclosure guidelines. It was the comments that were received by the Department of Energy from various groups including the Board of Radioactive Waste Management from the National Academy of Sciences -- I think that's what it was called, Warner. I can't remember back in those days anymore -- but, as well as an organization in the state of Washington said, you guys have really blew it in Chapter 7.

The guys that really blew it that put it together that, we were instructed to put things together, you know who we were, at the time were Tom Lango, Paul Gnirk and Harry Smedes. And we didn't have a lot of time but we went through a comparative evaluation except that we were mixing value judgments with technical judgments and it just didn't hang together. And it was pointed out by people.

As a consequence of that, the Department of Energy decided to do the formal comparative evaluation, a multi-attribute utility analysis in which the sites were compared on the basis of a very formal decision analysis process. Dr. Allen, Dr. North were part of those groups at that time that reviewed our work on the Academy of Sciences panel when we made the presentations.

In that comparative evaluation we incorporated, of course, the natural system guidelines as well as the preclosure guidelines but the natural system guidelines, we looked at the releases for 10,000 years for both expected and potentially disruptive, and for 100,000 years for the expected case, so people could look at and compare between and among the five sites that were eventually nominated.

[Slide.]

DR. GNIRK: In addition, in 1986 the environmental assessment for Yucca Mountain, of course and for the other sites were released. In the Yucca Mountain one in particular, as well as all of them, the lower-level findings for the qualifying/disqualifying conditions for the technical guidelines are laid out very specifically, very clearly for people to see.

In 1988, the site characterization plan, which revolves around what is required by Part 60 but the requirements of Part 60 were attached to all the requirements in the siting guidelines, the technical guidelines and the system guidelines and hooked together the terms of issues.

[Slide.]

DR. GNIRK: And finally, in this last year in -- this year, 1991, and last year, 1990, when

we looked at the various regulatory requirements that governed the development of an exploratory shaft facility and potentially a repository to Yucca Mountain site and we went through a very exhaustive evaluation of the applicable regulations that applied to discriminating between and among ESF options, we went through and sorted through the technical system guidelines from Part 960 to see which ones were indeed applicable.

Gentlemen, this sort of gives you the history of all this in brief. Of course, there were a lot of details, a lot of thinking over the period of time, that went into this. How do you apply these over the period of years, actually sit down and write the basis for a finding that's convincing in one way or another that they'll stand the test of time and test a critique and peer review as well as back in the time before there were guidelines and people were putting together the documents and the basis for looking at what you want when you select a site for repository in the future sometime?

I think that's all I have. Thank you very much.

DR. DEERE: Thank you very much, Dr. Gnirk. Are there questions from the Board? Yes, Warner.

DR. NORTH: I'd like to put a footnote in there with regard to the review by the Board on radioactive waste management of the 1986 multi-attribute utility analysis. Dr. Allen was a member of the Board at that time. I was a consultant to Peter Myers, who is the staff officer and who is in the audience and may wish to comment as well.

Our charter in that review was to examine the methodology. We looked at the data for one site; we did not look at the comparison between sites. So I think it should be clear that that review did not encompass the whole process.

DR. GNIRK: But it did encompass the framework and the basis, I think, for the process.

DR. NORTH: Yes.

DR. GNIRK: And you looked vertically and you looked horizontally, as I recall the instructions that time. You said, when you come back from the final meeting, be prepared to go through with --

DR. NORTH: -- all the data on one site we looked at and then we looked at all of the methodology. But then, we didn't look at the whole picture --

DR. GNIRK: That's true.

DR. NORTH: -- just the vertical slice and the horizontal slice.

DR. ALLEN: At one unnamed site.

DR. GNIRK: Which I think you figured out very quickly what the unnamed site was.

DR. ALLEN: Paul, in retrospect, would you have done any of this differently?

DR. GNIRK: Well, personally, no. I don't see what we would have done differently. Under the directions given us by the Department to craft a rule that they could review and decide whether or not they wanted to promulgate forward. In developing the individual factors that qualifying conditions, disqualifying conditions, potentially adverse factors, favorable conditions and so forth, I think we had exhaustive comment, exhaustive review.

I think the Department spent about one year longer in going through than was anticipated at Congress in doing this. And I recognize, it was probably hard for some of the states to accept what we came up with, but we tried very hard to be fair, honest and reasonable and tried to develop this generic rule. I don't think we would have done much differently now, if we were asked today to develop our Part 960 in some fashion that could be used for the identification and selection of sites for the development of repositories.

DR. DEERE: Paul, if this were being used to evaluate one site, how much of this

material would not apply and how much of it would apply? Because it's rather obvious, there are sections in there that are strictly comparative sections.

DR. GNIRK: Yes.

DR. DEERE: Or, written for comparative purposes.

DR. GNIRK: I do not want to debate the question, but it is bordering on policy, so I will turn it over to my associate, Max Blanchard, if he has a comment on that.

MR. BLANCHARD: I am not sure how best to go about answering your question at this stage. We know that 960 was promulgated for a specific purpose in the Act. It exists now, we've used it, as we screen from nine to five to three. We need some criteria to measure any one site. It still remains in the program, and we now have one site instead of three which, at the time, 960 was passed, it was assuming it would be used to go through that last gate.

The Nuclear Waste Policy Amendment Act, didn't circumvent that last gate, it just said start with Yucca Mountain first and characterize that, and we'll decide whether or not that is adequate. So it's not entirely certain that Yucca Mountain is going to be a suitable site. In that event, we will still have to deal with another alternative site, and maybe more.

So we have to have some criteria. The intent in the law was to clearly get that criteria out for everybody to be able to look at. I think it is natural that the Department use the siting criteria in 10 CFR 60, and encompass that pretty much in 10 CFR 960. We have evidence from the NRC that they felt that that scope, within 10 CFR 60 was adequately included in 960.

At the same time, the Department was on that kind of a track, all on its own, prior to the passage of the Nuclear Waste Policy Act, because when the program was managed by Colin Heath several years prior to 1982 Act, we had a siting criteria encompassed in our nuclear waste terminal storage documentation, and we had a document that looked not unlike what 10 CFR 960 looks like today. So I think there was an established intent to have that kind of screening criteria, both from an engineering and earth science perspective.

Probably one of the major things that came in as we shifted from NWTS criteria into the 10 CFR 960 was a little extra emphasis in the environmental aspects, and some of the preclosure guidelines. That emphasis, I think, was there, but it wasn't as recognized.

To move the program forward and make some decisions, the Department has, incumbent upon itself, to decide whether or not it wants to move forward with licensing. It has to have some criteria in mind because it can't prejudge what the NRC is going to say about our site. It's not a unilateral decision, obviously, from the Department standpoint. So in the absence of something else, a generic guideline like 10 CFR 960 I think is very good.

The Department has not taken an official position yet. It's still trying to complete an analysis that would include the legal aspects and the consequences of saying maybe something else ought to be used, in view of the Waste Policy Act's Amendment. But, in the meantime, we have every intent of applying 10 CFR 960.

The next speaker, Dr. Younker, will show you a rigorous attempt, given the information available, to apply it, and to show you where, at least those experts who looked at it, what their current opinion is, given the available data and the application of those criteria.

For the Department to move forward beyond the application of 960 and put something else there, I think that the Director and the Office of General Counsel will have to continue to sort through whether something needs to be there that would be one step beyond 960, given the Waste Policy Act Amendment, or whether it makes sense simply to leave things in place, to acknowledge that 10 CFR 960 was fully adequate for generic screening and it still seems to be adequate, given the state of the program, and that if there are some individual discrepant or

outliers, when you apply it to a specific site, then deal with those as it develops. I think either one of those alternatives, personally, can be dealt with adequately in this program. But, of course, I speak only from an earth scientist's viewpoint, and certainly not from any knowledgeable legal viewpoint.

I know that Dr. Bartlett, I know that Carl Gertz, and I know that the Office of General Counsel have had numerous discussions on this. I know that there have been analyses done and there are ongoing analyses, and the final judgment has not been made. But the intent of the Department is very clear right now, and that is to continue using 960, to apply the knowledge and understanding of the processes of work at Yucca Mountain, run it through the screening process to see whether or not Yucca Mountain survives 960 now, and continue to use it until something different occurs from a legal viewpoint.

DR. DEERE: Yes. I think you gave a good answer. My question was certainly involving the points that you brought, but it was even going a little farther. If you were to develop a new document, isn't it true that perhaps you would throw away 20 percent of the things that apply for site comparisons, but you still would be left with 80 percent of that document, which would be directly applicable?

MR. BLANCHARD: Yes. I would agree with you. As Paul mentioned in his presentation, as the team scoped what should be in 10 CFR 960, they were really trying to deal with many different geologic settings, many different rock types. So as of necessity, when you take that approach, it's kind of a funneling. You have to put a broad number of things in of criteria or guidelines in specific areas that may not have much of an application when you get to some specific site that you'll want to evaluate.

DR. DEERE: Yes, I would agree. But I would think that if a document were to be prepared for a specific site, it could be less encompassing, be a better document to deal with the site that is there. You would be able to streamline, but cut out things that obviously were for comparison purposes. You wouldn't have numbers in of 200 meters necessarily for erosion because you were considering something else. You wouldn't have dissolution because it was for salt or gypsum or sylvite or something.

DR. GNIRK: My point though on this is that it's a rule -- you're required to make a finding against this dissolution. You just can't simply say we aren't going to have dissolution and tough. We won't have dissolution, I agree. But you are still required to make a finding.

DR. DEERE: Why?

DR. GNIRK: Because it's required by the rule. I don't think that -- well, I don't think you can -- it's like Part 60 saying, well, the Department feels that this isn't appropriate, so we don't make a case against a particular aspect of it. I don't think it's a very difficult thing to write the justification for a finding of no dissolution at Yucca Mountain.

Secondly, my comment, Dr. Deere, with regard to the 200 meters, that is principally a disqualifying condition. That's a gate. It's either yes or no. Those were put in specifically to disqualify sites, if they could not meet certain very fundamental criteria.

DR. DEERE: Why?

DR. GNIRK: Because it was required by the law. The Nuclear Waste Policy Act required disqualifying conditions.

So your question is why would we disqualify a site because we could not get the host rock below 200 meters? Do you have a comment? I mean it's required by the rule. It's required by law.

The Department of Energy promulgated a rule, formal process, based on the law.

