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IN RE:

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OF

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MR. BLANCHARD: We will begin now. We had some people come in today that weren't here yesterday. I see John Linehan and Paul Prestholt. I see a face that I'm not familiar with. So I think, because yesterday everyone introduced themselves, I think John, why don't you start and tell the board and people here who you are and what role you have?

MR. LINEHAN: John Linehan, project director for licensing pending division on high level waste management.

MR. BLANCHARD: Paul?

MR. PRESTHOLT: Paul Prestholt, here in Las Vegas for the NRC.

MR. BLANCHARD: Thank you. Sir, I had --

MR. ROMMEL: Bob Rommel with REECo Construction Department.

MR. BLANCHARD: And Ernie?

MR. HARDIN: Ernie Hardin. I'm a geophysicist here at SAIC, and I'm here to help Mike Voegele out with his presentation.

MR. CLANTON: Uel Clanton, chief site investigations branch for the D.O.E.

MR. BLANCHARD: Okay. This morning we had on the agenda Session 2, which was our considerations for repository drifting -- perimeter drift, that is, as part of the site characterization.

In a similar fashion, we have a format from yesterday. Examine what the regulatory constraints seem to be, based on our understanding during the time we were preparing the SCP. This evolved from 1985 through the end of 1988. And right or wrong, those are -- I'll be talking about what we thought the constraints were at the time.

Then Mike Voegele will be talking about the scientific needs to satisfy the regulatory constraints and type of test program we've set up. Joe Tillerson will explain the engineering considerations that are needed to satisfy these two.

And then we have adjournment set for

something on the order of 12:30. We're very flexible, we don't need to do it by then. The question really is what your travel arrangements are. If you think you want to change them, we can assist if you want us to. So if you need someone to make some telephone calls for alternate flight times, Don, we'd be perfectly happy to help.

MR. DEERE: I think the three gentlemen are set to leave on flights at about 1:30, 1:45, something like that.

MR. BLANCHARD: So that's probably a very reasonable time in order to get to the airport.

MR. DEERE: Yes. Then I intend to stay on the rest of the day and be available to check out a couple documents or whatever that I might want.

MR. BLANCHARD: I guess I'd also like to ask Tom and Carl if either of you have any opening comments this morning?

MR. ISAACS: No.

MR. GERTZ: Nothing.

MR. BLANCHARD: Okay. With that as the beginning, then I would like to start with the regulatory considerations, and my introduction begins with this. It's a summary really.

The extent of underground excavations must limit the impacts to the site, as you saw yesterday. It must support, in conjunction with our surface-based test program, the gathering of representative data. And I'll go into that in quite a bit more detail, and in particular, that's the main focus of Mike Voegele's talk. It must also maintain flexibility to integrate with respect to the repository design. And that's the main focus of Joe Tillerson's talk.

Our considerations include both

legislative, that is the Nuclear Waste Policy Act, as well as 10 CFR 60 constraints and guidance. These became drivers for the scientific needs for the engineering effort that we outlined in 8.4 of the SCP. The regulatory constraints are derived from the Act, 10 CFR 60 and the NRC comments.

In section 113(c), there is a restriction. As we mentioned yesterday, one can read other words and emphasize other words, but the words we happened to emphasize over the last three years are: The secretary may conduct only such activities required to evaluate the suitability. That's where we've been focusing in terms of a conservative program. Conservative with respect to not allowing the department to issue what looked like a de facto repository construction effort.

In section 112(b), we required an environmental -- we prepared an environmental assessment and issued a draft in 1984 and final version in '85. As you know, it was the basis for which the Department screened from nine to five to three. Each of those included a scope of the magnitude of site characterization. And now, from a legal standpoint I think the Department's attorney's view is that that was an obligation in the law. We

met it, and it's passed.

However, our perception is that a number of agencies and a number of other people will be looking at significant departures should we choose to do so. And that the Department will need a justification for expanding the scope significantly, if we do.

MR. DEERE: Wasn't that at the time when there were still five sites --

MR. BLANCHARD: Yes. We got the three sites, and then the policy act amendment of course focused on one.

MR. DEERE: Right, when this was really drawn up, it was drawn up with a somewhat different purpose: To allow you to make comparisons?

MR. BLANCHARD: Yes. In that process we were following 10 CFR 960. And all of the positions have not yet been developed with respect to whether 960 still applies and the extent to which it applies. It has qualifying and disqualifying conditions in it, so my perception is at least the intent of it probably still applies, although I'm not an attorney. And that if we encountered something during site characterization that showed the site contained disqualifying conditions, that the

Department would disqualify the site because it didn't meet its own requirements.

MR. ISAACS: Let me --

MR. BLANCHARD: I may be overstepping my bounds, Tom.

MR. ISAACS: Let me just embellish this a bit. The citing guidelines draw up a plan for what factors are to be looked at at all stages of screening, all the way from a national screening effort, such as we started to undertake in the second repository, or at least let's say a larger screening effort regionally, all the way through the process of identifying areas of high likelihood of good sites, screening from areas down to specific regions, down to specific sites ultimately.

And with each of those there are elaborated in 10 CFR 960 a number of factors that are the minimum required to qualify a site at any point in the screening process, those factors which would disqualify a site, and the tests by which one evaluates those factors.

And then once a site has gone through that screening process, also factors that tend to tell you whether the site is more or less desirable. It may be qualified -- or if it's disqualified it's

obviously out. It may be qualified, but then there are to compare sites. Saying the more of this, the better the site. The more of this, the worse the site.

The criteria in passing through the gate as you go through the process is more severe, the tests that one must find for suitability of a site become more severe. Obviously the more you know about a site, and the more you hone in on a site the more you ought to feel confident that's a good site.

So the tests that are in 10 CFR 60 become tougher with time. But the process we go through is not in any sense invalidated because we are down to one site. 10 CFR 960 still applied as we go farther into site characterization, the conclusions we must find with regard to important factors will become more and more rigorous.

MR. BLANCHARD: Until we get instructions otherwise, we assume we're going to demonstrate if the site meets the qualifying conditions of 10 CFR 960.

MR. NORTH: Is the word "significant"

in your second bullet defined anywhere?

MR. BLANCHARD: No. I think it's in the gray area. It's up to the people to make the

case.

MR. VOEGELE: Max, I only wanted to emphasize that the point we were trying to make on this view graph was different from the concept of the screening process that's embodied in the 10 CFR 960 process. We are undertaking a relatively large program that has the potential to disturb the site at the Test Site. And such an activity requires an environmental assessment.

The point we were trying to make with this figure was that we believe that there would have to be significant -- or have to be discussions with appropriate parties before we could significantly change the scope of the characteristics of that program, relative to the impacts it would make.

MR. BLANCHARD: With respect to 10 CFR 60 complaints, 60.2 -- you looked at that one yesterday. Ralph brought it up, I brought it up -- defines site characterization undertaken to establish the geologic conditions and the ranges of parameters.

Now, we've keyed on this underlined statement, "the conditions and the ranges of parameters." We keyed on it because we think that establishing accurate parameter ranges requires representative data of the site of that

three-dimensional block. And we believe that plans to acquire representative data include two things, at least: One is examining features of particular interest. That is, anomalies. But we don't want a program that only examines anomalies.

Like Bill Wilson yesterday was talking about the Ghost Dance Fault. We have surface-based plans to do holes on each site, drill holes and tests, pump tests across that fault. We also have an underground program to drift to that fault. But we don't want to stop there because the characteristics of the rock around the fault are not the characteristics we want to project statistically across the whole block for the entire block.

So we must have something else, which is systematically acquired site data in a geostatistically meaningful way. Mike Voegele will discuss what these two constitute, and how we're pulling them into the program in much greater detail.

Still in 60.2. This requires a balanced approach for acquiring data, especially about the hydrology of the site. We must emphasize the rocks above, the repository horizon, rocks at the repository horizon and the rocks below. Because we're drifting into Topopah Spring because that's an

extensive test program down there, it's obvious that we want information, high quality information about that.

Once we have reached a conclusion, if we can from that test program the way it is outlined, about the suitability of the Topopah Springs and selecting the appropriate horizon within the Topopah Springs and feel comfortable that we can construct, then two other things become, I think, more important.

One is the rock units above that limit the in flow of water to the repository horizon. How much water from the precipitation event, how much runs off, how much infiltrates. Then where does it go when it infiltrates? Does it get trapped in the bedded tuff? If it gets trapped in the bedded tuff, does the bedded tuff act as an umbrella? Channel it away? It's the mechanism by which it gets into the next rock unit down, Topopah Spring. How much? So the rocks above limit the in flow.

And then, even in an equally important way -- perhaps more important -- the Calico Hills. The rock unit underneath Topopah Springs. We know it contains zeolites, but that's our natural barrier. So we need to know the flow path, travel time and the type of minerals -- the zeolites and clays that can

absorb radionuclides.

Another feature required by 60.2 in the concept of representativeness, our program requires flexible approach so that if we encounter a feature that is somewhat different than what our assumptions were, or feature that we hadn't recognized to start with, we need to expand underground excavation. The question is how large of an expansion? And what's our engineering capacity to accommodate that expanded excavation?

60.3, licenses required. This is part of the background why we developed the posture about expanding things. D.O.E. shall not commence construction of repository operations. And that seems to suggest that there ought to be a limit on the extent of excavation for characterization. And that there ought to be a balance between that and the limitation of actual expanding of site characterization effort, so that at the completion of that, we're ready to start placing waste.

In 60.15, requirements to limit adverse effects on long-term performance places practical constraints on some things with respect to the underground excavation. Subsurface excavation shall

be coordinated with the repository operations area. We discussed that yesterday, and as I mentioned, the thrust of Joe's talk is in this area.

And to the extent practical, boreholes and shafts will be located where things are planned for underground facilities. And we talked about that a little bit yesterday, and I believe that Mike Voegele will show you some plans, some layouts that show that.

To accomodate this, our strategy that

we've outlined, Chapter 8 Section 8.4, discusss the exploratory shaft. But also in Section 3 that describes the 106 study plans, is to locate the boreholes wherever pillars are expected in the underground facility. This meant that our exploration program had to work with those people who were coming up with a preliminary conceptual design. The conceptual design of the repository, the peculiar angle and the way it's laid out, already has built into it a strategy for where we've located our boreholes so that they would be in pillars, two drift diameters away from the outside boundary.

Also exploratory drifts, we'd like to use whatever exploratory drifts in the repository. So the drifts that we've laid out for Ghost Dance, underneath the Coyote Wash, Drill Hole Wash, right now could become mains or other drift access areas in the repository layout. And then the other thing for meeting that is to do things like we've discussed with you yesterday: Make the shafts -- if we incorporate them into the repository -- either men and material or ventilation shafts.

Now, where we're at now in terms of our own perception, is that we think we need more characterization information before we can explicitly define vertical and lateral extent of repository bound.

The content of the license application brings another paragraph into play that might be a constraint. It calls for a comparative evaluation of major design features that could be important to waste isolation, and attention should be paid in these comparative evaluations to alternatives. And we're not preparing the license application yet, but we're laying plans to. We've filled a whole lot of documents that we think are building blocks or building stones to the license application.

We also have an annotated outline for the SAR, and a fair number of people working on getting ready to prepare those reports. We'd like

not to expand this comparative evaluation larger than we need to have, and so we had a conservative approach to that. We'd like to just make the repository layout the thing. And if we have a perimeter drift, it may require that that's part of the comparative evaluation and alternatives; just some work that we'll have to do in the future that we have to be aware of.

Other things that became constraints I

think with the NRC comments -- what I'm going to do here is just summarize some of the comments. Comments that were made on the consultation draft.

Objection No. 3: Observed that the Department in the consultation draft didn't provide enough information to support the analysis of potential interferences. They were right.

Section 8.4 was relatively short, and during the time they put the consultation draft out and the statutory draft, we had a large team of people revising 8.42 and 8.43, expanding the description of evaluation: Test-to-test interference, and interference for construction operations with testing. 8.4 now is very extensive in that area, however, it still may not be enough.

There are bounding calculations,

qualitative and quantitative evaluations, and they're about the impact on our ability to characterize the site, as well as the impact -- potential impact of waste isolation. We are looking forward to hearing from the NRC with respect to whether they think we've done enough calculations, and we look forward to hearing from you the same thing.

Expanded excavation would need to be considered relative to the potential interference with the tests. And I think that's kind of an obvious thing.

In concluding the regulatory constraints, then, our view up to now has been that site characterization appears to us to be a comprehensive program that includes surface and subsurface exploration. It gathers representative information so we can develop a three-dimensional model and understand the natural processes that would change that model.

And the program, as we have outlined it in Chapter 8 of the SCP, addresses the need to obtain the hydrogeologic data from Topopah Springs and from the overlying and underlying rock units. We think it limits the potential adverse impacts on the site. We think it limits interferences. We think it

recognizes the need to integrate the exploratory activities, especially the underground activities with GROA design, basically the design of the repository. And it retains the flexibility to expand excavations if appropriate.

With that as an introduction, I'd like to entertain any questions you have. If you don't, then I think I'd like to ask Mike Voegele --

MR. NORTH: I've got a question. You mentioned Objection No. 3 from the NRC comments. I found their Comment No. 100 very interesting on this point. Now, before discussing that, is there anything in terms of the plan for drifting from the comment draft to the final -- to the present Site Characterization Plan? Or is it basically the same plan?

MR. BLANCHARD: No. I think we've made a number of adjustments --

MR. GERTZ: In the drifting area, though, Max?

MR. NORTH: In the drifting area? Or just more explanation for what you plan to do?

MR. BLANCHARD: I think we've provided more information about what we plan to do when we drift it and the kind of tests we were going to conduct at the locations. We've also assured ourselves that the design will allow us to drift in the fault structure to the south if we think we're going to use it for an expansion area.

And we also have, from an engineering standpoint, a design which can accommodate going down into the Calico Hills and drifting there, should the decision be made that we do that. We've not done that. We are currently preparing a risk benefit analysis to examine other ways to -- alternative ways to get information on Calico Hills.

MR. NORTH: I don't read this comment as addressing the question of going deeper into Calico Hills. I interpret it as going more into the southern portion of the repository area, and getting more general information along the lines that have been concerns to us on the board. Let me take the time to read comment 100, and read a couple of points with regard to the D.O.E.'s response from this material that we had last night.

MR. BLANCHARD: Sure.

MR. NORTH: Comment 100 from the NRC says the following: The extent of site exploration described in the comment draft indicates the D.O.E. Plans to explore only a small portion of the

underground repository block through underground testing and drifting. Substantially more drifting may be necessary to reduce uncertainties about the presence of faults and other geologic and hydrologic conditions.

In the comment draft, no exploratory drift is planned to cross the main waste storage area to the southern portions of the block, which, based upon existing information, appears to contain more faults and fractures than other parts of the block.

Borehole penetrations into the main waste storage area (boreholes from the surface, horizontal core drilling or other means) says may not provide the representative information needed to construct a reliable three-directional geologic model of the repository block, and to evaluate ranges of parameters that could affect repository performance.

Now, that's the end of the discussion of comment 100, and of course, on page 141 and 143 of this -- no, I'm sorry. Page 141, there is further discussion about the basis and the recommendation; I guess it's worth reading that as well:

The SCP should show that the proposed underground exploration and testing, together with surface-based site characterization, would sufficiently establish the geologic conditions and the ranges of important geomechanical, hydrologic and other needed parameters across the entire repository block. Alternatively, additional drifting to yield a more complete and representative characterization of the repository block should be proposed.

Now, their comments. And D.O.E. responds, which perhaps you can elaborate on, I'll just read a couple of sentences from this: The D.O.E. believes that sampling and testing associated with the proposed underground drifting, the systematic drilling program and the site vertical borehole study will provide the data necessary to reduce uncertainties about the presence of faults and other geologic and hydrologic conditions. I'd be interested in the basis for this conclusion.

Then reading from the bottom of page C-130 in your response: Substantial drifting through the waste emplacement areas, including the southern portion of Yucca Mountain, will occur during the early construction activities, and will provide additional information to increase confidence about rock property values and to provide information about representatives.

Now, I interpret this to mean that you

don't want to do it as part of the process up through the license application, but rather after that, in the early stages of construction. Which means this information wouldn't be available at the time of the license application, and you know, some uncertainties that we might have resolved at that point won't be resolved until later, where they perhaps would affect not only the performance of the repository, but also the potential size of the repository.

MR. BLANCHARD: Your point is well taken. I think you've interpreted our response correctly. The question is the extent of drifting. Our repository design strategy is not to put the repository in the imbricate fault structure, so we're going to avoid those. Joe Tillerson's talk will show you that we are staying away from that area, so that we wouldn't have to go into an extensive drifting and testing program in those areas which we think, right at the beginning, that prevents problems.

And we do have repository expansion areas. Joe will talk about two areas which we think will be in rock that we already perceive is good enough to expand the repository in. But we don't have the data to support it, so we can't defend our position. So that's the reason why we're not actively expanding drifting into the southern portion, or where the imbricate fault structures are.