DR. DEERE: But I would say for site selection, and it might have meaning for selecting one site versus another in different parts of the country, with different potentials for erosion, and when you come to a certain site, there are things that are almost just -- you're encumbered by a general statement that wasn't meant to apply at a specific site.

MR. BLANCHARD: I think what you said, Dr. Deere, is perfectly reasonable, that a set of criteria for a specific site would probably leave some of the things that are currently encompassed in 10 CFR 960 behind when you try to deal with that one site, is it acceptable, but I think that, at the same time, we are going to be able to deal with things like that.

For instance, what you just mentioned, the erosion criteria and the disqualifier for a certain distance down, it's clear that there was a higher intent from a systems standpoint, and that was to do things -- select a site and then design a facility that enhances the ability of the site to isolate and contain radioactive material once it gets out of the waste package, and if there is a particular aspect of a regulation or a provision of a technical guideline that's contrary to that when you apply it to a specific site, then it makes nonsense with respect to trying to use that, and if it turns out that, in the unsaturated zone, having a repository as shallow as you can make it enhances ground water travel time and enhances radionuclide retardation, then trying to continue to apply that guideline in a restrictive fashion that actually accomplishes less than what the overall guideline was supposed to accomplish -- in other words, it works against you -- that it, indeed, would be recognized by everybody involved in the system that it was nonsense to apply that particular regulation or guideline, and you could leave it behind.

Now, how that trips you up procedurally, I'm not sure, and I leave that up to the attorneys to work out.

DR. DEERE: Comments from other Board members on any topic?

DR. DOMENICO: Paul?

DR. GNIRK: Yes.

DR. DOMENICO: RE/SPEC was involved pretty heavily with the so-called sedimentary rock program with Oak Ridge, if you recall.

DR. GNIRK: Yes.

DR. DOMENICO: And I think, out of that, clay, shale was determined to be a good choice.

DR. GNIRK: Yes.

DR. DOMENICO: Were these ideas used at all there, as well?

DR. GNIRK: That's correct. I forgot about that. Very good point.

DR. DOMENICO: I knew they were, Paul. That's why I asked you. I'm a pretty good straight man.

DR. GNIRK: That's right.

When we did that evaluation or when we were involved in that evaluation with the people at the Oak Ridge National Laboratory, we set up the various comparisons or the points at which we compare the various media, the sedimentary rock media, on the basis of the technical guidelines.

That's a very good point, and I'm glad you remembered that. I was glad I got you as a reviewer.

DR. NORTH: I would like to ask more about the history of the application of these guidelines. When I first came into this process, five sites were being considered, and the analysis was being designed to aid in the selection of three out of five.

At the time, my recollection is that the guidelines were applied to all five, and they were

found to pass.

What about other applications of the guidelines, either to the four that did not go into the five of the nine or prior to assembling that set of nine candidate sites?

Are there specific examples which are documented where a disqualifying condition was found and the site was dropped from consideration because it failed to pass these guidelines?

DR. GNIRK: I think the answer is no.

Max, do you have a comment?

I think the answer is no. I don't think that there is anything that's documented in the application of the guidelines.

The first application was in the draft EAs, but back before the guidelines, there were the NWTS criteria, and I don't know how -- we didn't view disqualification in the same sense at that point in time.

MR. BLANCHARD: I agree with you, Paul.

The only real documentation package that I know exists is the one that goes with the environmental assessments, and while there was a number of early screening activities applying the NWTS screening criteria, the program had not reached the state of maturation where it was going to reduce the number of sites.

They were still considering crystalline rocks, or granitic rocks, if you will, and they were also rather actively considering argillaceous rocks, and it wasn't until the EAs were produced for a specific purpose by -- guided by the law that caused the program to begin focusing on a few sites. And while there may have been some disqualifying criteria that was informally available for the group and could have been embodied in the NWTS program documents, I don't think it was ever applied, because the program was expanding instead of contracting with respect to a given site.

DR. GNIRK: The exception might be, Max -- now that you gave me a chance to think, while you were talking, about this -- perhaps in the crystalline rock program, prior to the Nuclear Waste Policy Amendments Act, when they were screening sites in the northeast and the east part of the United States.

I think they did, as I recall, use technical guidelines for their screening process to select preferred potentially-acceptable sites, or whatever sort of terminology they used.

That document, at that time, was -- a document was prepared. I assume it was reviewed, and it may have been published and may still exist, because in that period of time, the program changed because of direction from Congress, you know, and I'm not certain we've had them.

But I think they were using the guidelines -- I'm almost positive -- at that time, but from the viewpoint of disqualification, Dr. North, I'm not certain that site areas were disqualified in a formal written fashion. I don't really know.

DR. NORTH: So you're speculating that, even if the guidelines were used in the crystalline rock program prior to the Amendments Act in 1987, the use was as a guideline for the comparison, rather than the application of the disqualifying conditions.

DR. GNIRK: If you look in Appendix III of Part 960, there are approximately a half-a-dozen guidelines that require findings at the stage of identification of potentially-acceptable sites, that findings are required, and I think they relate principally to the disqualifying conditions.

So I would assume, without having looked at this document that we're talking about, that these people, as I recall, probably looked at screening from the standpoint of disqualification and eliminated those site areas that would have been disqualified or they could not make a finding of qualification or not being disqualified, but I don't know what happened to the report.

MR. BLANCHARD: Dr. North, it may help for us to ask someone that is in the audience that managed that part of the screening program that preceded the application of 10 CFR 960. Dr. Critz George doesn't any longer work for the Department of Energy, but he managed that work even in those days under Colin Heath.

Critz, do you have anything to add?

MR. GEORGE: The one site which I recall being disqualified was prior to these formal guidelines. It was under the National Waste Terminal Storage guidelines. And that was the Palestine Dome in East Texas. There was actually a formal document written to say that we had come across, I think it was the Bureau of Economic Geology in Texas was in fact the geologic program manager, I think is the structure under which they were factored in the program.

They came across some data which made it clear that that dome would not qualify, and so a formal DOE letter or memorandum was written according to the guidelines that were in effect at the time, which was a predecessor to these than Paul has discussed.

By the way, I agree with Paul's recollection that there is some document that was created in the screening process, in the crystalline rock program, that showed this cut. It was used for screening purposes, but certain areas they had under consideration were peeled off as at least likely to be disqualified.

DR. NORTH: Thank you.

DR. DEERE: Are their comments from any members of the audience?

DR. GNIRK: I was looking for you.

MR. FRISHMAN: I am sure you were.

I guess I have to start out by saying that I commend Paul for having rewritten history the way I expected he might have.

[Laughter.]

MR. FRISHMAN: I think there are a few things that have to be pointed out.

As the Board recalls, I made a presentation, I guess, over a year ago about not the use, but the abuse, of the guidelines. And there have been a number of changes in the Department's approach since then, and we are going to hear more from Jean later on.

But I think there are some thing that need to be said in addition to the discussion here, because I think it has to do ultimately with the application of these guidelines. I am not particularly interested in wasting your time or mine in giving you my rendition of the rewriting of history.

First of all, I think Dr. North's question was a good one. And that is, have these guidelines ever disqualified anything? And the answer was correctly given: no.

And even prior to the guidelines, and I believe even with the answer that Critz just gave, the Department has never seen a site it didn't like, because no site it didn't like ever emerged anywhere. It's just every site they had, they liked.

If you talk about the Palestine Dome in East Texas, we had some geologists who made a pretty strong case that there were a lot of external-type problems with that dome, having to do with previous drilling and all the rest. And what is interesting about it is the Vacheri/ Dome in Louisiana that remained on the list had exactly the same types of problems. So I think maybe the state line had something to do with it.

And we have another example of state line in the application of the guidelines, after they were put together. And that was in the second repository siting program, we have the infamous Virginia-North Carolina Fault. And that was where a granitic rock body was somehow acceptable to the Department on the Virginia side but not on the North Carolina side. And the

only thing that divided it was the border between the two states.

So the guidelines are highly effective, when you want to use them.

There are a few other things that I think need to be talked about. And I want to first remind you of my previous presentation to the Board about the abuse of the guidelines. What I was focusing on there was another place where the guidelines have been used in the Department documentation that didn't show up in Paul's presentation. That was in the 1985 mission plan and the 1986 issues hierarchy, because that showed how the Department intended to use the guidelines in site characterization, because the requirement in the Act is that during site characterization, or as a product of site characterization, among other things you must show what standards were used to determine the suitability of the site.

The Ninth Circuit Court has established that the guidelines are the standard for the Secretary's determination of the suitability or non-suitability of a site.

So without any problem at all, the guidelines are the standard that is provided to meet that requirement of that Act under the list of things that must be done in site characterization, meaning you show a comparison against those standards.

I pointed out to the Board that in the mission plan and the later issues hierarchy, the comparison against the guidelines was established as sort of a final act before the Secretary's announcement of his determination of suitability. And it was arranged in such a way to where it was a pro forma determination.

The real determination was an analysis during and towards the end of site characterization of whether the site met the requirements of 10 CFR 60 and 40 CFR 191. It was not a real analysis of whether it met the requirements of the guidelines.

And I pointed out also that there are some requirements of the guidelines that are more stringent in the sense of being more definitive than you find in those other two agency rules, ground water travel time being one of them.

So the pro forma application of the guidelines was the beginning of the collapse of the guidelines, in perspective in determining suitability of sites. And since then, since I made that presentation, the Court has made its finding about the standard, the Department has gone into this latest sort of round-robin that we are going to hear from Jean about, and I'll be talking about that when she's done.

So the guidelines are still sort of up in the air. And you heard Max talking in terms of we really don't know yet whether in fact they are applicable or not, in terms of when we only have one site.

They are applicable in some sense, but based on Don's questions about how much of them would you throw away if you knew you only had one site, it is of, I think, considerable concern that they are not being viewed in their generic state.

And just as a footnote, we in the State of Nevada still have an ongoing lawsuit regarding the validity of the guidelines, and that lawsuit has to do with whether the guidelines in fact even meet the requirements of the Nuclear Waste Policy Act in terms of disqualification factors.

The final arguments have been had on that suit. The Ninth Circuit probably, after a whole new Court is appointed, sometime out in the 21st Century, may decide on that. I don't know. But right now, the guidelines are still under legal attack, for not being sufficient.

Now we are in a situation where we are wondering, and you are going to hear some more of that wondering from Jean in a few minutes, about how the guidelines really apply to a site.

Well, there is a simple solution, if the Department is willing to do it. And that is that the guidelines were promulgated as a rule under the Administrative Procedures Act. The guidelines

were required by the Nuclear Waste Policy Act. There is a specific provision in the Nuclear Waste Policy Act that says the guidelines may be revised. It didn't even have to be there, because under the Administrative Procedures Act it can happen anyway

So if there is an interest in applying new guidelines to determine the suitability of the Yucca Mountain site, then the Administrative Procedures Act must be followed. And I challenge the Department of Energy to get out there and promulgate some new guidelines.

I have just a few other things to talk about regarding the guidelines.

The issue of the salt sites, regarding disqualification and qualification, was an interesting one, because the Department of Energy almost didn't have nine sites as potentially acceptable sites. And this is a piece of history that I do have to repeat, and if Bill Bennett were here, he could confirm it.

There was an initial interest in using the guidelines in a rather perfunctory way, or just the concepts of the guidelines, to come up with potentially acceptable sites. And there was an initial effort to start out with only five potentially-acceptable sites.

I was working for the State of Texas before the Nuclear Waste Policy Act passed, and one of the issues that we had with the Department of Energy under the NWTS program was how are you ever going to make decisions that would differentiate among salt sites, because they had a lot of salt sites they were looking at.

They never would answer that question. The guidelines didn't exist when they were ready to name potentially acceptable sites, but they had kind of an idea from the NWTS standards that were talked about earlier.

Bill Bennett called me one day and told me what sites he was planning to have nominated; and I said where's the rest of the salt sites? And he said oh, well, we decided we don't want them. And I said well, there's Louisiana, and there's a site in Mississippi, there's another site in Utah that's maybe better than the one you say you want to nominate, if you start looking at some factors of it.

I said, how did you make this decision? He said well, we just decided. And I said well, that isn't good enough.

So he said well, what should I do? And I said put everything you know about salt on the table. And he said, do I have to? And I said yes, I think you have to, because otherwise we're going to put it on the table in another arena.

So that's how we ended up with nine sites. It was the idea of the sort of perfunctory guidelines that were working, and disqualification not having anything to do with other than preferences.

So that's just kind of an example of where that early history got us and how we ended up with the suite of sites we had.

Another interesting thing is that the 1980 programmatic EIS, or generic EIS for geologic disposal, laid out a set of high-level criteria, primarily exclusion-type criteria, the things that you run away from, and the things that intuitively probably kept the Department from ever talking about a site that it didn't like. That way, it was always able to have sites that it did like.

But if you look at that table, and compare it to Yucca Mountain right now, the table has approximately, I believe, 18 elements that are all negative factors in siting. Yucca Mountain exhibits 14 of those elements.

So the guidelines have not had an effect on where we are today. And that's probably why it is not surprising that there's a great deal of discomfort with the guidelines right now; and that discomfort, I predict, is going to go on, and I'll be talking about it probably in an hour from now,

about the level of discomfort.

So I think what we have to really recognize is that the guidelines were intended to be generic by the Congress. The guidelines were written by the Department of Energy and its contractors to take care of the sites that they already knew about and sites that they anticipated they were going to know about. And now we're stuck with them.

It's difficult to first determine they're legally sufficient. We're awaiting the Court to find that out. And it's even more difficult to determine whether, in fact, they are even technically sufficient for what we're trying to do overall, which is figure out a way to rationally come to geologic disposal.

So I leave that thought with you right now. We're locked into a legal situation that is uncomfortable to everybody for very different reasons. At the same time, we're in a situation where it is highly likely that somebody is going to have to try to figure out a way to bypass it, only because we're locked into one site that the guidelines didn't really fit in the first place anyway.

So we'll continue this discussion after Jean is done.

DR. DEERE: Thank you.

MR. BLANCHARD: Dr. Deere, in closing, I wish to point out a couple of features.

While people can attack the guidelines from their own viewpoint with respect to whether or not they accomplish what they were intended to, I submit to you that the guidelines are indeed, with the disqualifiers in them, more stringent than 10 CFR 60.

They were prepared by the technical staff within the Department, and the managers, to be more stringent. And the NRC, in supporting those guidelines, have agreed that they are more stringent than the provisions in 10 CFR 60.122.

That's the first point. I don't want anybody to go away thinking that the guidelines are trivia.

The second point is there are a number of geologic settings and a number of geologic rock types that the Department had in its NWTs program prior to passage of the Waste Policy Act. It was there for a purpose, to make sure that we were looking at all possible worthwhile environments.

And the studies that went on under the NWTs program were of an engineering and an earth science nature, and they screened out, using the available published literature, a lot of sites that were not suitable.

So the fact that we are not confronted today with dozens of sites which we would say should be disqualified or are now disqualified, it is not surprising that we do not have a lot of disqualified sites in the program.

In fact, if the technical, engineering, and geotechnical staff were doing their job, those inadequate sites should have been left behind, and I submit to you, indeed they were left behind. They were not carried into the screening when the Department went from five to three sites, with respect to the talk that Paul just gave today.

Yes, it's true that there were a number of other rock types and a number of other geologic settings that were among those that were considered when we first prepared the very first draft EAs. But, for technical and programmatic reasons, those sites were chosen not to move forward with, because we did not have, that is, the Department did not have confidence that those sites were as good as those which we applied when we went from five to three.

And so I personally do not feel that the guidelines are trivia, nor do I think they've been misapplied, nor do I think that they're inadequate.

Thank you.

DR. DEERE: Mr. Gnirk, do you have any final comments?

DR. GNIRK: No.

DR. DEERE: I think we're right to the point that we should have our break. In fifteen minutes we'll be back. We're right on schedule to start at 3:00 O'clock.

[Brief recess.]

DR. DEERE: Good afternoon again.

At this time, it is my pleasure to introduce our final speaker of the day -- probably not quite --

[Laughter.]

DR. DEERE: At this time, I will introduce Dr. Jean Younker as Chief Scientist with Science Applications International Corporation.

Dr. Younker is responsible for oversight and review of technical programs conducted by the Yucca Mountain Project.

SAIC is the technical and management support services contractor for the Yucca Mountain Site Characterization Project Office.

Prior to joining SAIC, Dr. Younker taught geology at the university level and served on the staff of Lawrence Livermore National Laboratory.

She has been involved with several aspects of the geological disposal program, including characterization of the near field waste package environment, site suitability evaluations for the environmental assessment, and the development of the general plan for the characterization of the site at Yucca Mountain.

She will give us an update on DOE's efforts to evaluate early site suitability.

Jean, thank you for joining us today.

UPDATE ON EARLY SITE-SUITABILITY EVALUATION STUDY

[Slide.]

DR. YOUNKER: Good afternoon, everyone.

[Slide.]

DR. YOUNKER: There are some times when you really wonder if you are where you really want to be right at that time. And this is one of them. But I actually asked Steve Frishman if maybe he would like to start. Since we know he is going to offer his opinions, he might give them first, and then I could respond to them.

What we are going to do with the rest of your meeting this afternoon is to give you the status of this task force activity that I've been managing for the SAIC office in Las Vegas. And I think I want to make it clear up-front, and I think you all realize this, but I want to make it clear that this is a contractor activity supporting the Department of Energy's office in Las Vegas, and of course, the OCRWM program in general. But the preliminary conclusions that I'm going to tell you about right now represent simply the conclusions of this task force group. And even the method that we've used and the assumptions we've made are currently in review. The actual report of this group is currently in review, in technical review, within the Yucca Mountain Project. And it will then go through a peer review, which I will tell you about in a minute. So that what I'm giving you is really quite preliminary, and I expect some of our conclusions will change as the result of technical review.

So I just wanted to make sure I prefaced my discussion with you by making it clear to

you we're telling you very preliminary, and the conclusions are probably going to change.

I'll give you a little bit of an overview of this task.

I think you heard about early stages of the setup of this task back several months ago, and so I won't spend a lot of time on that. I'll tell you about the procedures we've used for evaluating the site against Part 960. And our assumption, from the very beginning, was that 960 was the framework, that we would conduct this early site suitability evaluation within the framework of 960.

And I guess, as kind of a bottom line, we have found, for the purposes of this task force activity as defined, that 960 has really worked quite well for us, and I'll give you a couple of places where we didn't find it to be difficult to use it in a site-specific application. And I'll give you a status, then, finally, of the preliminary conclusions of the task force.

[Slide.]

DR. YOUNKER: As I mentioned to you, where we are in this evaluation is that, back in the late part of 1990, we had some preliminary scoping meetings, and some of your Board members and staff attended those meetings.

We then went through a period where we basically had, we formed a team composed of about 13 participants from the Yucca Mountain site characterization project, meaning that we have a couple of people from U.S. Geological Survey, a couple of representatives from Los Alamos, a couple from Lawrence Livermore, and several from SAIC. And that team was formulated, put together under quality assurance procedures such that we conducted this activity as a quality affecting activity, which means to us that we have very extensive documentation for every step along the way. We're operating under plans and procedures that are approved by our management and by the Department of Energy management, so that it's a carefully-controlled and very systematically-conducted evaluation.

Where we are in this is that we have prepared an evaluation report, and that report is, in fact, in technical review, according to the technical review procedure that my company uses that implements the Department of Energy's technical review procedure. And what that procedure requires is that the people who review it were not those who prepared it. It doesn't mean that they're completely independent of the program. That happens when we move to this stage here with the external peer review.

So the review right now is still people within the Department of Energy's contractors, and there are 20 people in fact meeting as we speak, resolving comments on the report.

In August, middle of August, about August 15th, we will have revised the report based on the technical comments we're receiving this week, and it will be then submitted to an external peer review panel. That peer review panel has now been formed. There are 14 members of the panel. They are, for the most part, university faculty. There were a couple of disciplines where we couldn't get university faculty and so, for example, in environmental quality we have a man who has his own company, environmental consulting company, as our peer panel member.

In petroleum geology, it also turned out that in order to get someone who had good expertise on hydrocarbon potential of the Basin Range, we had to go outside of universities.

But we tried, for the most part, to stay with university people. And they are people who have had no major previous involvement in the program. They are not people who have written a lot of documents, had previous funding from the Department, so that they should be about as new to the material that they're reading as is reasonable, given that you don't want to have to educate them from scratch. Some of them, in fact, have worked in the Basin Range, but just not on this program.