However, we do need to retain the flexibility to drift; the question is how much? Another 5,000 feet of drifting could probably be accommodated. But a sixfold increase couldn't be accommodated with the current engineering design. It's flat out not possible.

MR. NORTH: What about with total boring machines?

MR. BLANCHARD: I can't answer that question. Our engineering staff, I think, should answer that question. And I believe that in comment 100, our discussion for today focuses, and I hope the first part of that response given by -- is Mike

Voegele's theme for his presentation. So I hope, Warner, that we have good dialogue here. Okay? All right.

Mike, are you ready?

MR. VOEGELE: Yes. I believe the copies of the view graphs have been distributed, at least at the main table. I'd like to start. As Max said, my name is Mike Voegele and I'm going to talk about the scientific and testing considerations related to discussion of the utility of a perimeter

drift during the site characterization phase of the program.

By way of background, I'd like to point out that the discussion that we've prepared is an attempt to describe the rationale for the site characterization program, and the presentation has been laid out in a way to try to facilitate discussion with the board about how you would incorporate a perimeter drift into the site characterization phases of the program.

What I've written here is that we're going to try to examine the role of a perimeter drift in the site characterization program, in light of the total contribution that it can make to the characterization program. I recognize that that may be a little bit constraining relative to the possible interpretations of the question that was asked by the board, and I'd like to assure you that the presentation is more flexible than that.

In other words, we would consider, during the various stages of either my discussion or the discussion that follows, incorporating perimeter drifting at later stages, such as after we have obtained certain information from the site characterization program.

So there will be discussions, although my discussion tends to be focused on incorporating it at the start of site characterization. The intent of the discussion is not to limit that, but rather to investigate incorporating it during other stages of the site characterization program, i.e. prior to the license application.

The outline of this presentation is relatively simple. Try to describe the surface-based characterization program that we developed to acquire the information that we needed from the site characterization program, and to describe the ESF-based component of that characterization program. It's my understanding that there's been a presentation to the board that discussed the performance allocation activities that we undertook in the site characterization planning phases.

And so basically when I say "information needed from site characterization", what I'm referring to is the process where we laid out strategies to answer the licensing questions that we derived from the regulations, and from those strategies derive the type of information that we felt needed to answer those questions. And in both of these talks, I'm going to try to indicate the role

that these elements of the program have in a representative characterization program.

Thought it was appropriate by way of something that's probably considered background is information, to elaborate just a little bit on the concept of a primary exploration area. This program has focused its characterization and proposed repository development in what's known as a primary area. And in a moment I'll show you a couple of structure maps and show you what that physically is.

In the beginning stage of this program, going back to the early eighties, as the characterization programs were being developed prior to passage of the Nuclear Waste Policy Act, there was in fact a conscious effort on the part of the principal investigators to look at an area in the Yucca Mountain vicinity that had relatively few faults, as described as having rare fault breccias. That area contained about 2200 acres, and 1,850 of those acres meet today what we'd consider criteria for acceptable rock properties.

Current estimate, just for information of the area needed for a repository at an aerial power density of 57 kilowatts per acre is about 1420 acres. As I've indicated, early definition of that

principal area was based primarily upon some bounding structures that I'll show you on the next view graph. I'd like to point out at this time that other data that we have today that's virtually of the same quality of the data used to find this structure, suggests that rock with acceptable characteristics exists outside those structures, indicating that we do need more information before we can ascertain definition of the area with a relatively conservative position, assuming they were bounding structures.

This is an aerial photo of the Yucca Mountain area, and you can see on Bill Wilson's discussion yesterday, the Solitario Canyon fault runs along here. Another feature that will show up on the following view graph is Drill Hole Wash structure. So basically the early exploration was focused in this area. You can see on the next view graph something called an abandoned wash feature, and you can actually pick up that feature on this map, as well.

MR. ALLEN: Where are the exploratory shafts?

MR. VOEGELE: They're right up in here; in a moment. So I'm going to show you an early version, when Bill was talking yesterday he noted the

structure -- the maps he was using and the cross sections were from -- I'm going to have to do this in --

MR. NORTH: Turn it 90 degrees.

MR. VOEGELE: This is north. Okay.

MR. NORTH: I see.

MR. VOEGELE: This is an early phase of the map that eventually became the map represented by Scott and Bonk that Bill Wilson was referencing yesterday. I'll do it in two phases because the picture is a little bigger than the view graph.

Notice the Solitario Canyon Fault and the Drill Hole Wash faults. You can see the Ghost Dance Fault that Bill was talking about yesterday, the exploratory shaft locations are up in here. As you get to the southern part of that region I outlined on the previous picture, you can actually see that abandoned wash features that we were seeing in the aerial photo.

Now, the geologist laying out the early characterization program had a fair bit of information from mapping, and in fact moved to concentrate their exploration efforts inside of a block that was bounded by these structures that we can see here. The Drill Hole Wash fault, Solitario

Canyon, actually tried to stay away from the abandoned fault some structures and what's called the imbricate fault structures to the east of that area.

I'll be coming back to this map several times during the presentation, and I believe Joe has similar things to show you, concerning how the repository fits inside this area.

MR. CORDING: Briefly, could you just show approximately where the perimeter drift is located on that?

MR. VOEGELE: It basically falls in this area. Let me just do the best job I can drawing it. Generally that's how.

MR. DEERE: Round those corners a little so the TBN can get at it.

MR. VOEGELE: Joe is actually willing to discuss that.

MR. CORDING: So your potential site can actually go outside those boundaries of that perimeter drift; is that correct?

MR. VOEGELE: I did not intend to draw them outside the boundaries. In fact, it's a discussion one of which Joe has a view graph coming up in his presentation to show two potential areas that we consider to be pretty reasonable for

expansion, and they go in this direction and down in higher.

MR. ALLEN: Do we have in the room an actual large scale geologic map here that we could look at? At the break or something? Instead of just sketch maps?

MR. VOEGELE: We can have one.

MR. BLANCHARD: We can bring Scott and Bonk over. Does it have the repository perimeter on it? I don't think it does.

MR. ALLEN: At least the perimeter.

MR. BLANCHARD: Ernie, would you have someone bring copies of it?

MR. CORDING: Perhaps even a couple of maps. That will show the repository and one that shows geology.

MR. BLANCHARD: We'll do it.

MR. STEIN: Mike, can you say a word or two about the precision with which we note a perimeter?

MR. VOEGELE: Yes. In fact, that's

coming in like two or three view graphs, but thank you, Ralph. It sort of ties in nicely to what I want to say with the next figure.

There were indications yesterday, in

Joe Tillerson -- or Bill Wilson's talk, that there might be stratigraphic concerns as well, in addition to the structural concerns that might limit where you might place your repository within this area. I've tried to highlight the things that I referred to as criteria. I said several almost 2,000 acres meet these criteria.

If you look at our current understanding of the stratigraphy of the site, based upon some exploratory drilling that has taken place in the past, which I will show you in a couple of view graphs, Sandia has developed some maps that would suggest that if it remains a criterion for repository layout to not put the repository in the high lithophysal content of the rock -- the rock having the gas bubbles, higher porosity -- that this could become a constraint on the repository layout to this direction. That would impact primarily the top of the repository because they're higher up in this section.

There's also a concern or current criterion that would suggest we would not want to put the repository in the section of the Topopah Springs that has the vitrophyre. The yellow here is in fact where the current assessment of where that vitrophyre

would intersect.

MR. DEERE: It's not very thick, is it, that vitrophyre?

MR. VOEGELE: No. About six inches? Is it more? I'm in the "Grouse" Canyon, I'm sorry.

Bill, do you have a number for how thick?

MR. WILSON: Three to 15 feet.

MR. VOEGELE: Three to 15 feet. I'm sorry; I was in the wrong unit. I've also shown on this figure the overburden constraint, 10 CFR 60. And so, you would also then try, based on our current understanding which, as Ralph has indicated is based on a relatively limited amount of data, consider this white area on this figure as being the best rock we have we can currently assess for placing the repository.

MR. ALLEN: What are the straight dashed-dotted lines?

MR. VOEGELE: I'm sorry. This is the

western boundary of the Nevada Test Site. Probably the first map that we've shown you that indicates that in fact Yucca Mountain is not physically on the Test Site; it's just to the west of the Test Site. These are boundaries between the Air Force bombing

range and U.S. -- excuse me. Bureau of Reclamation controlled land.

MR. ALLEN: BLM?

MR. VOEGELE: Yes. BLM.

Now, the characterization program itself I've divided into two components for the purposes of this discussion. The surface-based component and the underground component. Surface-based component of the characterization program focuses on borehole coverage of the site and surrounding region, and it encompasses a systematic drilling program through which we intend to look at characteristics of various phenomena that describe that particular region, and trends and variability in those characteristics. It also includes a feature sampling program where we're intentionally investigating features that have been defined through things like aeromagnetic or other geophysical surveys; anomalies.

There are other activities in the surface-based program, things like mapping geophysical surveys, trenching, meterology, et cetera. The underground portion of the program conducted is divided into three elements, and basically there's a systematic mapping and sampling program.

There are specific tests to characterize processes and conditions, and the advantage you have in the subsurface is you have a little more flexibility in actually simulating processes, and there's exploratory drifting in the underground program. So I'll spend a few view graphs on both of these components of the program.

We have tried to design the program so that the surface and subsurface components of the program are complimentary, and the goal is to provide a complete three-dimensional description of the site. The surface-based is designed to examine spatial trends, variability and characteristics of phenomena in three dimensions.

The ESF program includes things like controlled simulations and exploratory drifting to investigate effects of underground construction in features that may not be completely typical of the entire rock mass. And we'd like to look at confirming construction techniques in the host rock, which is the Topopah Springs formation.

With regard to the question of representativeness, I tried to approach the question of representativeness through an approach that tried to integrate the data that we obtained from the

surface-based program and the subsurface-based program. The integration focuses on geostatistical evaluations of spatial trends and variabilities, and would use that information that we obtained from those evaluations as input to evaluate conceptual models.

The evaluation of those conceptual models could indicate several things to us, one of which would be the conceptual model is not correct or the correction data is not yet adequate. We'd try to use that evaluation between the conceptual model and our evaluation of spatial trends and variability to look at the adequacy of the characterization program, and try to refocus it, if necessary, to get better data, or to develop a new conceptual model which in fact more correctly fits the data we had obtained.

I'd like to say that generally, the ESF test location criteria are predicated on a need to extrapolate those test results to the overall site area. The reason I've said generally is because we've noted in fact there are specific ESF tests to look at primarily things that we don't expect to be extrapolated all over the site area, like drifting over the structures which are known to exist.

Surface-based drilling program involves

numerous boreholes to the water table in or adjacent to the repository block. It also has geologic investigation holes, and I've said including slanted holes and feature sampling holes. I want to very carefully caveat that slanted holes. We are currently undertaking a prototype drilling experiment to investigate how well we can drill a slanted hole dry, and that hole is being drilled in Solitario Canyon. Depending on the success of that program we'd make decisions upon whether or not we could do slanted drilling on the surface, or whether in fact we had to reevaluate the need for looking at it more extensively from the subsurface.

The program will obtain for us borehole and core samples, that will allow us to characterize things like the stratigraphy, matrix potential distribution, moisture movement along contacts and faults and some of the gaseous phase processes. We will be able to provide samples of geochemical and hydrochemical phenomena.

This is a map, and if I were to try to sketch onto it that figure we were looking at before, it would probably look more like that. This is a map of the drilling program, and basically there are copies of this map in Section 8.4.2 of the SCP. And

we will obtain for you a larger scaled version that I tried to do it this morning and was unsuccessful. One way or another we'll get you a larger scale copy.

It shows all of our shallow borings, the dry holes that had been drilled in the unsaturated zone, core holes, some of the water table boreholes and pavement studies. That's where they've actually gone out and removed the alluvium from the rock surface and looked in detail at the fractures that existed at the rock surface.

I'd like to highlight on this map the core holes, and those are the holes that would provide the samples that would give us the primary information that allowed us to make the assessments that I showed you a couple of view graphs previously of the currently known extent of the vitrophyre or the high lithophysae zone.

The point we'd like to make is they are relatively concentrated in this portion of the block and there are relatively few of them to be drawing very substantial conclusions about what that rock is really like in the repository. There's actually another one down here just off the figure, but they're relatively few.

MR. DEERE: And fairly close to that

drill hole wash structure?

MR. VOEGELE: Yes, sir. Bill -- Scott?

MR. SINNOCK: Many of those are actually shallow X's in Drill Hole Wash, that's the northwest trending line are actually shallow holes. Holes that penetrate Topopah, and I think there are five of them. Probably got G-4, A-1, B-1, G-1. H-1. H-1 is probably not on there.

MR. VOEGELE: That one I think is farther over here.

MR. ALLEN: What's the rationale putting all these along that one fault zone?

MR. VOEGELE: Bill, do you care to answer that?

MR. WILSON: Let me make sure I understand. Those are the existing boreholes?

MR. VOEGELE: These are the existing

boreholes.

MR. WILSON: They were drilled initially partly because of access availability, partly to test the Drill Hole Wash structure, and to define the boundary. There were a variety of reasons for the initial drilling program. Of course the plan drilling program will extend beyond --

MR. VOEGELE: That's correct.

MR. HARDIN: I think on close inspection you'll see from the map that there are a number of boreholes distributed on all sides of the perimeter.

MR. VOEGELE: That is in the proposed --

MR. HARDIN: In both existing and proposed. But especially in existing. Our data base now contains information on boreholes to the south and west. They're not shown clearly on that map.

MR. VOEGELE: Is that because they're larger scale than this map?

MR. HARDIN: Well, I would draw more red X's.

MR. VOEGELE: I was only trying to emphasize the core holes that would obtain the best data used to extrapolate the stratigraphy. I'm not trying to downplay the presence of water table holes and things to the west. I'm trying to emphasize the core. There is a proposed drilling program --

MR. DEERE: Excuse me. A number of those have been geophysically logged, haven't they?

MR. VOEGELE: I believe they all have, Bill. This is the proposed drilling program, and what I would like to show you on this map is in fact the holes that are really the elements of the systematic drilling program.

There are two people in the room who are able to address the rationale behind the statistical basis for the systematic drilling program better than I can. The point I'd like to make with this figure is basically that the holes have been laid out with a mind to be able to geostatistically determine the data that comes from those vertical core holes.

Ernie or Scott, do you have anything else to say relative to this --

MR. SINNOCK: They're also laid out not only geostatistically. But you have a good look at the aerial coverage across the site, at least in a vertical or slant profile. You get a good look at the stratigraphy and identify fairly wide spacing any major trends that may require further followup or more detailed investigation. Again, based on sensitivity or whether the analyses show that anything is sensitive to the variability we might find.

MR. VOEGELE: I think Scott indicated a point that I probably would have not forgotten, and that is that this is the first phase of the systematic drilling program. Depending upon the

interpretation of the results of these drill holes, the Site Characterization Plan describes a process to systematically gather additional information to find -- reducing the level of uncertainty.

I wanted to emphasize an aspect of the surface-based program in addition to the borehole coverage, and that's the surface-based infiltration program. It's a program to collect extensive data from numerous surface investigations and we'd attempt to characterize precipitation, runoff, infiltration, evaporation, transpiration and model that infiltration under a variety of expected and unexpected conditions.

The purpose of this activity is to give us a value or provide estimates of the flux distribution, and that would be a surface boundary condition effectively to our modeling of the repository performance.

This is the amount of water coming down to the top of the repository horizon. So there's an extensive surface-based infiltration program. The systematic drilling program that we discussed previously focuses on things below the repository horizon.

As Max noted, the other components of

the program that's very important is if that water does get to the repository horizon, meet the waste canisters and move on down through the horizon, the barrier we have that we'd be depending on is below the Topopah Springs.

MR. DEERE: Do any of the borings that have been laid out or have been done at the moment cross diagonally the Ghost Dance Fault?

MR. VOEGELE: Not at the present time. I believe there's a program of two boreholes, one on either side of the Ghost Dance Fault, to try to do some communications experiments.

MR. WILSON: And one of them will cross the fault.

MR. VOEGELE: The second element of the

program was in fact, is the underground portion of the program and I'd like to elaborate a little bit about these three portions of that program, and I'd like to introduce that by showing you another plan view of the site that addresses the question of why the exploratory shafts are located where they are.

There was a study done in 1983 by the project that did a figure merit approach to looking at establish the location of the exploratory shaft facility, which at that time was a single shaft.

There were several excluding criteria as a part of that study. This is consistent with the idea of the block-bounding structures that we talked about in the earlier view graph.

The scientists wanted to find a

location for the site that was inside of these block boundaries, but set back from it. And they focused on placing the location in rock that would be judged to be typical of the primary exploration block as a whole. They wanted to retain some flexibility. They tried to site the exploratory shaft location 1,000 to 2,000 feet from what they call potentially adverse structures, which would be things like the Ghost Dance Fault or some of the bounding features.

At this time of the program it was the goal of the scientists to drill horizontally out to those structures, and we've since that time changed to drifting to those structures. They wanted to ensure the success of the subsurface facility, and to do so, they tried to locate it in rock that would ensure its constructability, which in their minds was the best rock they could find within that primary area. And as a means of supporting it from the surface, they wanted to avoid adverse topography and rock slopes.

I've only selected one overlay from that activity. If you'd like to see what each of these things look like, I'd be happy to show you several more overlays. It's your call. Would you like to see what all those things look like?

We can get you a copy of this report, or hard copy of these figures if you'd like. This is the area that they set -- avoided the boundaries and set back from the boundaries to get into better quality rock where they felt they had more success at constructability.

So this is the first area they were concerned with. Relative to constructability and avoiding the adverse structure -- and for instance, you can readily recognize the Ghost Dance Fault on this overlay. This is the area that remains as the primary candidate for a shaft location.

When you consider that you want to be -- at that time they wanted to be close enough to these adverse structures so they could drill to them. Or in this case today where we could drift to them. These are the areas that are preferred.

If you look at the surface and try to find the areas of -- the flattest areas or washes where you could site a shaft facility, these are the

areas that are preferred. And basically, when you overlay those, you end up with these being the preferred areas for location of exploratory shaft. And this is, in fact, the one that was selected.

We noted that there's a characterization program to gather various types of data about the rock in the subsurface, and in particular we would look at evaluating construction effects on the rock, mass performance characteristics near the shafts and other openings. These would be deformation measurements, blast damage type measurements that Bill talked about yesterday.

There are a series of programs in the subsurface to look at, like diffusion, hydrologic equilibrium between the fracture and the matrix of the rock mass. There are tests designed to look at scale dependence, look at water mobility in fractures, there are tests designed to look for natural tracers.

We have programs designed to observe and evaluate geomechanical responses, including scale dependence and to look at geomechanical responses while drifting through what could be major structures. There are programs designed to investigate near-field waste canister environment and drift scale heating effects in the Topopah Springs.

I expect of more interest to you, considering the topic, is our program of exploratory drifting. It's a program to investigate what we expect to be potentially adverse geologic structures, and it complements our surface-based investigations, like the mapping of the faulting structures and if we're successful the slanted hole programs.

The features we'd like to investigate with our exploratory drifting program encompass a range of conditions of parameters such as flux, what the hydrologic character of the fault would be, the type of faulting, offset along the faults, whether or not there's lateral diversion of flux of water by the fault, the age of the fault and what the nature of the fault is at depth.

Remember that we have a relatively conservative set of bounding structures. Some of those faults might not persist in-depth, some of them may have a different nature at depth. They may not be truly normal faults. They may be deeper than is a concern to us for the repository. And there's also the question of looking at repository construction feasibility.

The three features that are targeted right now for the exploratory drifting programs

encompass, I believe, a fair range of the features. There's the imbricate normal faulting which there are questions related to high structural dip. Whether there is high flux in those faults. Whether or not there's competent rock associated with those faults. Whether we could mine through it or we couldn't mine through it. Whether it would have any impacts on performance.

The Drill Hole Wash feature is oriented such that it is thought to be a slip fault, and we are questioning the age of that fault. There have been some proposals in the past that in fact structures such as the Drill Hole Wash structure are the major conduits for re-charge of the water table in areas like the Yucca Mountain area. Again, there's the question of competency of rock near that feature and the potential for repository expansion. There is the question of whether Ghost Dance has hydrologic significance. I currently believe it to be a hinge fault. You reported that, Bill?

MR. WILSON: Which one?

MR. VOEGELE: Ghost Dance.

MR. WILSON: No. Solitario Canyon is.

MR. VOEGELE: Okay. Ghost Dance is thought to be normal fault?

MR. WILSON: As far as I know.

MR. VOEGELE: Okay. Again, there are questions of hydrologic significance. This is the major feature within the repository block, the Ghost Dance Fault, and we'd like to investigate whether there are ground-supportive implications for the repository development through that structure.

MR. ALLEN: What do you mean by that?

MR. VOEGELE: Ground support implications?

MR. ALLEN: Right.

MR. VOEGELE: There are questions

related to whether or not you could drift through a fault like the Ghost Dance Fault and not have stability problems. I'm not sure I answered your question.

MR. DEERE: Well, we know you can do it, no problem. The question is, is there water there? I mean the hydrologic thing is number one.

MR. VOEGELE: I'm going to show you a picture in a minute or two.

MR. DEERE: If we can't drift through it, it's because there is water there.

MR. VOEGELE: I need to emphasize that we've focused our program on these three long drifts.

But the program contains provisions to investigate other faults that we might encounter while we're doing the excavation of the exploratory shaft facility, and it also contains flexibility such that as we begin to understand the site character a little bit better and find ourselves in a position where we may have to do additional drifting to look at structures like the Solitario Canyon or features to the south, we have sufficient flexibility in the program so that the existing design can support that.

I'd like to show you where those features are. Basically, the drift to the imbricate fault structure runs along like this. There is a drift to Drill Hole Wash, and we've got a little jog in it here, and a drift over to the Ghost Dance Fault. So basically, that is probably not plus or minus ten degrees from the program of current drifting envisioned.

I wanted to emphasize, in fact, that there is a slant hole plan to look at Solitario Canyon, and if there is some success in that, we have the option of doing some slant holes to look at features in the abandoned wash in the imbricate fault structure. I think that's very heavily dependent on our success in the horizontal hole at Solitario

Canyon.

I wanted to show you one picture. This is in G tunnel. This is a picture of a drift that was excavated to look at control blasting. Look at a control blasting program in rock that, from a mechanical standpoint, I believe, is very similar to the Topopah Springs formation. This is the Grouse Canyon, and I expect you'll be in G tunnel. There was actually a fault in here that was mined while they were developing this drift. There's another drift up around the corner from this where the heated block test is in G tunnel.

I was involved with helping Sandia at that time, and we actually mined through another fault up there, and it occurred at a time of the year when the Test Site contractors shut down the Test Site over Christmas and New Year's. We mined through that fault just shortly before that, and we didn't even know it and it was unsupported. We came back four or five weeks later and we mined a little bit more and they put their support in it at that time.

I think the point Dr. Deere made is very well taken. The significance of these faults for terms of constructability is probably the question of whether there's water in them or not.

To summarize what I had to say about

the site characterization program, the points I was trying to make is that we've tried to balance and integrate the site characterization program to look at the characteristics of the sites from both surface- and subsurface-based programs. We've tried to make them complimentary so that we could actually integrate the data from the two programs.

The importance in site performance depends on the full unsaturated zone section and presence of the water table, low water table. It's the same point Bill was trying to make yesterday.

The strategy we have currently in our SCP for demonstrating long-term performance of the site really emphasizes the strata over above Topopah Springs and underlying the host rock of Topopah Springs, which would be a retardation question. Where would those radionuclides go if in fact they were dissolved by reaching the canisters.

The effects of faulting on performance

depend on the full unsaturated zone and we've tried to develop a variety of approaches to characterize those attributes.

Now, this concludes what I had intended to say. The following presentation from Joe

Tillerson takes the program that we've laid out here and tries to describe the exploratory shaft design aspects that address this kind of a program, and the question of integrating with the repository. I'd be happy to entertain any questions that you might have before I sit down.

MR. DEERE: Could you go over number four there again, please?

MR. VOEGELE: The point I was trying to make here is that we need to understand the full three-dimensional implications of the presence of the fault. We need to understand what the flux might be, whether there's re-charge at the surface, what its surface manifestation is, what it does in the subsurface, like it may form a barrier at the lateral core -- be part of a lateral diversion process, somewhere between the ground surface and repository horizon -- and that information is necessary to really understand what the implications of that fault would be on the repository performance.

We may look at it at the surface and see not a real high probability for it being a re-charge conduit, and at depth we may find out that it's dry. In between those two it's possible that in fact water might pond against that fault or perch against that fault. So we need to understand the full three-dimensional implications of the process.

MR. DEERE: I think you're absolutely right, but I just wonder if you have in the program sufficient exploration to get the information on that Ghost Dance Fault; it's right in the center of everything.

And all of the sketches where we see scenarios showing perched water and we have the ten-degree depths and then we have the Ghost Dance Fault. So it can dam it up, and it can also allow it to percolate down. So it's both a dam and a drain.

And I don't think we can -- I'm not sure you have enough exploration at present for a stage program to intersect that in enough places to be able to characterize it. And it's certainly going to influence Bill's model terrifically, I would think, one way or another.

MR. WILSON: I guess my answer to that

would be we'd take a look at it with the program that we do have, and if it turns out to be an important feature hydrologically we'll expand that program. We really don't have any information at all now. This is all conceptual.

MR. DEERE: Yes.

MR. WILSON: Take it one step at a time.

MR. STEIN: I might just add to what Bill said in regard to the Site Characterization Plan, that characterization plan is a document that presents our current best judgment of what we need to do in order to characterize the site and gather the data necessary to support our license application. But it's not meant to be a document that is the end.

We have a program, a continuing program.

As new information is developed, whether it suggests that we do additional work or we need to do less work, that would present it in our six-note progress reports, and the program can be changed to accommodate needed new information, or to come to a conclusion that the information that we have is sufficient to support a particular licensing finding.

So again, the only purpose of this comment is to say that there is a certain amount of dynamic movement, if you will, in a site characterization program, and this SCP represents our current best judgment of what that program meets today.

MR. DEERE: I think the danger you would run into with a limited amount of exploration on the Ghost Dance Fault is that if the boreholes give fairly good information and indicates that's an impermeable fault and will not have much effect, we will be basing our decision on only two points. Only going to cross two places.

And it's such a horrendous feature with respect to a crosscutting structure, as compared to the rest of the site inside of the boundary zone, as we know it. I mean, you might say it is a boundary in itself, and maybe we should be on the two sides of it, rather than having cut through.

So it seems before you can make information as needing more information, you have to get more information. I would think that's one point you could accelerate the amount of drilling. And concentrate a little bit more on that because I see it as a potential dominant character on the studies that you made.

MR. VOEGELE: I'd like to respond to

that in terms of a comment I believe it was Dr. North made yesterday regarding the contingency planning for offsetting the current plans within the site characterization plans.

The current plan for the repository conceptual design actually is predicated upon being able to develop that repository and stand off from

features like that if they turn out to be hydraulic conduits. So the comment that maybe we should be on either side of the fault is something that's currently planned. I believe the repository design has sufficient flexibility to avoid features like that if they are adverse.

MR. DEERE: I think that's very good.

MR. NORTH: Could you give us maybe a

couple sentences as to what that plan might look like? Would you avoid the fault entirely by putting essentially two repositories on either side of it? Or would you go entirely on one side or the other? Or would you drill one tunnel underground through the fault and protect it in a certain way?

MR. VOEGELE: All of those are options that would have to be pursued. I believe the current thinking leans more heavily toward the fact that the Ghost Dance Fault will not be a major barrier to the development of our repository.

MR. NORTH: One of my questions is if you find out it is a major barrier, when are you going to find that out, and what is it going to mean in terms of time and money to fix it?

MR. VOEGELE: You begin to get the information to answer that question from the drifting out to the Ghost Dance Fault that takes place during these earlier stages of site characterization.

Bill, maybe you could help me with the phasing for the hydrologic testing of the Ghost Dance Fault from the surface. Is that relatively early in the Site Characterization Plan? Dave is shaking his head yes.

MR. WILSON: I think so. Those are two of the unsaturated zones that we'll be doing cross-hole testing, and so there will be an extensive program at that site.

MR. VOEGELE: I believe Dr. North's question is focused on the Ghost Dance Fault for this purpose.

MR. NORTH: Yes. But a similar question could be posed with regard to unknown structures.

MR. VOEGELE: Undoubtedly, that's a true statement.

MR. CORDING: Your exploration program, as was being pointed out, I think, in terms of the vertical holes, obviously you're looking more at stratigraphy than you are not by doing sampling to any significant extent of unknown faults. You may sample across a known fault, but you're not doing

sampling of unknown near vertical structures. You have a primary area there with nothing through it to sample those types of structures.

The possibility of offshoots from Solitario Canyon or Ghost Dance or other features in there which you cannot detect from surface mapping seems to me to be high, and therefore, is there --

shouldn't there be some sort of program for going across at least normal to those primary directions of primary structures, regional structures? Principally, a north, northeast, northwest sorts of structures, across the entire site?

In other words, once you've gone across the Ghost Dance and looked at it and then you've decided that that is or is not a problem, what do you know about that primary area? It still remains an unknown.

MR. VOEGELE: From the perspective of having as much detail as we would have within this drifting program, the answer is certainly yes. I would like to answer that question from the perspective of trying to make decisions based upon information that you obtain from the continuing phases of your exploration program. I think that in fact, there is sufficient flexibility in this program to expand that drifting, as we get information that would suggest it's warranted to expand that drifting.

In the context of Max's presentation on the regulatory constraints, the important point to emphasize in fact, is that we have tried to keep the amount of exploration a minimum amount of exploration, we've tried to keep this a small facility.

There is support for your concept within the program of expanding this drifting to look at other features. I think we would like to base the decisions to expand the program of exploratory drifting on more information than we currently have from the borehole program today.

MR. ALLEN: But isn't it true that if the characterization plan goes through as now envisioned, we really won't know anything more about

the primary area than we know right now, except we'll
have some vertical holes through it that won't tell
us anything or very little about possible faults.

MR. VOEGELE: From the perspective of
having obtained horizontal information from a
horizontal sample of that feature.

MR. ALLEN: Well, insofar as faults are
obviously perhaps the major concern in terms of
anomalies, we may not know more about it than we know

now.

MR. VOEGELE: I believe that's a true
statement. I would ask Scott or Ernie to comment on
that if they have a comment.

MR. SINNOCK: I think considerably more
about both the structural and stratigraphic

characteristics of that three-dimensional block based solely on the drilling. Some of those can certainly slant. And particularly, accommodation with this drifting and perhaps expanded drifting.

I have to agree, I think this characterization program is going to increase our knowledge about stratigraphic structure about the block very significantly as what Mike showed you is now based on really three boreholes that go to the water.

MR. ALLEN: I agree. The question is on vertical faults, whether we're going to know much more about it.

MR. SINNOCK: Yes, I think if we design some of these to slant holes we'll know considerably more. Perhaps not in terms of offset, but perhaps in terms of mechanical and hydrologic implications of a fracture, whether that fracture happens to have offset along it, or whether that fracture may have offset.

MR. ALLEN: But the only slant is along the process Solitario T --

MR. VOEGELE: The slant hole along that fault is a prototype to demonstrate that in fact we can do slant hole drilling dry.

MR. ALLEN: Then if it works you would propose to do it in other places in the primary area.

MR. VOEGELE: I think that's correct.

MR. CORDING: Really, your slant holes are not -- I would assume that you're not going to be able to cover the entire profile using slant holes at locations of known or suspected faults. You're not doing that to explore for unknown ones; is that correct?

MR. VOEGELE: That's correct. I need to emphasize a point that going back to 60.15 and the regulatory requirement to try to limit the number of boreholes and shafts in your characterization program and make them coincident with shafts located within pillars in the repository is a very important aspect of the talk that Joe is about to give. I don't want to steel his thunder, but I think that you're trying -- well, the way Max puts it is we don't want to make Swiss cheese out of the repository block.

I think the way Joe's going to put it is in fact that we can't constrain the repository lay out too soon in the program. We have to retain flexibility to be able to move the attitudes of drifts when we get down there and find out it may be better to layout a repository oriented in a different direction.

The more exploration we put inside the block where we intend to put the repository, the more constraints we put on the flexibility in the repository layout, and that's been factored very heavily into our thinking.

MR. CORDING: I think that's quite true of the high angle features. But what about the drift? Its horizontal drift at that level. I --

MR. VOEGELE: My point is --

MR. CORDING: Why would that constrain the facility?

MR. VOEGELE: That drift then becomes part of the repository, or else has to be encompassed in some sort of barrier to be excluded from the repository.

The point I'm trying to make is that if, based on information that's available on day ten of your site characterization program you decide to lay

out a drift that goes like this to look at some structural feature or goes like this to look at some structural, then on day ten plus 20, you've decided you've got your repository laid out incorrectly by 45 degrees -- that's an extreme example -- you've constrained your repository.

That's really the subject Joe wanted to talk about, how to integrate the characterization program within the repository design.

MR. SINNOCK: I also had, I think if you look at the surface-based mapping program also, the major structures I think the geologists are highly confident major structures to identify. We have excellent layer geology, stratigraphic control to identify meeting structure. There's no reason to suspect significant offset at Topopah Springs level that does not occur at the surface and cannot be identified.

Therefore, the unknown features we're looking for are very small offsets that don't express themselves unambiguously at the surface, at which point that's why I make the analogy, the water and mechanical properties may not care whether there's offset along that fracture or not. So unidentified faults are going to be fairly small offset; fairly

confident of that.

So one of the issues is, are those ubiquitously fractured rocks acceptable rocks? Because I think we can thoroughly anticipate finding small offsets looking at that fault structure throughout that block.

MR. VOEGELE: Ernie Hardin had a point.