Okay. We will get their comments back, then, in early November, go through a comment resolution period with them, where the way our procedure for peer review is written, we document all of their comments, we document our attempted resolution, and we document cases where resolution cannot be reached, so that the record will then contain all of the cases where we made changes to the document based on their comments, as well as those where we could not resolve their comments, we will close out the peer review, and a final report will be provided to the Department of Energy in mid-December.

[Slide.]

DR. YOUNKER: Some of this background information I'm going to go through fairly fast because several of your staff have suggested that they're more interested in the conclusions than they are in a lot of the background information. I will kind of slide through some of this unless you stop me fairly quickly.

The background to this whole study is that in the Secretary of Energy's 60-day report when the new Secretary came in, he did commit to take an early look at site suitability, mostly along the lines of, is this site still a reasonable site to continue to spend money from a site characterization viewpoint; is there any information that's been obtained since the time that you last formally looked at the site from the question of site suitability or unsuitability? Is there any reason that the Department should not continue to commit the funds to this site?

This task force activity evolved as kind of a spinoff from that commitment. It is also, of course, responsive to the NWPA and the siting guidelines, because I'm sure you are aware from the previous discussions that both the Act and the siting guidelines request that if the Department becomes aware that a disqualifying condition or factor is present at the site, that they should take appropriate action.

Of course, the question has been raised, and rightfully so: Well, how would you know if you don't look, if you don't have a process by which you examine available information, determine if there is some indication of a disqualifying feature or condition present? Then you might barrel along for a number of years, spending a lot of money and not have really looked to make sure that that site still appears to be a suitable site.

The way we've approached this is, given the commitments in the Act and the Secretary's commitment, clearly this approach should be one that could be applied iteratively at some either major milestones within the program or as chosen as appropriate by DOE management.

[Slide.]

DR. YOUNKER: So our objectives then were to develop an approach within the framework of 960 for evaluating site suitability during site characterization. As you heard Dr. Gnirk mention in his presentation, 960 has kind of gates at which it's clear that you ought to apply the guidelines in a specific way. What we found, as we attempted to look at the guidelines and use them as our checklist, during site characterization, rather than after site characterization, at the time you are determining if you should go ahead and recommend the site for development of a repository, that there isn't clear guidance.

It isn't explicit as to how it is or what it is you do at this stage, because the guidelines were really not necessarily -- the guideline writers were not necessarily intending that you would explicitly apply the guidelines at this interim stage. You did it at the time of the environmental assessment, you're going to do it again officially at the time you recommend the site, assuming that DOE stays committed to the guidelines, but this use in the interim phase required us to sit back and think about it and look at what made sense.

Of course, bear in mind again that when I say "we," that this is the taskforce speaking.

The Department certainly has not in any way committed to a formal evaluation with conclusions being represented in a formal manner. This is just the task force providing input to the Department for their decisionmaking.

The other objective was to go guideline-by-guideline through 960 and kind of, in a sense, look at the status of new information against those particular guidelines that are specified in 960 in terms of whether you have a potential disqualifying feature present. I'll get to that in just a minute.

[Slide.]

DR. YOUNKER: The general logic diagram that we've used has evolved, I think, since the last time I talked with you. Basically, the way we think of ourselves in this task force is that the information basis from characterization and from design and development work is available to us at some given time. At this time, we just completed the draft evaluation report.

We're in this box -- we, the task force, are in this box making this evaluation which we will provide results or conclusions to the Department and the Department then has whatever Departmental action is appropriate -- they may take it under advisement. They could decide to do something more formal with it, but the information that we provide is just part of the information that DOE would use in their decisionmaking process.

Of course, the kinds of decisions that could be made, depending on the outcome, would be such things as continue and get more information, recommend the site. As you well know, we're not likely to make that decision right away. There's additional information that we do need to collect. Or they could abandon the site if a disqualifying feature is, in fact, determined to be present.

[Slide.]

DR. YOUNKER: As I just said, what you're looking at in terms of the information base is, what's our present understanding of site characteristics? I was really quite pleased with the taskforce activity in that the amount of new information that's been generated about the site, both from the standpoint of monitoring new data that was available through non-surface disturbing activities, as well as laboratory data, really is quite a bit of new information.

There's quite a bit in the non-geotechnical areas and really quite a bit in the geotechnical areas, so that I think you'll be pleasantly surprised when you see the report. It has, I think, something like 560 references and I would say probably 80 percent of them at least postdate the environmental assessment and quite a large number of them postdate the site characterization plan. There's really quite a good database that's been assembled for this particular evaluation that has not been collected in any one place before.

Obviously, in the guidelines that refer to the engineered system, we used that information that is available to us and the expertise of those who are on our panel and then our present understanding of the regulations.

[Slide.]

DR. YOUNKER: What we do then, as I mentioned earlier, is to focus on the disqualifying conditions first, since the disqualifying conditions are more explicit and more directly tied to site features and conditions. We look at the qualifying conditions as well, and I'll talk to you about how we've done that. We then will talk about how we believe the information supports -- and this is a little bit of an overstatement -- we on the task force and in the task force report, have presented the information that we believe supports a higher-level or lower-level finding as Paul referred to in his presentation. I'll go through that in a minute as well.

We then would, within this cycle, assuming that you do this again, you would then

reevaluate with updated information as we're doing now, based on the new information that's been generated since the environmental assessment.

[Slide.]

DR. YOUNKER: Just moving over into the site selection decision diamond for a moment, because we have Bruce Judd who is a decision analyst working with us on this task force; although he's not a voting member of the task force, he very much likes to think about what goes on when we feed the information to the decisionmakers. So as we go through various presentations, there's more or less of the discussion that -- probably Dr. North would enjoy hearing what goes on in the decisionmaking part of this process.

The kinds of considerations that we're sure will have to be taken into account are, of course, the status with regard to the siting guidelines, which is the part that we've focused on. But the question, if you want to continue, is you'd like to know what kinds of tests or activities there are available to you, and the value of that additional work relative to its costs when you make that kind of a decision. We have tried to put our information in that context to help the Department have a handle on making that kind of a decision in terms of continuing.

Obviously, the results of environmental studies --and you'll see when we get to the environmental part of the presentation that we, the task force, have concluded that you really don't have sufficient information until you start through the EIS scoping process to even know what your potential concerns are. The way 960 is written, you must, in fact, defer to -- in our view now -- I'm speaking only from the task force conclusions at this point -- you must defer to the EIS scoping process to define what the concerns are, what impacts will have to be dealt with.

In those cases, you'll hear me say that with one exception, that you really can't say that you have the information available to support higher confidence or higher-level findings than the environmental guidelines. Something that is obviously involved in this decision is what kind of information additionally is needed for licensing and then what other management considerations are appropriate, given the current status of the program.

[Slide.]

DR. YOUNKER: Rolling right along, I'm ready to tell you how we actually did this, and there is a fair amount of detail that could be presented here, and I will be happy to try to answer questions. I haven't put a lot of the detail in here for you.

This next couple of viewgraphs just repeats what Dr. Gnirk already covered with you, and I think it's important to just quickly refresh your memory.

You will hear me talking both about system guidelines, which are the organizing features for sets of technical guidelines, some that are geotechnical, some that get at the way the site will behave in the post-closure performance period, some that get at the ability to use the site with recently available technology, rather than pushing technology, some that get at rad safety concerns, and some that get at environmental quality impact.

So they are listed up here for you, and you've already had this from Paul. So it should be fresh in your mind.

[Slide.]

DR. YOUNKER: The next one simply lists the guidelines for you again, and we had one similar to this with Paul. We'll go through examples of the findings that are supported by the team in a moment.

[Slide.]

DR. YOUNKER: One aspect of the guidelines I think Paul mentioned to you is that each technical guideline has a qualifying condition, and many of them have disqualifying conditions.

This is one that I think was previously mentioned.

The qualifying conditions, in almost every case, make a statement such as this one: "The present and expected geohydrologic setting of a site shall be compatible with waste containment and isolation . . ."

One of the things that the task force had to do was to decide how we were going to interpret "shall be compatible with."

You know, the guidelines in the implementation or in the statement of considerations, the background information, provides you some fairly nice help in terms of what was intended by that wording.

In order to apply the guidelines in a site-specific way, as we have done in this task force, we have further interpreted that, as you will see, as I tell you a little bit more about the preliminary conclusions.

The key thing I want to point out on this viewgraph is that the guidelines do indicate that the site shall be disqualified if evidence supports a finding that a single disqualifying condition is present or any qualifying condition cannot be met, so that you do have this -- I think Paul referred to it as gates in that if, at any time, you have evidence at some level of confidence or of certainty that that site does not meet -- it meets -- has a disqualifying condition or it does not meet a qualifying condition, then you should take action to perhaps decide to not spend any further money on that site.

[Slide.]

DR. YOUNKER: All right. Now, in terms of the way we used the wording from the double-negative statements, probably the lawyers in the audience, like Bob Mussler, will go oh, no, she did it, but in order for us to be able to use the words, we had to turn them around, and so you will see that I am using them slightly differently than what I think the lawyers would like, and fortunately, they don't have to defend this work, at least not at this time; I only do.

So what we did was, for the definitions from 960 for the disqualifying conditions, what we have defined, for our purposes, for this task force, is that the disqualifying condition statement, if it's present or likely to be present, that will result in us making an unsuitability finding or saying that the evidence supports an unsuitability finding.

If a condition is not present -- this is a disqualifying condition, remember now; so it will be stated as a disqualifying feature or condition about the site.

If it's not present but we're not confident that new information -- we're not confident that new information might change our mind, meaning it's not present but we think we might find something out that could suggest it is, that's simply a lower-level suitability, and these are basically consistent with the higher-level/lower-level findings that Dr. Gnirk mentioned to you. They map into them -- let me put it that way.

If a condition is not present and it's unlikely that that conclusion will change with additional information -- so it's a disqualifying feature now; it's not present, and we do not think that new information collected at the site or new design information will change that conclusion -- then that's our higher-level suitability or our higher-confidence findings.

DR. ALLEN: Jean, could I interrupt for a moment?

DR. YOUNKER: Sure.

DR. ALLEN: Clarence Allen.

This word "likely," "condition is present or likely to be present," can you define "likely"?