MR. HARDIN: I might point out that hydrologic significance of the faults is integrated with the other hydrologic attributes in the site, in that if the fault acts as a conduit that water has to originate from infiltration processes and has to be diverted, our surface-based characterization program does provide basis for evaluating those other aspects. It's a package.

MR. ALLEN: I guess I would argue that no matter how good our geological program is up to date -- and I have no reason to be critical of it -- I guess, based on experience, we are going to have surprises. And somehow we have to be prepared to not be too surprised.

MR. GERTZ: At too late of a date, I guess.

MR. ALLEN: Yes.

MR. CORDING: You say well, it is

possible that we can extend the drifts at some later time, and although I'm not sure anywhere in your documentation you have an indication that we would, for example here is a contingency. We will drive across the site if we see such-and-such condition. So at this point it remains sort of a generalized --

MR. VOEGELE: There are two points I'd like to make relative to that. Do you know the exact section number in 8.4? 8.4.2.?

MR. HARDIN: For the drifting? 161.

MR. VOEGELE: 8.4.2. 161. And the other question I need to have answered is the additional amount of drifting that we currently believe we can support with the existing facilities.

MR. TILLERSON: Mike, the evaluation is done on the basis of 10,000 feet of drifting, and that was deemed that you could accomplish that.

MR. VOEGELE: So we have a program that encompasses about -- if my number's right, about 4500 feet of drifting in the main test facility, about 5,000 feet to the structures out here, and sufficient flexibility in the facility to support like another 10,000 feet of drifting.

MR. TILLERSON: Well, 10,000 feet was evaluated and was accepted, but the absolute limit

was not established.

MR. DEERE: Could you show us there on the map up there? I couldn't see it there.

MR. VOEGELE: I'm sorry.

MR. DEERE: I still can't.

MR. VOEGELE: Joe Tillerson has in his presentation a detailed map that will indicate this clearly. But there's about 4500 feet of drifting to support the testing programs within the main test facility. There's roughly 5,000 feet of drifting in the program to get out to these features. And as Joe said, there was an evaluation done that suggests that the support facilities for the exploratory shaft could support an additional 10,000 feet of drifting, which was our estimate of how to get down here. I believe that was a double heading to get down?

MR. TILLERSON: Single heading.

MR. CORDING: Down to --

MR. VOEGELE: Down to the structure in the southern part of the block that the NRC was suggesting that we look at when they commented on the SCP CD.

The answer to the question that was implicitly asked is, we did not make a commitment to do that drifting at this point in time, but did make

sure that the facility had sufficient capability to allow us to do that drifting as we got more information from the site characterization program.

MR. TILLERSON: That drifting, or other --

MR. VOEGELE: Or other drifting, yes.

MR. TILLERSON: There are more important things.

MR. VOEGELE: If it turned out that it was more important or more productive or more highly warranted to drift to Solitario Canyon to get information, as Dr. Cording was suggesting, I believe that could be supported by the facility.

MR. DEERE: You can see one potential, and that's the drift that goes to the northeast is to extend that on down to the southwest. You get yourself a second look at the Ghost Dance.

MR. VOEGELE: This is the repository; is that correct, Joe?

MR. TILLERSON: Yes. This is developed along what is currently thought to be the repository main.

MR. CORDING: In terms of the total area, what you have to have for the repository, what sized area -- does it fit within the boundaries of

Solitario Canyon and the other side? In order to get a full facility in, how much of the area do you really need to use?

MR. VOEGELE: Okay. The full facility, how much of this area in here?

MR. CORDING: That's correct.

MR. VOEGELE: Joe has an accurately drawn picture of that coming up in his first or second slide, but I'll show you my inaccurately drawn picture of it.

MR. CORDING: So you need to use most of that area, but you can avoid certain portions of the area at offsets of several hundred feet; is that correct?

MR. VOEGELE: Yes.

MR. GERTZ: The area in the green, yes.

MR. ISAACS: I've been looking for the right opportunity to make sort of a more generalized statement that might help in some considerations here with regard to the repository, so allow me a couple minutes, if you will.

When the Nuclear Waste Policy Act was passed in 1982 -- and those of you who heard the presentation at headquarters heard some of this -- there was, shall we say, a political compromise at

that point in time to consider two repository programs, and in fact the law stipulated that we go forward with the two. At that point in time the general estimate of the amount of nuclear waste that would need to be disposed of through the year 2020, which is kind of the time horizon they looked at, was about 140,000 metric tons.

So one of the provisions of the law stipulated that the first repository program could not contain more than -- or could not emplace more than 70,000 metric tons until NRC had issued an authorization for the second repository, indicating that indeed we were going to go forward. It was both a technical but mostly a political stipulation to ensure that we would go forward with two programs.

One of the bases upon which the secretary subsequently deferred the second repository program was that when you looked at what was happening in the nuclear power industry, spent fuel was being generated at a much lower rate than had been anticipated when the Nuclear Waste Policy Act was passed.

In fact, today's estimates of the total amount that will be generated through the year 2020, if you include defense wastes, is more like perhaps

110,000 metric tons. The variation is great, depending on what you think will be happening to nuclear power between now and then, but unquestionably considerably less.

The other thing you need to understand is that when the amendments act was passed, the second repository program was deferred by congress officially as well, and D.O.E. was told to bring a proposal sometime between the years 2007 and 2010 on the need for a second repository.

Now, all of this is to say -- and I've made this point to people on many occasions. -- there's nothing that requires in law that the first repository be 70,000 metric tons. That repository could be 50,000 metric tons, or 150,000 metric tons. The only stipulation in the law is that if it is greater than 70,000 metric tons, one of two things would probably have to happen: Either the law will have to change, or we would have to have a second repository program in order to meet the provision of the law.

The reason I've mentioned this is because of the way the law was structured when we initiated this program, we asked all the projects at the time, the three principal projects going forward,

to design their repository for 70,000 metric tons. That still made a lot of sense to us then, and it does now because of the way the law is structured.

But you need to recognize from a programmatic point of view that there is flexibility in the program, some uncertainty as to whether or not this first repository will be the only repository during any particular time period.

Clearly, if there was a resurgence of nuclear power, then at some point in time one will have to face the problem of more than one repository, for sure. I just want to add that as a piece of perspective because there's kind of an implicit assumption in a lot of discussions if it isn't 70,000 metric tons and only 68,000, then something failed. And that's not the case in the program. You have flexibility on both sides.

MR. BLANCHARD: Anna has to change her paper, and we had planned a break between Mike Voegele's and Joe Tillerson's talk anyway.

(Thereupon a brief recess was taken, after which the following proceedings were had:)

MR. BLANCHARD: Before I introduce Joe Tillerson, there are three things I'd like to call your attention to.

First, are there people in here who have not yet signed up on the sign-up sheet that's routing arouond? If there is, please raise your hands and we'll get it to you. Second, we have some geologic maps to hand out. Did you get Florian Maldonado's map?

We have them hanging over there.

MR. BLANCHARD: If you want more, we have more. But those are two good beginning maps. The Scott and Bonk map is a lot more detailed than either of those, and a larger scale. So if you really want to look at detailed structure, that's Scott and Bonk.

MR. WILSON: That's in the frame behind you.

MR. DEERE: And that one is available?

MR. WILSON: It's open file.

MR. BLANCHARD: Yes.

Third, we had talked about the DAA yesterday, and I wasn't quite -- my assumption was that we would mail copies of that to you because there are fewer volumes that weigh about 15 or 20 pounds. I didn't think you'd want to carry them. But if you want to look at a copy of the DAA we'll

bring it up. Is that worth your time? Should we bring one up?

MR. STEIN: Yes, I think you ought to.

MR. BLANCHARD: Marylou, would you get one from Jerry King?

One point that I think is appropriate, just from a context to introduce Joe, and as a finishing talk that Mike gave, and that is the discussion about the balance site characterization program effort that Mike talked about was constrained to the block. We did not intend that to be a presentation to you all about our 106 studies, 308 activities that support those.

There's an extensive unsaturated/ saturated zone program, there's a regional program, there's a techtonics program. So there's much, much more going on. Just please keep that in mind, and maybe sometime in the near future you would like to have a comprehensive look and total scope of the site characterization investigations, and we'd be pleased to put something together for you.

Joe?

MR. TILLERSON: My name is Joe Tillerson. I'm with Sandia National Laboratories. I'll be talking regarding the engineering functions that the exploratory shaft is required to perform, and then spending a great deal of time on the discussion of integration of the -- or coordination of the exploratory shaft activities with the repository.

There are five principal functions that are related to the ESF design, construction and operation that I'd like to discuss. The basic purpose of the facility is to allow the data to be gathered to be acceptable quality, and acceptable quality refers to idea of test interferences and things of that nature.

The second thing is impact of performance. We've discussed that in both regulatory concerns and other ideas. The principal focus of this topic is on effective integration with repository design, and then also talk about safe working environment in the underground and provide flexibility for expanded exploration and testing.

While the focus will be upon this, there will also be some discussion of some of the other functions as well. The first portion of the topic, describe the viability of the perimeter drift, as regards integrating an early development of a perimeter drift with the repository design itself.

And then the second portion of the talk will be on the feasibility of using the current ESF configuration to support the development, and there will consider three of the functions that were mentioned before. In particular, the working environment, data quality and the flexibility aspects.

With regard to the viability of integration with the repository design, the implications there are that should discuss the repository design, what its status is, and then in a bit, why it looks as it does. To give you a bit of background, the SCP conceptual design was developed to meet the requirements of both the Nuclear Waste Policy Act and some guidance from 10 CFR 60 to take into account site specific requirements.

We use that design for three principal purposes. The first one is to aid us in saying given that you have a concept of what the facility is that you would like to construct, what are the data that are needed in order to be able to reduce the uncertainties associated with that particular facility?

Also provides the basis for how can you best go about integrating the characterization program with the repository design? And this is both the surface-based program where we've talked briefly about the idea of trying to put the surface-based exploratory boreholes into where pillars would be planned within the repository.

Or, if you want to look at it from the repository design or standpoint, constraining the development of the repository design to ensure that it is a pillar as the final design comes out. And then providing the basis for the designers to initiate the additional design phases that will be coming, both the advanced conceptual design phase that would be initiated, as well as the license application design phase, and then following on later the final procurement and construction phase of the design.

In the conceptual design it was documented in two places. The basic design was documented in Chapter 6 of the Site Characterization Plan. It's the design that meets the requirements here in a more detailed conceptual design report which was published and provides many of the backup studies that are supportive the design itself and give a lot of additional details. So in two places. Either Chapter 6 of the SCP, or the multi- volume conceptual design report.

In that development, it's recognized that there are numerous uncertainties associated with the preliminary design, particularly a conceptual design of a first of a kind facility. Indeed, it was the purpose of that design to try to identify some of those uncertainties, both particularly as regards the data that are needed.

Obviously there are uncertainties with regards to equipment and other things, but I won't focus at all upon those types of things within this particular discussion. More upon the uncertainties related to the data that is being used.

To understand the viability of integrating the design of the repository with the perimeter drift, we need to understand both the pertinent design features and their related uncertainties. So let me take a schematic, this is slightly different from the view that you have in the handout, and let's talk just a little bit about the design. What it consists of, and how it would be developed.

The design basically consists of surface facilities, means of access -- both combination of ramps and shafts -- and then the underground facilities. The conceptual design was developed under the auspices of Sandia Labs, but I do not intend at all to pass off the idea that Sandia Labs did all of the work here. Bechtel was responsible for the surface facility's design.

The underground portion of the design was the responsibility of people at Parsons, Brinkerhoff, Quade & Douglas, a team that was formed to support us there. And numerous aspects of the design were analyzed by various people within Sandia and other contractors, particularly in the rock mechanics area. Contractors you might be familiar with are those at RE-SPEC, Paul Gnirk and some of his people, as well as Agapita.

Mined ventilation surfaces was one of the contractors to Parsons with regard to the ventilation aspects of design. So numerous people other than Sandia Labs have most definitely been involved in contributing to the particular design.

With regard to the pertinent design features, there's three that I'd like to call your attention to at this point in time. Tom has talked a little bit about the first one, and that is with regard to the capacity of the repository, and I think he shared with you a little bit of the uncertainties with regard to what the capacity is. But as you're

well aware, in the design area, you need a basis for your design.

The design basis for the conceptual design that we'll be speaking of is to be able to store 70,000 MTU within a period of 25 years. So in an operating time for the emplacement of the waste of about 25 years, more detail was prescribed in that with regard to receipt rates; you'd start out slow and you'd build up and all.

But principal feature here is ability to store within Yucca Mountain 70,000 MTU in a period of accomplishing that in sizing the amount of equipment that you would need and the number of headings you would need to be operating on to be able to accomplish this in a period of 25 years.

The second pertinent design feature is to take essentially the amount of energy that's related to the waste and decide how much of that energy, on a per square plan form area, per square unit of plan form area, would you emplace? In other words, how heavily are you going to load the geologic region in which you're storing the waste.

Evaluations that were done, we came up with 57 kilowatts per acre as the thermal loading that was selected for this particular repository.

That gives you, then, if you consider a number of things with regard to the 57 kilowatts per acre, you'd think well then, knowing how much energy is in the waste, you'd know exactly how much waste you'd need. It's not quite that simple because you'd have to have support facilities shops, you'd have to have accesses, test areas, and you would want to integrate those.

By integrating all those other things, you end up with a total within the perimeter drift of the repository as it's designed of 1420 acres. Remember the number that Mike talked about was 1850 with regard to the usable area at this point in time. So contingency of about 400 or so acres.

Let's look at the underground aspects

of the design. I'll describe some of those aspects of the design to you. When you see a design such as this, the immediate question that I think pops into most people's minds is, why is this repository shaped as it is? I will attempt to describe that because I think it's very relevant to the question of perimeter drifting.

The perimeter drift, to orient you, the drift we're talking about is the drift that goes around the area of the repository there. Its primary

use in the repository is for the return of ventilation air to the composite shaft, relative to the emplacement site, where you have emplaced waste and you're blowing air through that area, then you would exhaust the air in the drifts in which you're emplacing waste, you would exhaust that air, using the perimeter drifts.

You also use the perimeter drifts in a different way when you're developing a particular region, in that you will move air through those in the back to an exhaust through the tuff ramp. The ramp that you were using to take the muck from the development operations out. Remember, I said 25 years.

We would talk then about the current design is for a phased development of the repository, in that you would not open up the entire repository before beginning to store the first waste. But rather, you would develop in the current design, a panel at a time, moving in this direction, coming out this way for a panel of first roughly half of the operations, and then developing these panels on the way back to complete the operations.

The primary reason for this sequence is

associated with the requirement to maintain separate

ventilation systems for the areas in which you're developing, as compared to the ventilation for the areas in which you are emplacing the waste. The development sequence for the repository, as currently represented in the design, would be to use tunnel boring machines to develop the waste ramp and the tuff ramp to take, once you have reached the repository level, to use one of the tunnel boring machines as is needed to develop the portions of perimeter drift.

The other one that would be developed early on is the long extent of the mains clear to the southern end of the block. Obviously a portion of one of the mains would be developed as part of the site characterization program, and I'll show you an overlay with regard to that particular development in just a moment.

But the plan development would be to drive the mains to the southern extent of the block, and then to develop the panel access drifts off of those. And then, as the panel access drifts for a given panel ended up, to connect the perimeter drift to those portions of the panel that have been developed at that time.

So the perimeter drift would be

developed on a piecemeal type of basis, according to the design that's published in the SCP.

MR. DEERE: Would you run by that again for me, please? The two TBN's are coming in from the ramps, they are now available. One would continue down through the central drift?

MR. TILLERSON: Go through.

MR. DEERE: And it would go all the way through?

MR. TILLERSON: That's correct.

MR. DEERE: The other would be on a standby basis?

MR. TILLERSON: The others would be used to develop for this particular region here in the early development, and then on a stand by basis, being used periodically to develop the perimeter drift.

Now, again, part of the logic is associated with how do you establish the extent of your panel access drifts, or the extent of the panels? In the current design there are both engineering considerations relating to why it's shaped as it is, and there are constraints associated with the site itself; the geology or rock mechanics-related constraints or performance-related constraints.

Those are associated with the property of the site.

Let me give you an example of one that, in the current design, is an engineering-related constraint, and that is the squared nature of this particular region right here. This distance from here to here, roughly 3,000 feet. Designers, in developing the plans for ventilation, said we would like to have roughly a 3,000-foot desirable limit. Not a hard and fast type of number, but a desirable limit for purposes of ventilation. We would like to limit the extent of any one panel to 3,000 feet. So that's why you see the squared off region here.

The thoughts in developing the extent

of the panels is the idea that if additional area were to be qualified for use, then the way in the current design in which the extent of the panels would be developed is proposed to be that you would drive your panel access drifts out to the area in which you have established that you either want to stop because of engineering reasons, or based upon characterization information that you have found out, or information that you find out as you are developing.

So the development of the regions where you're storing waste in this region, for example, you

would be developing one to two panels -- translate that one to two years, in terms of the timing sequence roughly. But one to two panels in advance of the actual emplacement you would be developing the panels. You'd develop your access drifts and your perimeter drifts early on, and then you would go in, and within a given area, you would develop your actual emplacement drifts and you'd drill your boreholes in which to place the waste and the hardware.