DR. YOUNKER: Well, fortunately, the guidelines did define "likely" for us, and I guess Paul could probably read the definition of "likely" for us. Then I'll tell you that we probably

kind of defined it for ourselves, as we went along.

DR. GNIRK: The definition from the guidelines of "likely," apart from the misspelling that occurred when they typed up the guidelines at the Federal Register, "likely" means possessing or displaying the qualities, characteristics, or attributes that provide a reasonable basis for confidence that what is expected indeed exists or will occur.

DR. DEERE: I think we can say it's likely that Steve Frishman will discuss this presentation.

DR. YOUNKER: I think that's probably true, Dr. Deere.

Dr. Allen, I don't want to jump too far ahead, but the way we actually defined the term "likely," when "likely" was in the phrase of the guideline, was to go through a balloting process and actually, within the task force -- the voting members -- we put numbers on "likely."

Now, those are not currently in the report, but in our decisionmaking process as a group, we found that we had to do that in order to establish what we meant by "likely."

So we did define it probabilistically, or we explicitly laid it probabilistically.

[Slide.]

DR. YOUNKER: Now, it's a little bit different when you look at the qualifying conditions, which is the next viewgraph.

The reason for that is, of course, that the qualifying conditions are stated in the positive, in that you are suitable if you have them, rather than you are suitable if you don't have them. So our terminology had to turn around.

The unsuitability evaluation result is that the site cannot meet the condition or is not likely to meet the condition.

The lower-level suitable or lower-level finding is that the site is likely to meet the condition, but additional information could change that conclusion. So it's very much the analogy to what I told you on the disqualifying condition.

Available evidence does not push you to this finding, but you're not confident enough yet to say that new information won't change your conclusion.

So that's the lower-level suitability, and I'll remind you that Paul mentioned that lower-level suitability findings were made on almost all of the guidelines in the environmental assessment, with a few exceptions where higher-level findings were made. And, by the way, those were made on ones like -- for the Yucca Mountain site -- on guidelines like dissolution, which clearly really wasn't a guideline that applied to the Yucca Mountain site, and population density, where it was a factor, where it was very clear you could go out and measure it and say we don't have it.

For the qualifying condition, higher-level suitability, site meets the condition, and it's unlikely that the conclusion will change with additional information.

So those are the kinds of statements for each of the guidelines that the task force drew their conclusions from or on the basis of.

[Slide.]

DR. YOUNKER: This really is just the inside of that diagram of that second. It is the inside of this rectangle, in terms of the way we step through the evaluation.

What we did was to, as I mentioned before, look for -- and this should read disqualifiers instead of qualifiers, if you would like to correct that on your copy. We stepped through the disqualifiers, and if the answer is they're not present, but it could change, then that's your lower-level suitability. This kind of diagrammatically lays out what you just had on the last two viewgraphs.

If yes to any of the disqualifying conditions, then we would say the evidence supports an unsuitability finding. If the answer is that none of the disqualifiers are present, then the way we, on the task force, have looked at it is that in order to get over to looking at the qualifying conditions, because they all relate, you're back to a system guideline. Then you look at system behavior -- look at the qualifying conditions, within the context of system behavior. You ask the question of are the qualifying conditions met. The same outcomes are possible, in that if the answer is no, the information supports an unsuitability finding, yes, but it could change, then it's the lower-level suitability. And, yes, and unlikely to change, then you're in that higher-level suitability which, as Paul mentioned, is required at the time you take the site forward to recommend it as a repository for all the guidelines.

[Slide.]

DR. YOUNKER: For a disqualifying condition example, before I get to the actual preliminary conclusions, let me show you one for natural resources. The disqualifying condition here is that previous exploration, mining or extraction activities for resources of commercial importance at the site have created significant pathways. If you read the rest, it's from the potential repository to the accessible environment.

The steps that we went through, in this evaluation, as a team, were to interpret that disqualifying condition in terms of site features and conditions. So this is where you make your link from a more generic type of disqualifying condition to Yucca Mountain site-specific features and conditions.

We, then, as a team, evaluated the likelihood, based on new information or available information, including new information, since the environmental assessment, that the condition is present, and then looked at the likelihood that new information would change that conclusion.

This is a disqualifying condition where you will find that we are -- we believe the information supports the higher confidence -- the higher-level suitability finding. There is a summary table at the end I will go through with you to tell you about that.

[Slide.]

DR. YOUNKER: For a qualifying condition, as an example, just so you can see the slight difference, because of the need to look at the system behavior or system guidelines. Once again, our geohydrology qualifying condition takes us over to present and expected setting -- geohydrologic setting shall be compatible with waste containment isolation. So it always refers you back to that system behavior.

What we did, in this case, was to look at the features and conditions that are important to behavior, within the context of this particular guideline; look at the site, explicitly considering those features and conditions, and all of the uncertainties that we were able to lay out, in the database and in the models that are available; establish the likelihood that behavior is acceptable. And as I talk about this, and you'll see on my next viewgraph that much of this we've done, the system assessments, in our head.

These are not totally quantitative, based, as you might like them to be; but there are, as I think one of our team members talks about, our carbon-based computers. We did much of the system assessment -- we used whatever was available to us. But, in some cases, they were qualitative conclusions drawn, and evaluate -- so you evaluate the likelihood that behavior is acceptable for a higher-level finding; evaluate the likelihood that new information will change the conclusions for the -- oh, sorry, that should have been lower-level finding, and then the likelihood that information will change a conclusion for a higher level. So there's a typo. You

might want to change that to "lower."

[Slide.]

DR. YOUNKER: As I said just a minute ago, the conclusions you draw, working with a task force like this, can be either qualitatively derived or quantitatively derived. You can use a weight of evidence type of argument. In fact, the way we ended up laying this out is that our conclusions, if unanimous, we didn't -- we really didn't bother to use ballots, or we didn't lay out our probabilities explicitly. If we were unanimous, when an author presented his conclusions, based on the information to us that, let's say a higher-level finding is supported or is not supported, we did by acclamation, a question of -- we asked the question, does the team support that conclusion? If it was unanimous, we did not ballot; if it was not unanimous, we then went through some quantitative balloting to establish what the differences in thresholds for that condition being present or not present were amongst our panel. And then we talked about that -- certainly talked about the extremes, as you normally do in this kind of a process, about why people had orders of magnitude different thresholds or orders of magnitude different probabilities of a condition being present or not present. Then we would ballot, a final ballot, and that would be the result we would take forward.

One other side light on this that was kind of an interesting outcome, for me at least, is that for our -- we only -- we traveled with the consensus of the group. We defined consensus to be that if everyone believed the information supported a higher-level finding -- higher-level suitability finding, then we went with -- the consensus of the group had to be unanimous for the higher-level finding. If one person was not comfortable -- one of our voting members was not comfortable with the higher-level finding, then we kept it at the lower-level suitability finding.

It ended up causing a lot of discussion. There is still, I am sure, at this very moment, a lot of debate going on in the technical review that's being conducted out in Las Vegas about that.

It turned out that people wanted -- the team wasn't comfortable not being in the conservative mode. So to support the higher-level finding -- higher-level suitability finding, required all members -- required unanimous support.

DR. NORTH: Before you leave the slide -- Warner North. Do you really mean it, with the numbers in the upper right, probability that behavior meets a threshold that's greater than .1 or .01? That's a very easy test to pass. Did you mean to put .9 or .99 there?

DR. YOUNKER: It depends on how you define your threshold, certainly. You could turn it around and make it .9 or .99. Those were just examples, in that -- when we went through our balloting, the kinds of numbers we tended to come up with were one in 10 or one in a hundred, sometimes .2.

DR. NORTH: Right. But, what you mean is it's near certainty --

DR. YOUNKER: Right.

DR. NORTH: -- as opposed to the converse? So you need to change the numbers on that slide.

DR. YOUNKER: Make it big numbers, yes. I understand your point.

[Slide.]

DR. YOUNKER: This approach that I talked about, I usually give examples from the post-closure geotechnical, since that's my area, but I wanted to make sure that you understand that we had members on the task force covering all of the areas that are covered, the disciplines that are covered in the guidelines.

So for post-closure performance, acceptable behaviors are defined by the radiological

safety and -- pardon me -- by the regulatory standards, pre-closure radiological safety, we are given criteria that we have to meet, for the most part, in the regulations.

When you talk about acceptable environmental, socio-economic, and transportation impacts, however, you don't have anything laid out there for you, and so as I said, in that case we will have to define what the potential impacts are during the NEPA scoping hearing process, as it's applied to this site.

And for the reasonably-available technology guidelines, this particular set of guidelines refers to ability to do what you need to do, using reasonably-available technology.

So the acceptable behavior that you're looking at, the system behavior that you're concerned about is the ability to apply, to use this site with reasonably-available technology.

[Slide.]

DR. YOUNKER: All right. Now we are at the conclusions part here. The status of the guideline evaluations.

All right. Our report, which is in review, goes through reviews of very briefly the data and the conclusions from the environmental assessment. The report was not written to be stand-alone, and so to do a critical review of it, it will be necessary for a person reviewing it to have the environmental assessment for the site as well as the site characterization plan handy on their shelf, because we didn't really want to produce another very, very large document. So as a result, the report is only a couple of hundred pages, and it does require you to look things up. It refers back to the EA or the SCP liberally.

It reviews new information analysis developed since the EA. We attempted to put the crux of the arguments, or the important information, into the document. Even there, it will be necessary, I believe, for the peer review panel to have access to copies of all of the 500-and-some references that are cited, or at least those references which apply to their areas, because you just can't -- and we didn't think it was really wise -- transfer all the information from a supporting reference into the document, to really make it stand alone.

Okay. We went through, then, in the report, and as I said in the previous diagram, determined if any of the disqualifying conditions are present. And when you are reviewing the data and conclusions of the environmental assessment, of course, you realize that at that point in time we made that the first lower-level suitability findings for the disqualifying condition.

So what you're really asking is does information that has been collected since that time continue to support that finding. And that's the status of the findings.

We also ask the question, are any higher-level findings supported, and then, in the cases where they are not, identify the information that we believe is needed in order to support the higher-level findings. So that this is the part where, if well-done, it should be useful information to the Department in terms of how to focus and prioritize their program from the standpoint of as soon as possible getting to a level of confidence about the suitability or unsuitability of the site.

Our final step will be to provide the peer-reviewed report to the Department. And, as I said, that will be in December.