So there is a lot of development that is required prior to emplacing the waste, and it's that development that would precede the waste emplacement. So one to two years in advance of that you would be doing the establishing the final number for the limit, and then you would target for the limit the extent of your panel access drifts and then you'd target your perimeter drifts such that you connected with that.

Again, that is the current design philosophy. There are other aspects with regard to why, in the current design, we have limited the extent of the drifts, and let me describe those starting with this particular view graph here.

This is a cartoon type of figure of the

problem that was facing the designers with regard to how to fit the repository into there. One of the engineering constraints that I had discussed before was how far from the mains do you want your longest drift to be?

The second thing that comes in from an engineering constraint is, across this mountain, what is the maximum grade that you would like for your equipment in general to be operated on? In the current design, that maximum grade is set at ten percent. So that's a fairly high number, for those of you that are familiar with the equipment. It is not meaning that all of the drifts in there are by any means at ten percent grades. But you're talking about in general your waste mains, your panel access drifts so the more highly -- have the higher grades.

Your emplacement drifts are not nearly as so high a grade. You want a flatter surface from which -- to actually physically put the waste into the holes. But that is the second engineering constraint that I bring up, is the grade of operating the equipment.

The third thing that I bring up is for some portions of the mountain, you have a constraint -- for all portions you have a constraint that applies,

but for some portions you reach that constraint as it controls in that particular region, and that is the idea of defining the region in which we could place the repository within the Topopah Springs.

And then more fine-tuning within the Topopah Springs, we would like to stay below the region in which you begin to have high lithophysae or high vitrophyre content, or translate that into lower strength. That is where, over in this particular area, that's what is indicated by the schematic that we have here.

On the other side of the facility, particularly over here near the Solitario Canyon region, you begin to run into the idea that you would also not like to be operating where you have this vitrophyre in your roof area, or you don't want to be drilling through that type of material. You would prefer if you can, from a design standpoint, to remain above the vitrophyre.

So the approach that was taken here was to define a 45-meter thick slab, and that's basically enough room for the vertical emplacement drilling, the room itself, and a contingency area above and below that for approximately an additional amount of that space.

So if it's about 15 meters to include both the dimensions of the holes that you're drilling and the drift height itself, the 45 meters comes out to be three times that. So one space runs certainly in the roof, and one space runs certainly in the floor, and the approach taken in the design was try to fit a 45-meter thick slab through the repository considering the constraints associated with lithophysae, vitrophyre, some standoff from structural features and your equipment limitations.

The uncertainties that exist there are

certainly with regard to how much do we really know, particularly all the way across the mountain regarding the presence of the vitrophyre. Exactly how well do we know that stratigraphic content? How well do we know, and what data do we have that support exactly how much lithophysae is too much, or how much is acceptable, and what is the criteria associated with that?

Obviously the site characterization information that we're obtaining is intended to derive more detailed evaluations of this. But for purposes of the conceptual design, these evaluations have been made.

MR. DEERE: Question: Is it really

much of a constraint? Because even with the presence of lithophysae, isn't the compressive strength still well above any stress that would be generated around the cavity?

MR. TILLERSON: The answer is no. And let me explain a little bit more there. If you look at what are the loads, the loads that are emplaced within the drift areas or around a borehole or whatever you're looking at with regard to the stress-to-strength ratio, the loads come from the in-situ stresses obviously, plus the excavation in closed loads.

The idea is you produce stress as you open a drift. But also the thermal effects associated with this 57 kilowatts per acre, the Alpha Delta T stresses that come from that. If you look at the types of stresses that you're talking about there, you can end up with some areas in terms of quantities of lithophysae in which you would predict that with very high lithophysae, your strength is not adequate to withstand thermal loads. Generally it's believed adequate to withstand your construction-related type of loads.

But with regard to the additional thermal loads that would be imposed around the drift

that are several times those associated with just the excavation-induced loads, you can run into situations we believe, from the very limited data that we have -- we have about eleven tests, I believe it is, on 12-inch diameter specimens in which we have cored out Busted Butte some lithophysae material and have physically run that size specimens.

So there is some uncertainty with regard to whether the highest lithophysae we have would be able to withstand the thermal loads associated with the repository.

MR. DEERE: Do you recall what the strength value is of the large samples? Less than concrete?

MR. TILLERSON: My recollection is yes, less than concrete. But in Chapter 2 of the SCP there is some discussion of the specifics of that.

MR. VOEGELE: Both are tables of those strength values. Joe, it's probably also worth mentioning the thermal conductivity changes as you go into a higher lithophysal content material, as well.

MR. TILLERSON: That's right. You get even higher thermal stresses because your thermal conductivity of your lithophysae material is not as high as the thermal conductivity of the non-lithophysal material. Air is not a very good conductor; it's a pretty good insulator. Therefore, your localized temperatures around the drift would be somewhat higher in a drift that would be placed in high lithophysae material, than would be in a non-lithophysal region.

So those are the reasons we would like to avoid the lithophysal types of material, and obviously associated uncertainties with that.

MR. DEERE: Thank you.

MR. TILLERSON: There is projection of the structural features to depth, there are uncertainties also with regards to that. When we look at the questions regarding the uncertainties and we look at the design that has been developed to date, given some preliminary constraints that we established, we end up with the usable area that Mike showed you as being shaped roughly like this. That usable area being constrained over on this particular boundary by the high lithophysae type of thing relative to the repository. Over on this particular boundary by two constraints. The 200-meter overburden constraint that is part of the siting guidelines as a limit, and the presence of the vitrophyre, which run into over here.

The other things that come out with regard to the usable area is although this area here meets the criteria for being able to be used, you remember we chose not to use this portion of the area for this design on the basis of the lateral extent of the drifts being limited to about 3,000 feet. We chose to limit the use of this area because it is just impractical to develop such a small portion of materials.

The question then that arises is related to in any underground development, you end up with uncertainties with regard to what you're actually going to encounter underground, questions with regard to how much flexibility do you have within your design? One of the questions obviously would be with regard to Ghost Dance Fault, and what would be its impact.

MR. CORDING: Joe, you're also avoiding that area, that high lithophysae section, you're also avoiding that area because of the abandoned wash faults; is that correct?

MR. DEERE: That curved --

MR. TILLERSON: When the usable area --

MR. CORDING: In the lower right-hand side.

MR. TILLERSON: This particular region down in here is the area from Mike's view graph in which there were the abandoned wash fault regions. That was with regard to defining the usable area itself. The green being where the repository drift is now, saying we will stay within the area defined, but we may not use all of that.

The only point I was making from a repository standpoint, you just don't want to go into that region. This area with the different ventilations is feasible. But for purposes of this design, we chose to limit it to 3,000 feet. With that constraint -- and by evaluating the extent over here and other areas with that constraint, we were still able to meet the basic design requirements to be able to store 70,000 MTU.

So it is a question that the current design meets the constraints, but yet recognizes that there may be uncertainties that would cause you to lose some of the ground in the future, as well as there's a characterization program that may open up additional areas to be able to be used, and that's where I'll go with the next particular view graph.

We wanted to ask ourselves what flexibility would we have if the designers can

provide some input to the site characterization program in terms of exploring additional areas to give us the flexibility to assure ourselves we can meet the 70,000 MTU, or to evaluate whether or not you could expand to beyond 70,000. The question was from a designer's viewpoint, what areas would you like to explore, and why? And what aspects of those areas would you like to explore?

Take, from a repository designer's standpoint, the water table -- and you've not heard me talk much about the constraints associated with the water table. It's far beneath us; it's not something we worry about. That's not to say it's not something of concern with regard to the usable area because you doesn't have an area that can't have adequate performance. But it's not a major concern relative to the design.

MR. DEERE: You're not taking real serious, are you, the 3,000-foot limit on the ventilation? Because we have so many constraints that are natural that we have to stay away from, it seems to be that that's a little bit artificial.

MR. TILLERSON: I totally agree with you, and it was done for purposes of this design. Is it desirable? I tend to use the word "desirable" relative to that particular constraint, just for the reasons you're talking about. There are many other ways you could actually do that, and certainly then we would have no reason not to be able to use this particular type of area.

If you're looking at in the contingency or flexibility, that's certainly an option. It's some of the last regions that would be developed, so you would definitely have a lot of information about usability of those areas, given that it's a few panels in that area. You could do some special things if you needed to with regard to ventilation.

So no, we do not consider that at all a hard and fast type of constraint. But for purposes of the design, we did attempt to abide by it, and were successful in being able to do that.

MR. SINNOCK: Let me follow up on that

question. I don't know if it became clear. This study was applied to the defined primary exploration area which was defined by the geologist, which includes the line sort of corresponding to the Abandoned Wash Fault.

MR. TILLERSON: Right. We then look at the information we would like to see in order to reduce the uncertainties with regard to the

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repository.

The idea is would drill holes out here help you a lot in reducing your uncertainties with regard to where the lithophysae is? The answer is no. We'd like to have information up in here with regard to the extent of the lithophysae; how far down it goes to some good stratigraphic contact points there that are with regard to how you can possibly use that, can you not use it, to answer that particular question.

We would also like to have some information on the lithophysae itself and what its structural properties are much more so than the eleven tests that currently exist. And the question is, are you going to drill holes up in this area to be able to get that? The answer comes back no, you're not going to get drill holes. We will not get cores from drill holes from which you will be able to determine the structural compressive strength of the lithophysae material.

We are talking about voids, holes that are of the order of larger than a half dollar or so, depending upon the particular region that you're in. And so, from a two- or three-inch core, you're not going to be able to do that testing. That's a given.

That's one of the reasons that, in the evaluations of the exploratory shaft facility and what information do you really need from that, that's one of the reasons for the upper breakout room in the high lithophysae region there, is to be able to obtain samples from that to understand the behavior of that type of material, in the event that it would be encountered as you are developing your repository. We'd have those answers available.

So information that can help us with regard to potential expansion areas are related to lithophysae in this particular area, and are related to the potential use of this particular area down in here. Not going all the way down into the area of the abandoned wash, but possibly focusing upon can we use this particular area. That is, from a repository designer's viewpoint, what would help us the most with being able to develop the repository.

Now, what difference would it make is the idea that when you are looking at trying to fit the repository with your constraints into here, if you can raise the boundary of the top portion of your section here, then you can end up with an overall lesser grades within the repository, hence, a desirable feature relative to the operation of the

equipment from the safety as well as from the dependability/reliability type of standpoint. So that is important information to be able to obtain.

Obviously there's other concepts you could go to there. You could go to a multi-stepped repository and several other types of things. One of the things that is not obvious from what I have talked about thus far, is the idea that we have also considered some constraints with regard to what is desirable from a water control type of standpoint. And that is that with the development of a repository, we have also indicated that from a -- we are in an unsaturated environment, but if there is to be free water that were to come in there, what would you like to do with that water.

And from a ceiling perspective, what we would like to do is to say we would not like to have water that comes in from some of your mains or from your perimeter drift or access drifts or any of that. We would not like to focus that water into the rooms in which the waste is emplaced.

So some of the constraints in the design are that you would slant your drifts or you'd establish your grades such that your drainage would be from the emplacement rooms into your panel access areas, and into ultimately your perimeter drift or across the remaining perimeter drift down such that this would be the overall low point of the repository design. It's a passive feature that we think is reasonable and prudent to put in.

So given the desires of the designers then, what that is translated into the site characterization program is our recommendation that the preferred expansion areas be identified as the region to the southeast, there's a projection either to extend further south or to stop here; or the region up in these are 2E's and 2A's. That's nothing other than just a designater. There's no particular meaning to those designations.

But this is a figure directly from the

Site Characterization Plan which we have made known the desires from a repository design that says in order to assure flexibility in your development, you're developing the additional -- qualify your additional ground for possible use as a repository.

Now, how does this impact us with regard to the perimeter drift development? The idea is it impacts you very directly in that if you start your perimeter drift and you develop it in this region, you need, before doing that, to have

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sufficient stratigraphic control such that you know where your perimeter drift really should be. Same thing down in this particular area.

And so, this can lead to some prioritization, with regard to the timing of the development of the drill holes within the site characterization program, is to be able to get this information at some point in time before you need to make a decision. And particularly, if you begin to consider the idea of early development of a perimeter drift, the idea that stratigraphic control in these particular areas needs to be much more firmly established than it currently is.

The other point I would add is particularly with regard to lithophysae, it has to come from core type of information, not from logs or other things or from non-cored holes. And the reason is it's very difficult to pick up that transition in a meaningful way from non-cored holes.

MR. DEERE: Was there any indication in any of the geophysical logging? Could you distinguish between the rock that had the lithophysae and those that did not?

MR. TILLERSON: Ernie?

MR. HARDIN: The compensated gamma-

gamma density tool does show some lineal response.

MR. TILLERSON: It shows some response. It's a question of without the cores from that, would you be willing to make your decisions relative to repository. And the answer is it gives you correlation, but it's not sufficient by itself.

MR. DEERE: Is the extension of the Ghost Dance Fault, as shown there, also the Ghost Dance Fault? Because I don't think I've seen this one before.

MR. NORTH: You mean the south?

MR. DEERE: Yeah.

MR. TILLERSON: I suspect that is cartooning with regard to the artist here, but Bill, help me.

MR. WILSON: I'm not sure that that's a named fault. We'd have to look at the geologic map.

MR. DEERE: Because that makes the Ghost Dance look a little --

MR. WILSON: Yes. I think the gap is a real --

MR. TILLERSON: I'm not sure if this connection is as strong as it is. I would much more rely upon this to take a look at it than I would let a design artist take a shot at this.

MR. VOEGELE: Joe, I have the numbers for Dr. Deere on the strengths of the material if you want.

MR. TILLERSON: Okay. The physical

probability intact rock mass the TsW1 is the designater for the lithophysal region.

MR. DEERE: So about 30 megapass?

MR. TILLERSON: No, let's see. The compressive strengths of 18 or so, of 18 megapass. And again, recognizing the limited number of samples that that is taken from.

So we see that site characterization information that is planned to be obtained could result in some changes in the future designs. So please don't consider that the design, as currently configured, that the actual location of the lines, the actual sizes of the drift, are really indeed what physically will be built or must be built in order to do this.

This is a conceptual design, and information could end up changing the location of perimeter drifts, as well as their elevation. So early development of any type of perimeter drift would certainly have to consider the sequencing associated with when would you get enough information

in order to make that particular decision.

Or else, if you went ahead with an early decision and, for example, chose a perimeter drift coming in this particular direction, it could certainly complicate life for the repository designers in terms of how to put in some sort of drift into the repository, or how to stand off from it with the development of the repository that has a drift at some unique or odd angle relative to the others.

The next series of view graphs that I have, they're on why is the perimeter shaped as it is, currently planned sequence of the development for the repository. That's what I've covered verbally. I just wanted to include those into the view graph package to reiterate what I had done, such that you wouldn't have to just be depending upon notes that had been taken. So some of the principal things there for the next two view graphs I will not discuss.

But I will reiterate just a bit with regard to the principal uncertainties in the design related to early development of the perimeter drift are the location of the boundary between this TsW1 and TsW2; the non-lithophysal versus lithophysal regions. Limited stratigraphic control available

from current surface boreholes, and that the site characterization could allow both lower grades, as well as changes in physical elevations of those drifts.

There's also some difference with regard to the perimeter drift regarding what is your projection to depth of, for example, a Solitario Canyon feature or other faults that are along the boundaries.

MR. DEERE: Well, I think that's pretty persuasive there, that an early drift could not or should not precede your stratigraphic boreholes that you have laid out now. Because the stratigraphic boreholes and position of those contacts are going to affect your repository greatly.

MR. TILLERSON: Very definitely. They certainly will do that. In my mind it's a question of when do you obtain the information, as opposed to do you.

MR. NORTH: But it's also true that you could not possibly start the perimeter drift for two or three years after the exploratory shaft characterization starts anyway. You've got to get to your exploratory shaft.

MR. DEERE: Sure.

MR. TILLERSON: Just to reiterate on that, the development in that area and the extent of maturity of the designs themselves, with regards to the way in which the ventilation systems would be working, the 30,000 feet, how real, what are the other options there. How would you go about trying to develop to the north in that upper left-hand corner of the region. And so, some of the things that are related to maturity of the design itself.

So having discussed the viability of integration with the repository, which I think is the principal concern or principal engineering consideration that you would have to take into account, let me finish off the talk with talking about feasibility of using current configuration to support that.

In other words, do we have the flexibility to be able to support additional developments, or what types of consideration would come in, relative to data quality and work safe working environment and the feasibility for expansion of the ESF, not feasibility of expansion of the repository.

And again, this is just the idea we need to understand the possible construction-to-test

interference-related concerns, and how much constraints on the additional exploration would we be developing as a result of a commitment to a perimeter drift.

With regard to worker safety considerations, the principal concern is regarding using single entry heading, relating to personnel evacuation concerns. I say this relative to the current perimeter drift, as identified in the repository design, is only a single heading because it's only used for a single return type of situation. Obviously, for purposes of characterization and safety aspects associated with that, you'd look at two things: Type of headings, or you would need additional access or additional shafts or ramps to be able to do that.

MR. CORDING: Of course, there's a lot of projects in the western United States where access is through a single heading five miles back. Sometimes ground is much more difficult than anything that would be anticipated here.

MR. TILLERSON: That's true, and there's no reason to say you can't do it. But I'm saying with regard to considerations you would look at the feasibility is, is D.O.E. willing to develop

that type of a heading? And recognizing it is feasible, it has been done.

But the question is would you prefer to do it that way? You would have a direct decision here because it's single heading, dual heading, or do you put another access in in some way for emergency drifts. Exactly how you do it is considered.

MR. DEERE: I agree with that. I don't think it would turn out to be much of a restraint.

MR. TILLERSON: With regard to the construction-to-test --

MR. STEIN: Joe, I might mention that currently we have certain D.O.E. orders that do constrain us. It isn't the orders. We could address the orders. But they do apply for the development of underground facilities. That's in addition to all the other requirements that we have, like MSHA, NERSHA and the rest of them. But we do have D.O.E. orders that provide certain constraints on underground faults, in terms of worker safety.

MR. SALTZMAN: Ralph, do we not adhere to a California mining requirement?

MR. STEIN: That's part of the D.O.E. order. The order specifically calls out the California Mining Code.

MR. DEERE: And does that offer a

constraint to a length of a single heading?

MR. STEIN: Well, it doesn't call that out specifically. As I recall the code, it just talks in terms of what kinds of capabilities do we have to have underground in order to provide protection for worker health and safety. We would have to look specifically at what strengths, if any, would be applicable to this. And of course, you can always appeal those, whatever constraints there are.

MR. TILLERSON: In the spirit of the conservative program, a little bit of background. The conservative program -- and correct me if I'm wrong, Ralph, I believe it is that California code that led us to the idea of putting in the second shaft.

I would also point out that there are a lot of places with a lot more extensive underground development that has been done off of them that do not have a second shaft as an emergency egress means.

So we would have to deal with the question of the spirit of that, and how it would be interpreted in this particular thing. Feasibility of doing it from an engineering standpoint, yes.

From a posturing with regard to the

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regulations or abilities to meet the regulations, that would have to be considered. I do not intend to say at all that the other people are operating outside of existing regulations.

To comment just a little bit about the current layout and how we've separated the principal experiments from the --

MR. GERTZ: Let me just add one thing on that Joe for a matter of perception because I deal with that a lot here in Nevada as the project manager.

And I think you all might recall a recent nuclear waste accident in Germany, where they had a mining accident. They didn't have the proper shoring going through the water table, and it killed a miner. It was called a nuclear accident.

Shut down the experimental program for a year and a half -- maybe it's still shutdown, as Jerry tells me. It's that kind of perception that we as managers feel we couldn't deal with.

So if we're looking for one of two ways to go, we're taking the conservative way for not only worker safety, but for almost anything we do. And that's some of the outside effects that we've asked the designers to deal with.

MR. TILLERSON: With regard to

construction-to-test interference, very briefly I'll show you the current layout and how we've separated that within the idea of further revisiting of that would be required if we were looking at a sixfold increase off of the current development. In particular, if you look at this particular figure and notice that you had had a figure 4.7 out of the overview report, is also a good one here.

The point I'd make here is that we have intentionally, in the design, the exploratory shaft designers -- which, by the way, the exploratory shaft designers the H & N is surface facilities, Fenix & Scisson in underground facilities design. Sandia is not responsible for that design, but we are working very closely with the people there with regard to integration of repository.

That's why, when you look at the drifts that are planned, they are not your most direct distance to the Ghost Dance Fault or the most direct distance to some of the structural features. They are integrated with the repository, and are shaped the way they are because of the repository design.

This is the feature here in which you'd be dumping muck, loading it into the ES-2 and carrying that to the surface. Hence, what we have

done is for the experiments that are most sensitive to the construction-related types of activities -- in particular the waste package tests that are over here, the hydrologic test, the heated block types of test -- we have separated those physically from the area in which the muck haulage is concerned.

The closest area related to muck haulage it is a non-heated test in which you're basically looking at the excavation effects in a drift. It is the construction of this drift that you're monitoring from these two drifts that are on the side of it. So that's a monitoring type of test that we believe, given that you can install your instrumentation within a few feet of the face of your drifts, it's not likely to be impacted by the mucking operations that would go on. But the muck from the development currently would be hauled in these particular areas, and then dumped into this area. And that's the part that the designers have very wisely separated from the testing.

The only thing that might -- just to alleviate curiosity, this particular drift here is the one that they talked about yesterday that is the demonstration breakout room. It's the first room that you develop after hitting down there with ES-1 to be sure that your orientations and structural support system and all are okay. But no long-term continuing type of testing can be done in this particular area. So those are some of the thoughts that have gone into the actual local layout.

The question you would have to address is, is your muck haulage capability within the shafts capable of being able to handle the types of -- the quantities that you would be developing from a perimeter drift? And is this a sizing question, timing type of question that you would end up with there.

And then also, with regard to would you increase, by increasing the amount of excavations to the project by sixfold as compared to the long lateral drift, would you be increasing your chance for construction-to-test interference? I doubt that that would end up being a controlling factor.

MR. CORDING: Is that intended as the muck haulage also for the development of the facility?

MR. TILLERSON: No. There's very little use in muck haulage for the development of the facility. What you're doing is you have the two ramps that come down. You have the tuff ramp -- excuse me. You have the waste ramp in which you

would physically drive the waste underground, and you have the tuff ramp, and it is a ramp access for all-inclusive there.

With regard to the flexibility of additional exploration from the exploratory shaft, how much would you constrain that by a decision relative to the perimeter drift? And it's the idea that you would have to evaluate, obviously, your capability of your current system, muck removal, your ventilation systems, the sizes of your fans, et cetera. How well you could do that with regard to the perimeter drift development.

A piece of information that we offered before is the Title 1, during the ESF Title 1 design, a study was made by the architect-engineers on the possibility of drifting to the south. The study was done from the standpoint of do we have sufficient flexibility in the design to be able to accommodate that in some reasonable type of manner. They looked at drifting of an additional 10,000 feet, and I might say that the 10,000 feet started from this point here.

So it's an additional 10,000 feet to the south, along the mains, if you will, to the south. And it was dual heading type of development, and the analysis indicated that yes, you do have the flexibility within the current design to be able to accommodate that.

The question that you would address would be if you accommodated the perimeter drifting -- roughly 30,000 feet or so -- would that be essentially all that you could do? Or would you be giving up something else. That's just a question that you would have to look at in terms of priorities, not to say that we necessarily would preclude.

Let me close with just a summary view graph, in which I will just identify the principal points that I made before, and that is, the timing of the perimeter drift, it's important concern. And in particular, additional data would be needed and additional design considerations prior to making that particular decision.

Feasibility of using current ESF

configuration would be related to those things that probably would not be the controlling factors nearly so much as the timing relative to integration with the repository.

Any questions that I might be able to address?

MR. CORDING: If you were to find it necessary to avoid, for example, the Ghost Dance

Fault -- and I know there's different ways of avoiding it. One is not emplacing waste at that location, another is not to penetrate it or minimize the penetrate; just for access. But if you had to do something like that, looking at the layout of your facility, how would the facility, your mains and other features, be accommodated?

MR. TILLERSON: Use that view graph as a point. Let me also introduce to you Jim Grenia from Quade & Douglas, who is one of the principal designers in the underground aspects. Jim, feel free to jump in with me on this.

In my mind it depends upon what point in time you learn that information. If we postulate that you learn that you need to stand off from a certain aspect of it after you develop a particular perimeter drift, then you're talking about how many emplacement rooms, given that you have your panel going through there, how many emplacement rooms might you want to stand off.

MR. ALLEN: What's the approximate trace of the Ghost Dance Fault on this right here?

MR. VOEGELE: Joe, I have an overlay that's just about the right size of that.

MR. TILLERSON: You've got one, Mike?

Let's see, how close are we here? Let me estimate and then have some of you guys that really know, something about like that? Let's see. We can look at this one with a slightly different scale. Remember, we're talking about this particular dedicated testing area up in this region, and we're talking about this comes out to the target region.

MR. DEERE: Can you rotate it 90 degrees again?

MR. TILLERSON: Right. So there would be obviously other options, depending upon what type of information you found. If it were major water conduit then you've got to decide you don't penetrate it at all with the repository.

Or, do you want to have separate accesses coming in and develop on one side of it versus developing on the other side of it, and no firm planning with regard to how you would handle this. If it's just a construction problem, you don't believe it's a water problem, that's a different story.

The idea is you could go ahead and construct your haulage ways, panel access to get through that. Shore those up very heavily but avoid it with some physical standoff from your emplacement

drifts. A lot depends on what information you would find out, particularly related to water or non-water.

MR. ALLEN: But it's nevertheless true that the great bulk of the underground storage area is the opposite side of the fault from the bottoms of your shafts.

MR. TILLERSON: You're saying that this area is far greater than the area that's up in here?

MR. ALLEN: At least that's the way it's sketched, yes.

MR. TILLERSON: That's correct.

Jim?

MR. OWENS: Just a point, Joe, I think when you said about the development in the test facility. You mentioned that the DBR, that it would be done once ES-1 is down. I think the plan is to have it done as is to sunk and be finished by the time --

MR. TILLERSON: Sure. The first shaft that reaches the repository --

MR. GERTZ: Which is ES-2.

MR. TILLERSON: -- which is ES-2, would be the one that you'd do the demonstration breakout from. Jim, you're correct. I was incorrect in what I said.

Mike?

MR. VOEGELE: It might be worth pointing out there are alternative layouts to the original conceptual design under the conceptual design report, some of which might -- I believe it was Dr. Allen's question -- might look like they could facilitate development of the repository from the western side of the Ghost Dance Fault more readily than the one we have on the board right now.

MR. VOEGELE: Jim, do you have anything else?

MR. GRENIA: I was just standing up so I could hear the question.

MR. TILLERSON: The question is how might you accommodate something you could find out about Ghost Dance fault, how could you accommodate that in the design if you had to approach it differently?

MR. GRENIA: Presently we're not expecting any water in the faults. It's basically an engineering problem to drive through and establish access. Then we would plan to lay off either side of the fault and go right ahead with emplacement. Because design is flexible enough that all you'd need is access across.

MR. TILLERSON: That's the assumption in the current design, and there are other options, as Mike mentioned the other types of layouts that you could --

MR. CORDING: When in the program would

you first drive across, say in an east/west direction fully across the site in what was described in one figure as the primary area? You talk about driving the perimeter drift and driving the mains. When do you, in the plan at present, when do you first drive east/west across the full site?

MR. TILLERSON: The first time you would have in the current plan east/west across the whole site is when you would begin to develop these panels in this area. So obviously you could develop --

MR. DEERE: Turn north up so we can look at it like that. Yeah.

MR. TILLERSON: You would develop -- you could, if you wanted to, modify your sensitivity to develop one or several of those early in the development. There's nothing that would necessarily preclude you from doing that. Just that the current design, as far as the amount of detail that was in there, we looked at doing the development in that

type of a sequence.

MR. CORDING: If you decide to change the orientation of the mains, that would be done during your preliminary or your exploration phase in the vicinity of the northeast corner, and the drifts that you had planned that extend out to the Ghost Dance; is that correct?

MR. TILLERSON: Jim?

MR. GRENIA: I might add this: That during the ESF portion of the design, when you do the demonstration breakout, that may change your orientation of the whole repository. When you cut that first room off the shaft, you may elect to reorient your lanes.

MR. TILLERSON: Basically what we're doing, we're buying into a progressive type of approach there, and that is that when you develop this room, that is the first room type of information at the repository horizon that we will have. You will look very closely at that before you decide which way you're going to actually go with these particular things. Assuming success with the first one, our intention would be to drive these types of things, and obviously using this information as you're developing --

MR. DEERE: What information does that give us on the really structural things that may cause reorientation of the drifts and reorientation of one corner versus the other, et cetera? None at all. It just might --

MR. TILLERSON: Not from the major structural features. It's only from the mining support, you're correct.

MR. DEERE: And that we know can be done. It's just a question of a little more, little less. It's not a discriminatory item at all. As I see it.

MR. VOEGELE: Dr. Deere, yes, it is. There are requirements in 10 CFR 60 that we evaluate alternatives for things like the layout of the repository design and select the one which gives us the highest confidence or the best isolation and containment situation. And so, one of the reasons you would do something like this layout experiment, the demonstration breakout room, would be to find if there were in fact differences in the fracture you might introduce in the rock mass as a function of which way you laid out the drifts.

MR. TILLERSON: But we're talking small degree. You're talking five, ten, some sort of

orientation there.

MR. DEERE: And we're talking about something that would mean a major change; that is the structural features and whether it's water bearing or potentially can be water carrying if the climate were to change or we have perched water tables that can drain into it. Really something that is a very great restraint if it has certain adverse characteristics.

MR. TILLERSON: Yes. It's that type of thoughts that have led us in the exploratory shaft program. I believe the proposal is to drill in front of the development into those areas, the drill hole wash structure to see if it has large amounts of water.

Then the question is do you really want to physically complete your drift all the way in through. The answer may be yes, in order to understand it, we do. Or no, it's more conservative to stand off from it. So that type of information would be done relative to particularly the drill hole wash structure, as well as I think it's a matter of course for most of the exploratory drilling.

MR. DEERE: Could you go back to the drawing, the map you had just before this? Right. Now, could you mark the three exploratory drifts from

the shafts? I think the scale would be of interest.

MR. TILLERSON: That one I took too long.

MR. DEERE: I like that a little bit better. I thought we had already made some points this morning.

MR. NORTH: Let's mark the southern extension on that, just for comparison also.

So the discussion about doing more drifting up to another 10,000 feet, that's down that main shaft?

MR. TILLERSON: The part that was evaluated in the Title 1 study, and I don't know for sure which one of those three mains, but the scale I'm drawing here is that. That was to evaluate the feasibility from an engineering standpoint using the facility to do that.

And one of the things with regard to this drifting is that from the new types of structures that you would be encountering, it's not obvious from the information you would be encountering new types of structures. We would not necessarily be encountered by one of these, but in terms of the amount of exploration you have done on the site, quite clearly there is a difference.

MR. CORDING: At the end of that you're trying to get another one of those fault systems there; is that correct? Or not? You're just trying to get through that facility, but not to those other areas outside. Like the abandoned wash and --

MR. TILLERSON: No, in that we did not look at physically going further down and --

MR. CORDING: But then the decision to go that additional 10,000 feet would be based on what type of information?

MR. TILLERSON: The decision to do additional drifting in whatever direction might be appropriate is based in part upon -- and Mike, you help me with the characterization program, but in part based upon the stratigraphic information and the other information you obtained from your surface-based drill hole, as well as in some instances, how far out you go to hit the Ghost Dance Fault if the Ghost Dance Fault is recognizable and there? That's the question. How far before you decide it's not there? How far before you decide well, let's keep going anyway. Those types of questions are things that will be decided there as part of the characterization program.

But in general as I see it, and I think

it's consistent with what's in the SCP, the surface-based drilling program in some of the areas will influence what information is found there. For example, if the stratigraphic information from this particular area could not be correlated with what we think is currently there, that might be a reason for some additional drifting toward the south, or additional boreholes toward the south, depending upon which way you could best characterize whatever uncertainty that the new site characterization information had given.

Going this direction, there's not a lot that would lead you to going long distances in that direction, that I can fathom. Going this direction, the idea of, Is the drill hole wash structure real in terms of its hydrological implications in the site is, from what I've heard from the hydrologists, a very real question. And then it would be turned over to the engineers of could you develop your facility in that particular area. And then the question is obviously further to the west or further to the south.

MR. DEERE: It would seem to me like the minimum you would want to do with those drifts would be to extend where you turn and go out to the left. Is to come right on down the main drift until

you cross the Ghost Dance Fault a second time. Could you dash in a line across there for me? Just bring it on down?

MR. TILLERSON: Okay. You're talking about as a minimum do --

MR. DEERE: Right. Little farther. Great. Now I think you are really looking at what I consider a key structural question.

MR. TILLERSON: That's correct. Let me also put in another consideration, and that is if you were out this far and there may be possibilities that you would find it advantageous to go with some of your emplacements. Short distances or something like that. There are a lot of those types of questions that will undoubtedly be addressed.

MR. GERTZ: What's the significance about being able to see the Ghost Dance Fault at the repository horizon? What do our geologists say? 50/50?

MR. DOBSON: The surface exposure of the Ghost Dance Fault is very small, and there's only a few -- in fact, practically impossible to pick up when you walk across the surface and it's recognized primarily because it's a short visible ream up, and so it has geomorphic expression. But it's not

entirely -- there's certainly not a large broken zone around Ghost Dance Fault. But because of the exposures on the sides of those hills are covered with some rubble; if not, we don't have a clear exposure of the surface. So I guess it's kind of, as Joe characterized, it's 50/50 what we'll find when we get down.