[Slide.]

DR. YOUNKER: These are the preliminary conclusions, likely to change. But let's see. Let me first say that of the 18 disqualifying conditions that I'll go through with you, we believe as a task force in the current report that 14 of the 18, the information supports that statement that we've defined as being the higher-level finding or the higher-level suitability, 14 of the 18 disqualifying conditions. And I'll go through those with you, and show you the ones for which we believe there is still a question, where new information could change the

conclusion that the lower-level suitability finding is present.

For the qualifying conditions, I can tell you, I'll give you the answer on that one, too, in a summary, and then go through them.

There are 24 qualifying conditions, and 12 of the 24 we believe the information supports the higher-confidence or higher-level finding. So it's 12 of 24 for qualifying and 14 of 18 for disqualifying.

Now, let me give you some further information on that.

In the cases where there are NAs in my "disqualifying condition" column, that doesn't mean that we don't think a disqualifying condition was applicable. That simply means 960 didn't give us one in that particular guideline area. So the NA means no disqualifying condition specified in 960.

However, bear in mind that the first question you ask when you look at a qualifying condition, in the way we've set this analysis up is, are there any site conditions or features related to that particular qualifying condition, let's say in geohydrology, that would be potential disqualifiers?

So you ask the question, even if you don't, because of the way the guidelines are constructed, and the way we've applied them, you still ask the question, is there a disqualifying condition present, in the case of the guidelines where no disqualifying condition was included in 960.

Was that clear? Somebody nod.

Okay. I told you about the consensus. So these conclusions represent the consensus of the team derived in the way that I've just described.

Let me remind you again that this system guideline for total system, for post-closure, is its compliance with 191 and with the subsystem guidelines for 60. So this is basically the compliance with EPA and 60 performance objectives.

The way we looked at these, then, for geohydrology, the reason why that one remains a lower-level suitability finding as it was in the environmental assessment for both the disqualifying condition and the qualifying condition, is because there's a concern amongst the group that we still don't have the information to really know that we don't have fast paths. Site characterization data in some cases will be critical for us to establish, and as you know, the wording on the disqualifying condition is path of likely and significant radionuclide travel. Is that correct? So that the absence of information to determine if we have fast paths at the site is what causes this particular disqualifying condition to not be recommended or not be supported for higher-level finding.

For the other ones, if you notice on this page, and on the next page, the rest of the post-closure -- let me go through the disqualifying conditions with you first.

[Slide.]

DR. YOUNKER: For erosion, it was at the bottom of the previous page.

For dissolution, for tectonics, for natural resources, and for site ownership and control, the task force is comfortable in supporting the higher-confidence finding.

Now, remember what that says is that we don't believe that the site is unsuitable on the basis of available information; we don't think new information is going to change it with regard to that particular guideline. That's the statement that we voted on.

DR. ALLEN: Could you remind me what the tectonics guideline is?

DR. YOUNKER: Right. The tectonics disqualifying condition is nature and rates of fault movement are likely to lead to or are expected to lead to loss of waste isolation.

DR. PRICE: And the statement, when it's given like that, is unanimously supported?

DR. YOUNKER: That is unanimously supported by the task force, that we don't believe that nature and rate of fault movement at the site is likely, I think it says likely to lead to loss of waste isolation. We don't believe current evidence supports that, and we don't think new information will cause us to change that position.

Now, that doesn't mean that we don't have concerns about tectonics at the site, because you'll notice that the qualifying condition for tectonics remains at the lower-level suitability.

And one thing that's interesting about this particular guideline, and I don't know if this is what you're bringing up, Dr. Allen, but the disqualifying condition does not include volcanics; it only includes fault movement.

Volcanic activity is over under the qualifying condition, because the way it's worded -- and Dr. Gnirk could probably enlighten us on why they did it that way -- for some reason, this is just nature and rates of fault movement. And our team feels really quite confident that a post-closure facility at the site, given -- I should make one other statement -- given nominal conditions in the other areas of concern, a major post-closure tectonic episode, or fault movement, is not really a suitability concern.

DR. ALLEN: Then why are we spending so much money on characterization in this area?

DR. YOUNKER: We believe it's not driven by a concern for a post-closure fault disruption of the underground facility as a potential hazard for exceeding the EPA limits.

So I guess let me see if I can be more explicit.

What we really, I think the task force would say, and what we say in the report, is that there are reasons why you need to gather information about the seismic hazards at the site. There are reasons why you need to gather information about the way post-closure disruptive processes may cause problems in meeting the EPA standards. But from the standpoint of post-closure tectonics, per se, the way that guideline is written, the disqualifying condition says nature and rates of fault movement.

And the conclusion that we reached is explicit to those words. It is that the nature and rates of fault movement are not likely at this site to lead to a loss of waste isolation.

We are very much focused on the intent of that particular guideline.

DR. ALLEN: Again, let me come back to the definition of "likely." If you judge likelihood on a scale from zero to ten, is anything over five likely and anything under five unlikely?

DR. YOUNKER: Yes. We did have to ballot this one, as I'm sure you would have guessed. I don't know if I can remember the exact range of where people's thresholds for, you know, we have that all in the record of the meeting where we voted on this -- I think that most people have thresholds of one in ten or less. It was a less than one-in-ten chance that this particular condition would change.

DR. ALLEN: Well, then you've decided that less than one in ten is unlikely, but how about five out of ten? Is that likely or unlikely?

DR. YOUNKER: Yes, that discussion occurred. All I can say is, I'm not sure that particular answer is in the record of the meeting. Bear in mind that this is explicitly addressing nature and rates of thought movement likely to lead to loss of isolation. It doesn't get at volcanics. It doesn't get at seismic hazard, which is covered in the next set of guidelines.

DR. BARNARD: What did you use for definition of "loss of isolation"?

DR. YOUNKER: Let me think if we were explicit. I think we probably used -- I'm not

sure that we actually balance or we actually elicit people's opinions on that. But I'll give you my guess. My guess was probably fifty percent of the standard, something like that. That's my guess; I'm not speaking for the group on that.

Okay, let me see if I can give you the rest, any other -- sorry. Sure.

MR. BLANCHARD: I'm not part of this study so I can't reflect on any of the points that the group has made about tectonics but I would, Dr. Allen, like to point out that with respect to the tectonics hazard, this discretion is on post-closure and the major focus of our current program in terms of funding and level of FTE is in preclosure looking at the seismic risks for the preclosure aspects of the program and the risk to the waste handling building and things like that.

I believe the perception is that if we gather all that information correctly and use it for preclosure, we'll have basically everything we need for postclosure and so the postclosure hazards that are discussed here are not really, the program is not being driven by postclosure. It's preclosure seismic hazard assessment.

DR. YOUNKER: I think what you're seeing here is the group opinion that -- and I think this has been prevalent back even at the time of the environmental assessment that once that facility is there and sealed and closed, that postclosure tectonic behavior -- except for something low-probability, like a direct volcanic penetration or something like that -- is really not a significant hazard from the standpoint of loss of waste isolation.

The idea that if it's a dry site and you have a new fault or renewed activity along the Ghost Dance Fault, what does that do to you if there's not additional water. And remember, as I said, we assume nominal conditions so there isn't additional flux available when you're making this finding.

DR. ALLEN: But what is significant hazard and what is likely or unlikely are two quite different things. I mean, a significant hazard may be still a very low probability event.

DR. YOUNKER: Yes, that's true. I think we focused on the likely to lead to loss of waste isolation. I think the number was, in most people's minds, on the order of 30 percent to 50 percent of the standard.

Let me state it another way for you and see if this helps. In the cases where we couldn't come up with a credible scenario, none of the references or the experts that we were eliciting opinions from could come up with a credible scenario where that particular event could lead to a violation of the standard, cause a loss of waste isolation. Then we considered that new information was not likely to change our conclusion. We just couldn't come up with -- that was kind of a cut-off that we used in a sense because there was no credible way that we could see that that could be a suitability concern.

Dr. Reiter?

DR. REITER: Leon Reiter. Two things in response to what Max said, that you're concerned more about preclosure, I noticed flipping ahead that your preclosure tectonics, you had high level findings both in disqualifying and qualifying conditions. The second question I wanted to ask you is: It says using the standard, you must have made some assumption about engineered barriers; was that a uniform assumption or how did you take that into account?

DR. YOUNKER: The question about engineered barriers, I think what you would find -- and I don't know that we were explicit about this as we should have been, Leon -- but I think what you would find is that just like we assume the nominal case for the other conditions existed, I think that we probably were assuming nominal behavior.

Now, whether that means you met one part in ten of the fifth at the engineered barrier

system wall, we didn't explicitly talk about that. We really looked at this from the standpoint of site futures and conditions that could cause you to -- you know, could individually cause you to judge the site unsuitable.

So that's a good question and I think I will need to take that back to the group. I think we need to be explicit about that. Could I hold on the preclosure question? Because that's part of a different discussion, but I'm about to get there, I think.

Let me tell you, say, for natural resources for example, both of these disqualifying conditions have to do with either pathways already created by exploration activities or activities outside the controlled area would be likely to lead to loss of waste isolation. And we could not come up with -- and within the PA group that was supporting this activity, they do not have credible scenarios for activities exploration and resource extraction outside the controlled area, which is what the disqualifying condition reads, that would be likely to lead to loss of waste isolation. So one, we had a unanimous higher-level finding supported by the group on that one.

It was the same thing for presence of existing pathways, significant pathways. We think we've done adequate investigation of the site, but if there were significant pathways that have been created by previous mining activities at the site, then we would know about them, significant pathways from the repository to the accessible environment.

DR. CANTLON: Tell me again the distinction between one and two.

DR. YOUNKER: I'm sorry. I can't get all the information on one table. There are two parts to the natural resources guideline disqualifying condition. The first part is that there are the previous exploration activities that have created significant pathways. The second part to it is that the activities for exploration or extraction of resources outside the control area would be likely to lead to loss of waste isolation.

DR. DOMENICO: The qualifying conditions for natural resources, like you say, condition is likely to be present. But look up above for dissolution; it says condition is present. Is the "condition likely to be present," that second-order finding?

DR. YOUNKER: Right. Let me go back.

DR. DOMENICO: I'm a little bit confused on that.

DR. YOUNKER: I'm going to walk you through the qualifying conditions real quickly now for the post-closure group.