MR. NORTH: It shows up because it erodes more easily when rocks are on both sides?

MR. DOBSON: Yes. Whatever that translates into, underground.

MR. SINNOCK: Actually the offset increases to the south, and as you go to the north, it pinches out at least in terms of surface expression. So where the drift is, I don't know. The offset may be in the orders of a few to ten feet, it increases to a maximum of maybe 150 feet about its midpoint.

MR. CORDING: It seems to me that there's also advantages and you're not just searching -- you're searching to try to find what other conditions across the site. If you don't find faults across the site, that's wonderful. Or if you find minor features.

A lot of what you have at the point

before you drift across are interpretations based on surface mapping, and based on, again, interpretations from vertical boreholes and offsets, which is not a direct indication but an interpretation of the possibility of faults.

And if one goes across this site, you actually get down there and see what the conditions are, and you have essentially proven across that zone what some of the anticipated conditions are based on interpretations. It's specific site information that

you won't have with the present plan until you are
actually drifting out with your emplacement, to get
ready to emplace the waste.

MR. BLANCHARD: This happens to be the most appropriate air photo we have at hand right now to bring out the point I think that you were just making. The general consensus has been I think, from the Scott and Bonk study, that the Ghost Dance is probably an extension of the Abandoned Wash Fault.

There's a lot of structural feature that shows up here, as you can see by the shadow produced by the sun angle, that this is where the Abandoned Wash Fault is. The exploratory shaft is in Coyote Wash right up about here, and so you can't see any superficial expression from an air photo of the

Ghost Dance Fault.

MR. ALLEN: We were shown in Washington a large scale photo that had very clear geomorphic control along the fault.

MR. SINNOCK: I think the one Joe showed you, you could see the fault.

MR. BLANCHARD: Well, I don't believe that's the case. A number of us geologists have been out in the field -- Dave, you've been there quite a few times. I've walked across what's been mapped as the Ghost Dance Fault a dozen times and never seen it. I'm not saying it's not there. I'm saying it takes a very well trained eye to see it, and it doesn't show up all that readily from aerial photos.

MR. SINNOCK: At the location of the shaft. Further to the south there's an actual surface expression.

MR. BLANCHARD: As you go south, the displacement increases. But as you go north, placement drops off to zero.

MR. SINNOCK: If you put up the other photo I think we can see it.

MR. ALLEN: It's a fault line start, but not a start, I think.

MR. SINNOCK: Right here. This is

Ghost Dance.

MR. DEERE: And the shaft there is --

MR. SINNOCK: Coyote Wash is here. There comes a drill hole. Looks like here.

THE COURT: Just up the road from the pan.

MR. SINNOCK: This is it leading into --

MR. BLANCHARD: Right there is the exploratory shaft site. I think you all are misplacing an air photo feature with the Ghost Dance Fault in our discussion. I think we have to overlay -- I don't think that's it.

MR. DOBSON: That is it. That is the feature that is mapped as the Ghost Dance Fault. When you walk across it in the field it is difficult to find, but there is a significant geomorphic expression. And that's what Scott said. And the apparent offset increases to the south.

MR. ALLEN: There are plenty of places you can walk across the San Andreas Fault with no impression under foot. But on an aerial photograph it's quite clear that something is there.

MR. STEIN: I don't know whether it's worthwhile to interject at this point, except it does remind me of an experience that I had out here about a year ago. I was interested in going out and looking at some of the faulting, and there were two geologists from the project that accompanied me.

We got to a point and one of them pointed out, There is one of the faults I was telling you about. I looked and I said well, I don't see it. And the other geologist said Well, there isn't any fault there.

Then the second geologist said Now, on the contrary, the fault is over there, and I looked over there and I again didn't see the fault. And the first geologist again said There's no fault over there. The fault is over there. And I just kind of backed away from it all. But that's what this situation reminds me of.

MR. CORDING: I think that also brings up a point that when you get down and drive across these things, then you have a chance to physically test the ground. I know there are other levels you're concerned about in terms of the flow of water. But you physically test across your site and check out the things which are basically hypothesis at that level, in the facility. This is hypothesis now, and a lot of it will remain hypothesis until you've actually drifted across.

MR. ALLEN: Also, the photograph we were shown in Washington had a very clear lineation on it. It demanded some sort of geologic explanation.

MR. BLANCHARD: We are going to take a short break now.

(Thereupon a brief recess was taken, after which the following proceedings were had:)

MR. BLANCHARD: We would appreciate it if everyone would take their seats so we can finish up this session.

I only have two view graphs. I don't want to restrict any questions or conversations about this subject. One view graph is a summary of what's going on, and the other one is conclusion of what we have.

First, what we tried to represent to you but probably didn't very thoroughly, because it's a subject of another briefing about the extent of site characterization, is that we've tried to lay out a three-dimensional view of program, the goal of which is three-dimensional characterization so that we can understand processes apt to change that picture, and it includes a systematic approach as well as examining anomalous features. It includes surface and underground drifting to investigate these structures.

We think at this stage, from a conservative posture, the program is representative. Of course, that's up for debate: What is the extent, and how representative is it? We tried to defend in our opinion what we think is a conservative approach, using a surface and underground program with limited excavation.

As long as y'all are brainstorming about this particular subject -- where did Joe Tillerson go? I wanted to use one of his view graphs. He has been using view graphs which show the lateral constraints on the development of the repository. If we take a step back and think about what we're trying to do here, there is a constraint that has had an impact on the layout of that repository. It's perhaps not all that clear.

That is, in 10 CFR 960, we have a disqualification condition, if there isn't 200 meters over. That evolved partly as a consequence of a potentially adverse condition that was in 10 CFR 60, which indicated that there was a potentially adverse condition if we didn't have 200 meters. When the department was looking for screening criteria, it

liked that, and the team said well, why don't we make that a disqualification condition? So we did that in our infinite wisdom, in the process of screening from nine to five to three.

The question now, though, is how appropriate is that, given the nature of the geology and the hydrology and the structure that we're dealing with? The point I want to make is that the barrier is below the repository. So anything we can do to increase the travel distance, increases the travel time, and it provides more rock and more barrier than what we have.

And so, if we're going to do a little bit of brainstorming about looking at some of these boundaries that Joe has shown laterally, one of the ones we ought to also look at is a 200-meter overburden cutoff that we've placed and tried to decide well, should it, given the conditions we have here, really be a disqualifying condition.

We have a lot of very old surfaces at the site that provide information to us. Erosion is not a question under the time period -- is not a concern under the time period that this repository is going to be intact.

MR. DEERE: But doesn't that limit

almost coincide with the edge of the Solitario Canyon fault? So that if you tried to take advantage and move farther to the left --

MR. BLANCHARD: Well, it does on the west side, but not on the east side. And that's where these expansion areas come into play that Joe was talking about. For instance, when you look at the water table and -- when you look at the structure it dips to the east.

MR. DEERE: Yes.

MR. BLANCHARD: And so, in order to stay in the Topopah Springs as we go eastward, we get shorter and shorter travel distances to the water table. And one of the things that drives us to a steep dip in the repository is the 200 feet overburden. And if that was not applicable, then we wouldn't have to have such a steep dip.

Now, there might be other things, like lithophysae might have to be studied in more detail. But the more we can make that repository farther away from the water table, the better off we all are.

MR. WILSON: So it's a question of not extending it, but raising it?

MR. BLANCHARD: Yes. Raising the whole repository. Or doing something which changes the

angle so in those areas that you might want to expand into, you actually end up with a repository less than 200 meters down.

MR. NORTH: Do you have some other materials that show that? Because this diagram doesn't really do a good job of showing that tradeoff.

MR. BLANCHARD: I know it doesn't. We do have some screening materials. I think it came from -- is the best diagram from the Sandia screening report? Sharla Bertram?

MR. VOEGELE: With respect to the 200-meter disqualifier, I think the best one are in the Mansur and Ortiz report.

MR. SINNOCK: I think we have a map of the overburden repository.

MR. BLANCHARD: Yes. We can provide you with some information.

MR. NORTH: What I'm avoiding is a situation where we have to think through the design tradeoffs. Supposing the 200 is relaxed to 175 or 150, then what does it do to this whole picture? That's the diagram I'd like to see.

MR. STEIN: Max, I think it may be appropriate to jump in at this point. It might be very well to talk about the 200 meters, but that is part of the site characterization.

There is a requirement in the Nuclear Waste Policy Act that says for us to put together general siting guidelines. 10 CFR 960 is the siting guideline that we put together, as a result of the requirements of the Act. It was also a document that had to be concurred in by the NRC.

If we're going to make changes to that document, then we have to go through a process where we interact again with the NRC. We're talking about time here to do it. It isn't that it can't be done, but NRC would have to be involved in and concur with that change in accordance with the Nuclear Waste Policy Act.

MR. BLANCHARD: I think you're quite

right, and -- Clarence?

MR. ALLEN: I don't understand what you're saying. The cross section we have that we were shown shows the repository tilted of course towards the east. But if you either try to raise it or make it level, the east end of it gets up into the overburden tuffs. And that's --

MR. BLANCHARD: But it doesn't get out of the Topopah Springs unit.

MR. ALLEN: Well --

MR. BLANCHARD: It depends where you're drawing the cross section; it's a cartoon.

MR. TILLERSON: It's not all of the Topopah Springs.

MR. ALLEN: It's not a cross section,

it's a cartoon?

MR. TILLERSON: That's correct.

MR. SINNOCK: That cross section that you saw is derived -- there are two or four times vertical exaggeration from the graphic system. It is a scaled plot of the contact between what we call the TsW2 and TsW1. Both are Topopah Springs and the TsW1 is the higher lithophysal content of the Topopah Springs.

MR. BLANCHARD: Now, staying still with this first point about what's representative and how do you construct a three-dimensional picture, Ralph's point was very good in that it is not an unilateral program. Everything we do ultimately is based on interactions with the Nuclear Regulatory Commission.

And the strategy that you will find in the Site Characterization Plan that's reflected in 8.1 and 8.2, those sections as well as in 8.5 from a schedule standpoint, is predicated upon taking those things that we recognize are important features to

waste isolation. Preparing something like, if you will, position papers about them. To help us determine how much is enough to make a point, and then interacting with the NRC about that draft position paper to determine whether or not we've got sufficient information.

I think we're on the right track for demonstrating regulatory compliance on that one subsection because all of these are building blocks into the whole picture.

The assumption is that based on that interleaved process, interacting around position papers, we would eventually reach a point where we more or less have mutual agreement that continuing on with further investigation in some areas probably is not going to produce much more information, and the uncertainty isn't going to change very much.

We envision over the long term some of the 106 studies may wind down early. Others the scope may expand because on the basis of these interactions, things will be brought up that we don't know about now, and these studies will actually be a little more comprehensive than we have. Perhaps even some new ones will be created. So we have tried to build in an interview process to address the

three-dimensional picture of what's represented.

Also, we expect the program, as it's developed, to be sufficient in terms of the ability to retain flexibility to expand. Just how much, Joe has indicated in his presentation that in order to accommodate a sixfold increase in drifting, they would have to do an engineering analysis to decide just what is their limit. They know they can get to 10,000 feet of drifting. How much more, and whether it would be warranted is another question, and more analysis would have to be done.

A perimeter drift early in site characterization seems that it would constrain or could constrain the repository layout in ways that we would not want to do right now. An improved data base could indicate the need for additional exploratory drifting, perhaps coincident with mains or with emplacement drifts or perimeter drifts. Any of these could indicate the viability -- what am I trying to say here; improved data from borehole program obviously has an impact on where we drift next and the extent --

MR. DEERE: Could I ask you to put a

red circle around that here and I want to come back to that, if I might?

MR. BLANCHARD: Sure. The repository design concepts should include development plans that could use early perimeter drifts or mains, or access drifts. And that's our perception for the strategy for future examination of the conceptual repository design.

MR. DEERE: Before going to the fourth bullet, perhaps I'll look at the third one: A perimeter drift early in the site characterization program could constrain repository layout.

I think, in the discussions we have had and the information you have presented, this is the only logical conclusion that one can arrive at. An early one now is just too early to be put in the right place for almost any reason.

Therefore, it comes down to the fourth one: Improved data base could indicate need for additional exploratory drifting -- as you have already discussed -- (perhaps coincident with mains, drifts, perimeter drifts) or indicate viability of perimeter drift.

Well, I think that this is a conclusion that I would imagine we would be able to agree to. That we do need the information to get a better data base which will be coming from your planned drilling

program, before one could look at this in greater detail.

MR. BLANCHARD: One of the things I

think that is coincident with your observation is
that we ought to go back and look at our planned
sequence of drilling to see whether or not we are
maximizing this particular feature. I am not sure
that we are right now. And so, it would warrant a
re-examination.

MR. NORTH: I'd like to reinforce that.
It seems to me the implication of point four is the
need for detailed contingency plans, as to how the
additional exploratory drifting might be done, given
all the logistical issues, and given the information
needs and site characterization.

MR. NORTH: In other words, pull it all
together. What information in the improved data base
is going to take you in what direction? And then
given that direction, how do you propose to take
action as a consequence?

MR. BLANCHARD: That's very reasonable.

MR. DEERE: I think another point is we

need an improved data base to be able to proceed with repository design.

If the fault, the Ghost Dance Fault has

a displacement of ten feet at one end and 150 feet farther down, as Scott mentioned, this has to be verified early with your boring program to see where that takes place. Otherwise I can see our horizon, our target horizon being 150 feet apart on one side of drift with respect to the other. Do we have 150 feet of room to play with in our restraints between the lithophysae and the vitrophyre?

So the offset is fairly important, otherwise it's very difficult to make a design at the present time; not only for the perimeter drift, for all of the drifts. So I think we should relook real fast at your boring sequence, as you have already suggested you think you should.

MR. CORDING: I think one other point is that in looking at the improved data base, regardless of what that data base shows, there may be an indication here that one should expand exploratory drifting, that one could make that decision even at an earlier stage.

You've made a decision to go so far. The decision could be made to go further or less, even at this point. And it seems to me that in looking at the possible ranges of results that you will get from the surface drilling, one could still

conclude that, regardless of what the conclusions are, we will need to do more drifting, even in certain specific directions. Or at least we will need to definitely use so many more feet of drift in one or two possible directions; something that, in other words is not just a contingency later on, but building even in at this point that we're going to do something more.

MR. BLANCHARD: Your point is referring to the picture that Joe modified where he showed, with a very few feet of drift you could perhaps penetrate and test the Ghost Dance Fault three times. That would build confidence.

MR. DEERE: Yes.

MR. CORDING: And building confidence in what is across, for example, the full width of the site. In terms of an east/west direction where most of the major structures pass. Or would pass if they're there.

MR. BLANCHARD: Yes. Then that being the case, considering the conceptual nature of our layout, the need to limit the extent of the excavations, the need to limit the impacts, the need to get a three-dimensional picture, it seems that decisions right now about a perimeter drift are

probably not warranted.

But at some point in the program, additional drifting -- and it might be a perimeter drift -- certainly is called for. How we do it, when we do it and the conditions that cause us to say now is the time I think needs some results from site characterization, and perhaps some results from the first drilling tests on either side of the fault because that could probably be done sooner than drifting to the fault, and actually running tests.

There are a couple of other things that

I have here. One was I have one copy of the Scott and Bonk map which is more detailed, like this one here but not colored. I can give that to you all now, and if you want other copies we'll mail them to you.

And then I had a list of a couple of other things. One was the design acceptability analysis. We brought in four volumes here, which represents the analysis we did in December, January and February, and our attempt, using an independent technical review team, to determine the viability of Title 1 ESF design to be sufficient for moving on to start Title 2. That's contained in there, all of the details are in there.

There's about a 75-page executive

summary, which is very good. If you don't want to go into the details, I would suggest that when you get your copies, pull out the executive summary, work with that and then everything that's referenced in the executive summary is in the four-volume set. Assuming that you didn't want to carry that with you, we were going to make plans to mail it to you. If you'd like to take one copy we can do that.

MR. DEERE: I will probably be back after lunch, and I would like to look at it here, then I'll have you send it to me later. I don't know if the other three gentlemen will have a chance to look at it before they leave; I doubt very much. But I think we would like to have -- how many of you would like copies? I know Ed needs to have one.

MR. BLANCHARD: We assumed we'd just send a copy to each of you.

MR. DEERE: That will be fine.

MR. BLANCHARD: Along with the Scott and Bonk maps.

MR. DEERE: And Ed Cording also needs a set of the SCP eight volumes or nine volumes.

MR. BLANCHARD: Does anyone else need an SCP set?

MR. DEERE: I might add, the

presentations you have made to date will be very helpful to us in going back and rereading a number of parts, which now make much more sense to us since we understand the historic development and the status that have gone into that presentation. I think this has been very helpful to allow us to go back. There's a lot of information in those volumes.

MR. BLANCHARD: Two other things I might bring up. One was we promised to give you a markup of Section 8.4 which pointed you in the direction of where the analysis and evaluations were, so you can look at what the bounding analyses are and decide on your own. We'll do that and will mail it to you.

Something else too, that I think would help from a planning standpoint: We have something called site investigations plan. It's a large folio in a big booklet, and it lays out map by map, topic by topic what our plan investigations are; the view graph that Mike Voegele showed. For every different group of investigations, we've got them laid out with codes and symbols so you can see real easily where they are. You don't get that in the SCP because of the way it was produced and bound.

You may want copies of those too

because that lays out discipline by discipline what's planned, not just on the block itself, but elsewhere too.

MR. DEERE: Certainly we would like one of those at our office in Washington, which we will have now in about two and a half to three weeks.

MR. BLANCHARD: There seems to be one other remaining item that was talked about. I don't know whether you're interested in it or not. It was brought up yesterday, and that is the study plan analysis. It was only briefly talked about. It doesn't really relate to either of these two topics, but it was brought up. We could send that to you when it's finished.

MR. ISAACS: What is it?

MR. BLANCHARD: Well, it's the basis for having a degree of maturation on five excavation phase study plans and demonstrating it. Even though they weren't prepared under a quality assurance level program, the program that they were prepared under is equivalent to quality assurance Level 1. It really is more addressing suitability from NUREG 1318 and quality assurance standpoint; technical content, I don't think, changes one bit.

Dave, would you like to add anything to

that? He is the author of that evaluation.

MR. DOBSON: No. I would just agree, it's not a technical document. It's a summary of the quality controls that were applied to the five studies.

MR. BLANCHARD: Shall I scratch that one off?

MR. DEERE: I would say if you could have it sent to our office later we would like to have those things in a single office so we can refer to them.

MR. SALTZMAN: I think it relates more to the subject of quality assurance than the subject of study plans.

MR. DEERE: Yes, but we're going to be into that in a later date, so it would be good for us to have it.

MR. BLANCHARD: I have five actions here that we just talked through that we will start the wheels turning to send to you.

Tom and Carl and Ralph, are there other things?

MR. DEERE: Do we have a copy of those conclusions? I didn't seem to find it in mine --

MR. VOEGELE: That was inside the blue

cover. The summary page was passed out separately.

MR. NORTH: It had a staple on it.

MR. STEIN: That's it right there.

MR. DEERE: Okay, I'm sorry. Yes, thank you.

MR. BLANCHARD: Why don't we just start that way. Ralph, anything else?

MR. STEIN: Have nothing more to add.

MR. BLANCHARD: Tom?

MR. ISAACS: I just want to make a couple of closing remarks if I might, on behalf of the Department.

MR. DEERE: We just wanted to caucus for about five minutes before we have our completing remarks. So would you like to take a break and come back?

MR. ISAACS: Sure.

(Thereupon a brief recess was

taken, after which the following
proceedings were had:)

MR. ISAACS: Would you like to proceed, Dr. Deere? Or would you like me to proceed?

MR. DEERE: I will if I may, and we'll let you have the last concluding statements.

MR. ISAACS: Sure.

MR. DEERE: First of all, we do appreciate very much the great amount of time that has been devoted obviously to a lot of your engineers and geologists and management in preparing for this meeting. It has been very useful background for us. It makes it a lot easier for us to understand the reports that we've been reading; the volumes we'll certainly go back again. The new maps, the cross sections, et cetera have proven to be invaluable.

The purpose of our meeting was to discuss the two possibilities: One of using the raise boring; and number two, of an early perimeter drift to help in site characterization, primarily to reduce the unknowns. This was the major region for the perimeter drift. I will take the second topic first.

We feel that the summary that was placed up there with the third item, that it did not appear to be practical to do at this time the perimeter drift as a very valid conclusion, and certainly one in which we agree.

We also like your number four bullet, which stated that as a data base is established with a drilling program that you now have laid out, you will always reevaluate the information and see the desirability of increasing the lengths of some of your exploratory drifts, or the viability of a perimeter drift at that time. Again, we are very much in agreement with that.

We also know, from the field mapping and the information that Scott and others have given here, that there is very good evidence of 150-foot offset on the Ghost Dance Fault at about the midpoint of the proposed site. Near the shaft it is expected to be less; 20 feet, 30 feet, ten feet, that's one thing that is not known as yet. And someplace to the north that fault which appears to be a scissors fault, will die out.

So we might not get a representative look at that fault by borings, or by our drifts as currently laid out, near the north end. If the displacement has been ten feet, I would imagine that the fault zone characteristics could be considerably different than where the displacement has been 150 feet.

So Bill, in detail, we don't know where you have laid out your slant hole to go across that fault. But it would seem to us that may be in the area of greater displacement, which would be more or less the center of the site. And that may well

coincide with where you are.

MR. WILSON: I think so.

MR. DEERE: Yes. We don't have that detailed. Then we come to your conclusion, and again are in agreement with the conclusions on your last slide, with a minor modification. I will quote that last sentence: "Information from the site characterization program will help define the repository boundaries, and may warrant additional drifting, perhaps a perimeter drift at a future date."

Our change would be to have the "may" become "will" because we definitely feel that your information will warrant additional drifting, and perhaps a perimeter drift at a future date. And with that feeling, rather strong feeling that we have in mind, nothing more than that, we think it would be prudent right now to increase your drift lengths at this stage and not leave them as contingency things.

You still may have a contingency that will require additional drifting. But at least we will hit the Ghost Dance Fault in two places, and one farther to the south where the offset is greater. It's still not very far south, but it's in the right direction. And that, together with the borehole information, may suffice to characterize it. We also feel you do need a perimeter drift across the site to the west. If that --

MR. GERTZ: Not perimeter, exploratory drift.

MR. DEERE: Exploratory drift. Excuse me. -- across the site to the west to prove that you have no important cross north/south striking, more or less, or northwest-southeast structure cutting through the main area of your future repository site.

And I believe that those are the conclusions that we have derived from the information I have presented to us, that there would be a great deal of decisions you will be making as you get the stratigraphic borings and the structural borings finished. But this is just in anticipation for planning.

Now, with respect to the other question which we discussed yesterday and the board or the panel members continued last night their discussion, Dr. Allen, who is the chairman of our panel on structural geology and geoengineering, will give our concluding remarks with respect to that.

MR. ALLEN: Well, we think you made some convincing arguments for the excavation of Shaft

No. 1 by the techniques that you had originally proposed. At the same time, I think we still feel that there are some very good arguments for at least one of the shafts having exposures that are relatively free of blasts and water contamination.

Therefore, we suggest you might think

about some sort of a compromise proposal, something like this: That Shaft No. 1 be excavated as you had planned, by conventional methods, with the only exception being that you look very carefully at the list of experiments you expect to do in that Shaft No. 1, trying to differentiate those that are necessary to be done as the shaft progresses in-depth, which certainly some of them must be done. And differentiating those from experiments can be done later, either out of Shaft No. 1 or Shaft No. 2 at a later date.

For Shaft No. 2, we would like to see this either raise bored reamed out in some way to in effect give exposure without contamination and some possibilities -- which, I think we still are not firmly convinced which one of these might be most advantageous -- is indeed from the bottom of Shaft No. 1, to drift across the future location of the bottom of Shaft No. 2, and then simply raise bore from that location.

Another possibility might be to excavate Shaft No. 2 by conventional methods, but at a minimum realistic diameter; eight or nine feet, whatever that is. Go down to its total depth by conventional methods, then drift across to the bottom of Shaft No. 1, arriving there basically at about the same time that Shaft No. 1 is planning the schedules.

So you arrive there at the same time Shaft No. 1 is completed at the bottom. Then go back to Shaft No. 2 and either raise bore it, extending it out to 14-foot diameter or whatever seems appropriate, or perhaps coming in with a V mole or some sort of operation from the top, of course taking the waste out of the bottom and coming back up through Shaft

No. 1. The second procedure is giving the advantage that as you go down from the top the geologist can be right directly behind the machine, almost instantaneously observing what's going on.

There are a number of possibilities here, but I think we would just urge you to give some serious consideration to some sort of a scheme here that will allow you to get those uncontaminated exposures that will arise either from a reaming out or a raise boring type of procedure.

Don, you know the nomenclature here better than I, and perhaps you can expand on this.

MR. DEERE: Well, I will describe for just one moment what I would prefer on a personal basis because of experience in mapping inside of raises for exploratory work.

That is I think that after Shaft 1 is done and the drift taken across to the base of No. 2, and then being able to raise bore perhaps with the center hole, your exploratory hole being right down the center of that shaft, with your geophysics and your other logging, and then reaming that out so that you have a 12-inch diameter hole to accept your raise bore and then to take it right to the surface in the question of 12 days or 14 days at a small diameter; six to eight feet. And the mapping then could be done coming down from the surface with all the time that one wants.

And for drilling out across, the mapping Bill yesterday pointed out that a rough shaft has advantages and allows you to get the dip of the structure and not just the strike. But a smooth surface in a small bored hole allows you to stand and see the structure on two sides, and to get a perfect angle of the strike that you could never get looking

at a small block. And it's much easier to do in a six-foot shaft or eight-foot shaft than it is in one full size. You see it in an undisturbed condition, you see the gouge or the filling or the mineralization. You see if the joints are open or closed, and the amount of damage you do is very minimal.

It's really a very, very efficient exploratory tool for mapping and observing characteristics of joints, frequency. It would be very nice for taking samples, six-inch samples, whatever you need, by coring right into the side for five feet or whatever, four feet, three foot -- we have taken cores right from the surface and gone in only one foot and tested them. The disturbance is so minimal in hard rock with respect to the depth that you're working. And have that available for doing everything that you want all the way down.

Soon as you get your six-foot photographed and mapped, you shotcrete it. The small shaft, shotcrete would be sufficient. And you continue down with your mapping and your testing over the time available.

Now, when you get all through with that -- and incidentally, Shaft No. 1 is being used

for your haulage and all the other things you may want to be doing as you're developing your rooms and other areas. When you get through with this, one then reams it with a final pass to the diameter that you want.

Now, an alternative to this two-pass raise boring is to raise bore only once with your 14-, 15-, 16-foot diameter, as required, and do the same thing. You have a little more of a stability problem. You might have to add rock bolts, but you can now do it because you're not going to raise bore them out. And the shotcrete, and come on down. So that's two possibilities of the raise boring, as used.

Now, Clarence Allen's suggestion was that one also consider the V-mole, which comes down in a vertical mode and drops its muck into a pilot hole. That pilot hole can be raise-bored, or another alternative that he mentioned was -- I think you mentioned it -- was that -- yes, that the shaft would be sunk in conventional methods, No. 2, to nine feet or ten feet, and then raise bored out to your 14 or 15, or V-moled down; either one.

MR. ALLEN: That alternative was simply

one of trying to save time so you weren't totally dependent on No. 1 being all the way down before you

could even start your drift, horizontal drift.

MR. DEERE: Right. But if one were able to save a couple months' time in the testing or three months' time in the testings of Shaft 1, so that you do get down to the bottom or have a chance to come across, then raise bore up, I don't think the overall program would suffer too much. Maybe two months, maybe four months. But I think this is the kind of a thing that really is not going to count very much. We get better quality information.

So we would simply leave this as a suggestion that has developed from the discussions we had ourselves before we came, from the information you have presented to us to your analysis of the problem and the difficulties which we are well aware of exist, and we think it might be of interest for you to look at this combination to see if you think it is a viable alternative or not. That's our recommendation.

MR. ISAACS: Okay. Let me make a few remarks, if I might, both in general in closing on behalf of the Department, and also with regard to the recommendations that I heard. Let me start by saying, if I might also in your presence, that I appreciate very much the tremendous amount of work that was done

by the staff in preparing for these presentations as well. I think it was well done, and certainly needed. And we're going to have to do these well.

I was reflecting recently on the fact that with the establishment of this board and already five panels and a can-do attitude, that it wouldn't surprise me in the least that not a month goes by but we don't have somewhere in the program either a meeting with the board or one of the panels, and that's a tremendous obligation on the part of the Department and the program and try and do a professional job and tricks not lost on any of us and the impacts that has on both these folks' ability to do the job they have to do, and what it means in terms of the overall progress of the program, and I appreciate the work of all of you who have done it, it's a very difficult problem and recognizing that we're going to have to take a hard look and still meet these kinds of requirements.

I also want to thank this panel for the very cooperative and productive approach that you've taken to this particular issue. This is the first of probably what will be a lifetime of interactions, shall we say. I reflect back on something you said yesterday, Don. We sent you a copy of the Canadian

Technical Advisory Report, and that was TAC No. 9. They've been in business for nine years and counting.

MR. ALLEN: We expect to be in business for 10,000 years.

MR. ISAACS: Since you're supposed to go out of existence one year after we begin placing waste, that causes me a great deal of stress, Clarence.

Let me also add that I think it's important for all of us to recognize that we all have an appreciation of the many integrating factors that come into this program. One cannot make any kind of decision when you live in this program for a while, you'll see that, that does not consider not just the technical implications of what you do, but what does it mean in terms of the overall program requirements? What does it mean in terms of the law? What does it mean in terms of legal requirements? What does it mean in terms of our institutional obligations which are prescribed by law?

And it's very important that we interact with the states and with the local governments in a very responsible and rigorous fashion, and that we certainly do not forget the tremendous obligation to work very closely and

cooperatively and successfully with our NRC licensures because this program is not going to succeed unless we are able to do that in a very successful way.

And last but not least, the fact that I think it's inherent in the law an obligation not just to conduct this program in a scientifically outstanding manner and a scientifically acceptable manner, but that we must also keep in mind the benefits and requirements to do this in a timely way, be successful in a timely way and do this in a cost effective way. Doesn't mean the cheapest, but the most cost effective.

It's incumbent to say the litmus test we do in this program is that we do the best job we can in carrying out the provisions of the law we're trying to do here. This is a very difficult program, very dynamic program; I think that came out very clearly in the presentation.

I think it's important, from the Department's point of view, that we work very cooperatively and successfully with the board and with the panel. But we need to make sure that together, we don't try and make ad hoc commitments on the run of a substantial nature.

The fact that we have obligations to the NRC, that we have obligations in law for hearings, for public hearings, for comments on draft documents, for finalizing those documents, that we have obligations for interacting responsibly with the states and locals means we have to do things in a fairly responsible and rigorous fashion.

The reason I say that is to simply suggest that we need to make sure that we take full advantage of the obvious tremendous insight that is available to us here, and that we adapt the program as best we can to do things so that we carry out to law to the best extent possible, and that we have the most technically credible program possible.

But we also need to balance that against the process by which a monster like this moves forward. Because this is a program, as Carl pointed out, where we have 1400 people working just at Yucca Mountain alone. This program goes beyond Yucca Mountain. We have concerns about transportation, interactions with utilities, cast designers, transportation vendors et cetera that are all part of the program that ultimately get drawn in. It's a very large program, and we need to do this in a rigorous fashion. So we very much appreciate the

recommendations and suggestions that were made here today.

Obviously based on the presentations, we need to go back and reflect on how best to take advantage. I very much appreciated the way in which they were characterized as it really ought to take a hard look at this general area and you might want to do it this way or you might want to do it that way.

But here's what we think you can do to enhance the program instead of saying, thou shalt such-and-such. We need to fold that into the process, we need to fold that into the implications for the rest of the program's obligation with regard to interactions, costs and schedules, and we need to get back with you in a responsible and timely way and tell you what we think we can do in response to those kinds of suggestions and how we would like to perhaps interact with you on these subjects, yet again to reiterate on what makes sense for the program.

So with that kind of a context setting,

let me say I think it's been a very successful meeting. I think the staff has gotten a lot, I certainly have gotten a lot out of this. I think you've given us food for thought that may indeed enhance the program.

On behalf of the Department, at least from Headquarter's point of view, I thank you and we look forward to many more like this in the future.

MR. GERTZ: My only comments, not at all to repeat what Tom said, but we appreciate y'all coming out. Certainly here at the end of June we're going to have a more comprehensive overview of the entire project, and we look forward to that.

We want to make sure we answer the questions you want answered so that we can be productive during that day of presentations and day of tours. We're looking for your suggestions there, and I, on behalf of the science project, really appreciate the scientific questioning and interactions that you bring to the project; it really helps us.

I think people who have been on this project -- not myself for ten years, but many have. And sometimes we get too focused and too narrow-minded, and we appreciate an outside look that stimulates the thinking. We're glad to have you here, and look forward to seeing you in a couple of months.

MR. DEERE: Thank you very much. It's been very enjoyable. With respect to the briefings, in the future, hopefully as we gather more and more of this background and get more knowledgeable, many of the meetings let's say a year from now will be on more specific topics where we already have the background.

But in these early meetings, indeed we need the background. We need to have exactly what they're presenting. This leads us, of course, into wanting additional documents, and we of course have accumulated quite a number of those.

This meeting was very helpful, and we'll have others being sent to us, and this is the kind of interactions that we need to know what to ask for, and we think this has all been very helpful.

MR. GERTZ: I guess I just have one other thing that I profess when I speak about the project locally, is I think boards such as this are necessary to assure and improve public confidence in the process. So I think it's a vital step, and I think Congress recognized that when they chartered y'all with it. So we look forward to it.

(Thereupon the proceedings were concluded.)

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