[Slide.]

DR. YOUNKER: What you'll find on the qualifying is that just like we told you we were going to use the terminology in a certain way, "the condition is likely to be present" means that the available information does not lead us to the unsuitability finding; we believe the available information supports the lower-level suitability, which is that the condition is present.

So that's what "likely to be present" -- it's just the wording, basically, from 960.

DR. DOMENICO: One more time. If you said, "the condition is likely to be present and future information shall probably support that," would that be a higher-level finding?

DR. YOUNKER: Yes.

DR. DOMENICO: So when you don't have that second clause --

DR. YOUNKER: Future information is unlikely to change.

DR. DOMENICO: That's a high-level --

DR. YOUNKER: That's the higher-level finding.

DR. DOMENICO: So when you don't have that qualifier, it's a low-level finding.

DR. YOUNKER: That's correct.

DR. DOMENICO: So you're not sure.

DR. YOUNKER: That's correct.

DR. DOMENICO: Okay. Thank you.

DR. YOUNKER: As I said before, the way we looked at these qualifying conditions was that if there was no credible scenario related to that particular topic, such as rock characteristics post-closure or erosion, dissolution on the next page, that could lead -- that was likely to lead to loss of waste isolation and that new information was not likely to change that conclusion, then that's when you get that second phrase, which is the higher-level finding.

[Slide.]

DR. YOUNKER: Okay. You saw the ones on the previous page that are at the higher level.

DR. DOMENICO: What were the qualifying conditions for future climate change, previous page? Because you said it's there.

DR. YOUNKER: All of the qualifying conditions are the same general -- tie back to the system guideline. They will say something like "compatible with containment and isolation" or "likely to lead to a loss of waste isolation" in the case of the disruptive ones, like climate change.

It says, "likely to lead to a loss of waste isolation"; future climatic changes are likely to lead to a loss of waste isolation.

In that case, I think the group is -- you'll find, when you look at the write up on that one, the evidence is fairly strong that this site is going to remain climatically about like it is now for the next 10,000 years, but there is just enough of a lack of confidence of minor climatic change. How does that affect the hydrologic system?

The group is not confident enough to say that future information cannot change your conclusion on that guideline, the qualifying condition.

[Slide.]

DR. YOUNKER: Okay. Let me run you through the other packages of guidelines.

The preclosure radiological safety guideline turned out to be an interesting one from my viewpoint.

What happened in this case, as you will see, is that the -- even the system guideline, which is compliance with the radiological safety criteria -- even the system guideline has that phrase that the new information is unlikely to change the conclusion.

The technical guidelines that support the system guideline for radiological safety you see here -- population, site ownership, meteorology, and offsite installations, which has to do with the ability to interact with other facilities in the area that could potentially interfere with or you could interfere with their operation.

What happened in this one was that there was a fair amount of confidence in the team and in the people that supported the team that you intend to rely on engineered systems and equipment that is -- has been proven in other facilities, nothing beyond available technology, and that these conditions in no way present undue constraints or hazards, so that the overall basis for being confident in this particular set of guidelines and, therefore, believing the information supports the higher-confidence finding is that the group does not believe that you have any fundamental suitability issues related to preclosure radiological safety.

The meteorology, the population, the offsite facilities are all in a favorable or, at least, a not unfavorable position, and we don't think new information is likely to change that.

So that's the basis for this one, which is a fairly aggressive position. It's placing a lot of faith and confidence in the ability of the design process to do what it's supposed to do, and we do have some people on the team who were pretty confident that it could do that. So I think they

tended to influence us overall.

DR. CARTER: Jean, can I ask you a couple of things?

Two questions: I wonder if you would refresh our memory on the population in density and distribution, as far as the guidelines are concerned.

DR. YOUNKER: Sure. Okay. The disqualifying conditions are -- there are three parts to it.

One is that the facility would be located in a highly-populated area, one is that it would be adjacent to a one-square-mile area with greater than 1,000 population, and one is that DOE could not develop an emergency preparedness program.

That's the three parts to the disqualifying condition.

Now, qualifying condition is that doses to highly-populated areas are not likely to exceed small fractions of the limits and -- I am paraphrasing this a little bit -- dose to public unrestricted area not likely to exceed the applicable limits.

DR. CARTER: Okay.

The other question I had is on offsite installation and operations as far as interference.

Now, an example of that, would that be ground motion, for example, from the weapons testing program?

DR. YOUNKER: Yes.

The ground motion gets considered there, as well as releases from other facilities. Any type of interference activity that could occur would be considered there.

DR. CARTER: Okay. Thank you, ma'am.

DR. CANTLON: Jean, did this radiological safety take into consideration transportation or only onsite?

DR. YOUNKER: Yes. It did take into account transportation from the standpoint of -- let me rephrase this.

It was looked at both here and in the transportation guideline.

There is an interpretation necessary in order to figure out where transportation-related radiological risks get considered, and I think, our writeup, we put it over under transportation, but we also refer to it here in the system guideline writeup.

I don't know if that's how the writers of the guidelines intended, but that's how we interpreted it for our purposes.

[Slide.]

DR. YOUNKER: Okay. Let me move on to the environmental quality, socioeconomic impacts, and transportation.

In this case, as I alluded to earlier, because you don't have -- you haven't defined what your potential concerns are, your suitability concerns, until you start the EIS scoping process, in this case the members of our team that are responsible for this part of the report have, I think, convinced us all -- and we do have a consensus on this -- that it wouldn't be prudent or make sense to do anything other than remain with the lower-level conclusions that were made in the environmental assessment, except in one case.

Environmental quality, that second disqualifying condition, simply says that you don't put the facility in a national park or a protected area, and we believe that the DOE can probably be counted on to not try to put the facility in a national park or protected area.

So we rely on the institutional controls and the good judgement of DOE management to recommend that that condition can be supported at the higher level. But other than that, you will notice all the rest of these are the lower-level suitability finding, remaining the same as the

environmental assessment.

Now, we did review the information, so there is a good review of new information available since the environmental assessment, and we had no reason to question any of these findings.

So it isn't as if we ignored them. We did go through, and in fact, there is a lot of new information in transportation, a lot of new information on socioeconomic impacts that's reviewed in this report.

DR. ALLEN: But since this is site-specific to Yucca Mountain, clearly Yucca Mountain is now not a National Park. All you're accomplishing here is that the Park Service is not going to declare it a National Park.

DR. YOUNKER: Yes, you're assuming that there will be interagency cooperation; that this area will not be declared a protected area at the same time the DOE is attempting to move forward with the repository program at this site. Yes, I think that's kind of the basis for it, which we thought was reasonable.

[Slide.]

DR. YOUNKER: We have one more set of guidelines. Those are the preclosure ease and cost as they're referred to. If you read 960, you will see that the cost had to do with the comparison of costs among sites. We really did not, for this phase of the evaluation, consider costs, other than when we discussed it in the group. We did ask ourselves the question: do we believe the technology necessary to handle these conditions at the site would be exorbitant from a cost standpoint?

In other words, is there something at this site from the standpoint of either surface terrain or rock properties that would lead us to extremely expensive technology? That's about the only real consideration of cost in this present evaluation. So what you're really looking at then, from the standpoint of system guideline is: Is there anything about surface terrain, rock properties, ground water conditions in the facility or seismic hazard, tectonic related problems that would cause you to have to go beyond reasonable engineering measures, standard engineering measures, reasonably available technology, as the term is phrased in the guidelines?

In this case, what you find is that the preclosure tectonics disqualifying condition, as well as the ground water conditions for hydrology -- which is what is covered in this list, as well as the rock characteristics, meaning the mine-ability from a work safety standpoint -- all three of these, the taskforce is confident that you do not have to go beyond reasonably available technology.

Now, there was a lot of debate, as you might expect, on the tectonics disqualifying condition and likewise with the qualifying condition. The seismic cost/benefit study that was done by Bechtel for the Department or for Sandia a couple of years ago was our major source of information that supports this particular finding.

What that shows -- and I'm not the expert on this; Leon knows a lot more and maybe Dr. Allen knows a lot more than I do -- but what it shows is that you can go up to something like a .5 design basis and the costs are fairly pretty much flat, and then they start to really go up when you get above something like .55 or .6. But from the standpoint of cost as well as availability of technology, that report, and other reports tied to it, led this group to believe that the technology is available to handle the expected conditions.

So you know, the question of whether the confidence is high enough that when you go out there and get all the site-specific information you're going to get on slip rates and on potential for surface displacement, whether that really stands, this group at this point in time --

and this is one that I suspect is going to get very heavy scrutiny during technical review and during the peer review -- this group is confident that it will not push us beyond reasonably available technology in order to cope with the seismic conditions that are determined to be present at the site.

A personal bias in this one: I was a little bit uncomfortable about this one, but I listened to some very strong arguments. The available evidence at this time looks solid. It appears that you will not have to push technology.

DR. DOMENICO: If you had to go for some reason to two levels for the repository, would that make the cost exorbitant? That's not an easy question.

DR. YOUNKER: Interesting that you should ask that. See that conclusion right there for rock characteristics? The qualifying conditions for surface, hydrology and tectonics are all at the higher level. We believe that information supports the higher level of confidence for surface terrain, for ground water conditions and for tectonics. However, you'll notice that for rock characteristics, we don't have the higher level of confidence yet.

DR. DOMENICO: Is that the reason?

DR. YOUNKER: Two reasons, really, came through very strongly. I was somewhat surprised by that conclusion as well. That was that the contingency -- assuming reference design now, so many thousand metric tons were to go into this facility -- the contingency in terms of rocks' available space, lateral extent, vertical extent, just did not lead to a confidence that you were potentially going to find out you had a space problem, especially given that in everyone's mind is the question of what if we want to keep it cooler?

DR. DOMENICO: You will swear that we didn't rehearse this; right?

DR. YOUNKER: We did not rehearse this.

DR. DOMENICO: Okay, thank you.

DR. YOUNKER: That is exactly the reason why the rock characteristics conclusions supported by the group right now is the lower confidence, the lower-level suitability. We just don't feel like we have the evidence in hand to be confident that we have enough usable rock.

DR. ALLEN: Did I understand you earlier to say that by the time that characterization is over, if you're going to move forward, every one of these qualifying conditions has to be favorable at the high level?

DR. YOUNKER: That's correct.

DR. ALLEN: You also stated that the vote had to be unanimous in order to be at the high level. Does that mean one person can block the whole thing?

DR. YOUNKER: The unanimous vote is the way we, this task force, defined the way we would operate. From the standpoint of how the Department would ever make those decisions, that's certainly their prerogative and their purview. All I was saying for you was -- everything I've said here today is the way this particular task force has chosen to operate.

I think we hit everything on this one that you needed to hear about. Let me ask if there are any further questions or comments.

DR. DEERE: We're now open for comments or questions from Board members.

DR. CANTLON: You referred a number of times to the fact that there's a great deal of new information that's emerged about the site or relevant to the site. As you now look at that new information and the task force looking at this growing body of data, is there anything about the nature of this framework that you think would be modified to bring in this new kind of information? Is there some aspect of the structure by which you've looked at disqualifying and qualifying that could be improved to take cognizance of this emerging information?

DR. YOUNKER: I guess my personal opinion is that it is very difficult to think about the suitability of the site in terms of these discreet features. You know, you say, well, clearly what kind of hydrology I have depends on what kind of geochemistry I have, depends on what kind of disruptive processes like climate or tectonics I have potentially operating on the site. I recognize that there's no easy way to do the -- from the system viewpoint, although certainly the intent in grouping the guidelines the way they have and the way Paul described for you, was for you to take a system perspective on the set of technical facts that you would look at.

I think moving toward that system perspective, in my view, is an intelligent way to move, however, we are, as I said, and as Max has said, bound by the use of the guidelines on a case-by-case basis right now, or guideline-by-guideline. I think my view right now is that it worked reasonably well. We'll see how the technical review and the peer review panel react to the report.

We didn't have to stretch things and we didn't have to -- other than in cases like erosion or dissolution, we really didn't spend a lot of time saying we don't think that's a problem for this site.

DR. CANTLON: To be more specific then, the coupling of the processes is under address in the framework?

DR. YOUNKER: Well, I think you have to be very careful to make sure that you define what you mean. When you look at just the geohydrology or just the climate change, what are you assuming about the rest of the conditions? Are you assuming a nominal behavior? Are you assuming they're all at their extremes, you know, their adverse extremes? Those kinds of discussions need to be explicit with the group as you go through this kind of an evaluation.

DR. DEERE: Warner North.

DR. NORTH: I am impressed by this framework. I like the orderly process that you've gone through. This is certainly a nice way to summarize, with these two levels of findings, just where we are against the 960 guidelines.

Leon Reiter, I believe, said earlier in the day, the devil is in the details. It strikes me that on this issue, as on some others we have seen, documentation becomes absolutely critical, that you have to get down on paper in suitable detail what it is that the experts used as their reasoning in coming to these conclusions. I think it is very useful to have the ground rule that there was unanimous consent, and then where there was not unanimous consent, go into more detail as to what was the basis for the disagreement, and what are the implications of that.

I, personally, would not care to see a long discussion regarding whether or not Yucca Mountain would become a national park. I don't think that's a significant issue on which I would be motivated to read further. But, on the other hand, if I look at the geohydrology column and the disqualifying condition, I believe the only time you have the lower-level finding on a disqualifying condition, that one, I think, I'd like to know a great deal about. I suspect the interested and affected parties might feel much more strongly than I do on that particular subject.

So I will urge that as you continue this, you give consideration to what an outstanding job you can do in providing documentation leading to the conclusions you've presented.

DR. DOMENICO: Jean, you're the only one that I have heard who says you don't anticipate any climatic changes in 10,000 years. I thought the consensus is that you probably will return to some pluvial conditions. So I don't understand -- can you put that slide up -- maybe I don't understand the qualifier or the disqualifier there. Because -- the one that said climate, I believe.

[Slide.]

DR. DOMENICO: "Climatic -- condition is likely to be present." What condition? Did something -- the climate could change, but will not lead to radionuclide release? I'll buy that.

DR. YOUNKER: All this means is that we endorse the lower-level suitability finding and the environmental assessment, by making that statement. Any place where we don't make the additional statement that the new information is unlikely to change the conclusion, it simply means that we are confident that we can meet the lower-level suitability finding, which is the available information supports the site to be suitable, with regard to climatic change.

DR. DOMENICO: What is the qualifying condition that's stated?

DR. YOUNKER: This one is the one that says "climatic changes over 10,000 years are likely to lead to a loss of waste isolation," or expected to.

DR. DOMENICO: So those are coupled? It's not just a change in climate?

DR. YOUNKER: That's correct.

DR. DOMENICO: But it's the effect of such a change?

DR. YOUNKER: In fact, of course, you expect some amount of climate change. But you will find there are a couple of new interesting references included in this report that give us, I think, a much better handle on what those expectation should be for 10,000 years than what we had at the time of the EA.

DR. DOMENICO: Thank you.

DR. DEERE: Additional comments from Board members? Staff -- professional staff?

MR. BLANCHARD: Max Blanchard, with the Department of Energy. As a manager watching this evolve, one of the things that those in our office are concerned with is: Are we spending our budget prudently? I just wanted to point out that it's not easy to jump from results of this study into deciding each fiscal year how to spread the money.

Let me give you an example. The preclosure tectonics qualifying condition is -- the way it's worded is, in essence: can the effects of expected tectonic activity be accommodated with reasonable available technology?

One may, using expert judgment, reach a conclusion, with some degree of confidence, that the answer to that is yes. But that does not give you what you need to have in order to design a facility. You have to do a lot in order to go, with confidence and in a defensible manner, through a licensing process, a design basis earthquake and a structural design that will withhold the criticism of all those who need to review and critique that design.

So I just offer the observation that in those areas where it looks like the "higher-level finding" may be offered up, in the eyes of the multi-discipline experts, it may not even suggest that we're ready to terminate any of the work in that area, simply because an answer there just says, well, in the upper bound, we're confident we're within available technology, but we haven't said what we have to do to design and build the structure and make sure that it satisfactorily passes those hazards. Thank you.

DR. YOUNKER: In fact, the report makes it very clear that there are areas where this group would recommend that you may not need to focus much additional site characterization activity and that would not be one of them. Because in that case, we just state that for design purposes, it's clear that there are specific pieces of data you're going to have to obtain that we don't have right now. We are basing that conclusion on the expectation of what the results will be with regard to recently available technology. So that's a very good point.

DR. DEERE: Thank you, Max. I would like now to open up for questions from the audience.

MR. FRISHMAN: I am going to refrain from commenting on any of the conclusions. But I do want to just sort of get us in the right frame of mind.

Since we all now have a set of definitions for all of these words that we understand so well, I want to know if you believe me when I say to the extent practicable, it is likely your evaluation and determinations have given me reasonable assurance that my siting concerns will be mitigated.

Do you believe it?

[Laughter.]

MR. FRISHMAN: Now, less seriously, first of all, I think, given the presentation and the method that has been undertaken here, with the expert judgment approach, I think just for the Board's purposes, it would be useful to at least examine the record of the days of discussion that have gone on with the Advisory Committee on Nuclear Waste with the NRC regarding expert judgment, and the use of expert judgment, because there is some highly informative discussion in there regarding not only how the Department of Energy applies its expert judgment approach, but also what other people think about methodologies using expert judgment. I think that is one way to help further evaluate what was just presented to you.

I do have one question. In trying to link this work together with other work that the Department is doing, is there any linkage at all in the information that the people were using in these elicitations with the information and also the results of the test prioritization expert judgment work that went on?

I'd like to give just one example, and this is just one that I happen to remember. In the area of natural resources, by having set some fairly narrow definitions, the test prioritization people first determined that there was only a .002 probability that there would be natural resources at the site that would, in one way or another, affect the licensability of the site.

But then they also evaluated whether the planned tests -- or to what extent the planned tests might find those resources, if they are there. The probability was .57.

I just wonder how much of that is either incorporated or not incorporated into the elicitations and the conclusions that you've just presented?

I won't say an awful lot more about it.

DR. YOUNKER: That's a question I can answer.

We had the same decision analyst leading our team, working with us, as was on the test prioritization, and I'd say about 60 percent, 70 percent of our team actually served on the expert panels for TPT. I did as well as -- I'm thinking there's only two or three of the 14 voting members did not vote.

We used their information. In fact, we had the report as the basis for many of our discussions, and we would look at their conclusions. In some cases, we found that we agreed; in some cases we found that we disagreed, but it was because we had framed the question differently.

And so we did use it fully, as part of the information that we relied upon to then move forward with this evaluation.

MR. FRISHMAN: Was that .57 determination sufficient to lead you to a higher-level finding?

DR. YOUNKER: What we did in the case of the value of information part of the TPT, this particular evaluation has not moved into the area where we explicitly looked at value of information of testing.

What we have are really what I would call "seat of the pants." I mean, they're basically

estimates of the areas where confidence is not high enough yet, and we think we're going to have to get additional information. But we don't have a value of information TPT type of analysis to say what the probability is that if we go do the best test we have, that we'll really get that information in an accurate fashion, which is what you're getting at.

MR. FRISHMAN: What this leads me to is my continuing amazement with the conclusion of another expert judgment process that went on with the Calico Hills risk benefit. And that being that without additional data, the conclusion was that the Calico Hills is an even better geologic barrier than we thought it was.

So I just kind of point that out, that your reliance here is one on the use of an expert judgment process where in fact all you've done to date is galvanized the existing biases within the system. And it will be very interesting to see where it goes from here, and whether eventually you believe me when I some day again make that same statement I made at the beginning.

DR. DEERE: Thank you, Steve.

Are there other comments from the audience?

[No response.]

DR. DEERE: Thank you, Dr. Younker.

On behalf of the Board, I would like to thank all of those who have made presentations over the past two days, for contributing to what we feel was a very interesting and productive meeting.

We also appreciate the related comments from the other interested parties in the audience.

I would like to go back just for a moment to last Monday's meeting of the Panel on Structural Geology and Geo-Engineering, and state that the Board would be interested in studying the report of the trade-off studies for the ESF South Ramp locations and the optional shaft.

I understand that we have now received a copy of that report in our office, but we probably will want to examine the referenced information and some of the backup data and analyses. And I've asked Russ McFarland of our professional staff to follow through on gathering whatever information we feel we would like to look at.

In closing, I would like to thank you all for coming, and we are adjourned.

[Whereupon, at 4:30 p.m., the meeting was adjourned.]

