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NUCLEAR WASTE

TECHNICAL REVIEW BOARD

OPEN MEETING

Panel on Structural Geology and Geoengineering; and the Panel on Hydrogeology and Geochemistry.

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P R O C E E D I N G S

CHAIRMAN DEERE: May we reconvene? Good morning, ladies and gentlemen.

MR. BLANCHARD: Before we put the vuegraphs up that describe this morning's agenda, Dr. Deere, what I'd like to do is just kind of look over what my perception was of the open items from yesterday and see if we agree.

There were some discussions about greater information on the influence diagrams that Dr. North brought up as Hollis Call was giving presentations. We said that we would have that information in our reports, so we are carrying that as an open item

MR. NORTH: The greater detail was for more than just the influence diagrams, but the process for assessing expert judgment?

MR. BLANCHARD: Yes, and I'll do a little doctoring on the words there.

Then the vuegraphs that Hollis Call used yesterday, there were several he used that weren't in the preview packages. They were xeroxed here at the hotel last night and handed out by Candice this morning.

If someone wants a copy of those and didn't get them, please see Ken. He will make sure that you have a copy. They were distributed around the table for the Board this morning.

Then the last discussion which was brought up mostly by Leon Reiter, although a number of persons discussed that, was will the final report include the arithmetic averaging as well as log averaging on the expert judgments.

We've discussed this with our decision analysts on the Calico Hills Task Force and they will be able to include that as a part of their final report. So for those who want to look at the arithmetic averaging, they can see what it would be like if it was used.

Those are the only three that I culled from yesterday's discussions. Do you have more?

CHAIRMAN DEERE: No, not formally. We spoke a little about the peer review on some of the items. I just thought it might be interesting if certain of the items, such as the groundwater or hydrogeology does have a peer review.

I think if might be of interest if we consider helping you do that. As a matter of fact, there's a specific group of items. I'd want to talk with Pat Domenico and Roy Williams, but we feel that maybe we could take one item that we have questioned and put together a peer review of geohydrologists outside the program and see what range of values we get.

I'm really more concerned about that than I am

number three, whether there was arithmetic average or log average because what are we averaging is the question?

MR. BLANCHARD: That's right. Of course I'll carry this on and try to reach an approved list before the close of business today.

CHAIRMAN DEERE: As you probably suggest, this is not a real firm offer. It's a suggestion I would like to pursue with the members of the Board and also with you people.

MR. NORTH: I'd like to expand on that to suggest that a workshop be considered in which an across the board peer review of the expert judgments be carried out where we have both the expertise and the time to get into the judgments in detail.

I think this should follow the availability of the detailed documentation. Perhaps a time period of late in the fall might work.

One thought that occurs to me is that perhaps this might be of interest in connection with one of the professional society meetings of the kind of Board members have attended a number of times as a way that essentially the judgments underlying this analysis can be reviewed with a large number of interested people within the expert community.

MR. BLANCHARD: Our Wednesday morning agenda

was to begin with the Exploratory Shaft Alternative Task Force Study. The first speaker of the morning comes from our office, Ted Petrie, who is the Branch Chief of the Exploratory Shaft Branch. Ted will open that discussion.

MR. PETRIE: Max mentioned that I'm the Branch Chief of the Exploratory Shaft Branch. I'm also at least temporary the Acting Director of the Issuing Development Division. Member Leo Little, you may remember him, he's found a better job.

(Laughter)

MR. PETRIE: This is our agenda for today. We're going to start off with an introduction; then Tom Hunter, Sandia National Labs will give us an overview of the alternative study; Al Stevens, also from Sandia, will discuss options and supporting information. Then Lee Merkhofer, one of their contractors, will talk about the methodology, development, and the pilot study results. Paul Gnirk, another one of their subcontractors, will talk about the methodology,implementation and the current status; and then I'll summarize when they get done.

Just a little bit of recollection to get us in the mood here, the activities leading to the initiation of the ESF Alternative Study, we received comments on the SEP from the NRC and from other parties; the TRB Structural Geology and Engineering Panel, a

geoengineering panel, offered suggestions on the ESF construction and testing. We performed some evaluations and issued guidance for implementing a study.

The scope of the study, we conducted under a fully qualified, Subpart G OPRA (ph) QA program. We need to identify the preferred repository accesses and construction methods, identify the preferred locations, and select the preferred configuration and construction methods.

The plan is being carried out by the Department by having the Yucca Mountain Project Office direct the work through Project Office Engineering Development Division. That's where I come from.

The Sandia National Laboratories has been assigned to lead technical coordination responsibilities and Tom Hunter is leading that activity. He will be up in a moment.

The project participants, the remainder of them, are providing matrix support to each task within the study as needed. Some of those folks are here and they will answer any questions you have.

There were six specific tasks. The first three of them are completed. That is to evaluate the requirements, identify proposed options in configuration options -- we just discussed those with you the last time

we spoke: develop enough methodology for the evaluation of the options -- that's completed.

The remaining three tasks are really the heart of the whole thing and that is the recommendation of the preferred configuration and construction method; revision of the ESF requirements documents and repository design requirements documents to be consistent with the third option, and preparation of the report.

Just the reiteration of the goals -- to find a traceable decision basis for the design -- that's probably the significant thing here. We obviously had some decisions made before. They were well traceable. This will be a traceable decision method, no question about that.

We're going to address the NRC objections and concerns; address TRB recommendations and address concerns of the State of Nevada and local agencies.

Then, once more, this is the way we're going to be presenting this. Since I've gone over this, quickly, overview, options, methodology, development and methodology implementation and current status are somewhere at the end.

With that, unless there are some questions for me, I'll turn it over to Tom Hunter.

MR. HUNTER: Good morning, members of the

panel, ladies and gentlemen.

My job this morning is to provide an overview and introduction to the work which has been going on on the ESF Alternative Study but before I do that, Ted mentioned that there are some key people who will be providing support and I'd like to introduce a few of them, if I could, because they are going to be perhaps answering the specific questions.

As Ted mentioned, there are several contractors supporting the effort who we think play a key role in some things which will be discussed today. If we could, we'd like to call on some of them to address some specific questions if those might occur.

We have from Parsons Brickerhoff, Quade and Douglas in San Francisco, Dick Herrie and Matt Fowler who are in the middle of the room. They represent the repository underground design activities.

We have as well from Fenix and Scission who do the exploratory shaft design activites, Dick Bullett the Technical Project Officer, Bill Kennedy and Jim Scott.

Then we have as well from Los Alamos, the Coordinator of the In Situ Testing Program, Hemi Calia (ph) who is here.

What I'd like to do this morning is to summarize the activities that have occurred to this point

in a very general fashion and outline the framework that we will use for our discussions this morning.

There are a couple of key points which will be made by subsequent speakers but I'm going to introduce those key points and go over them with you so that you'll see them when it occurs in subsequent talks.

Finally, I'd like to layout for you the schedule of activities. Where we are now within the activity and how we plan to conclude the activities over the remaining months.

Let me repeat for you the speakers that I'll be introducing and talking about which is myself, Al, Lee and Paul, and then try to describe for you kind of a general framework which we think describes what the study is.

We think the study really boils down to the following situation. We have, as the follow-up to last year, established an ESF configuration which was a couple of 12-foot shafts, drill and blast construction. The tests will describe some 35 tests in the SCP and most of the testing was done in a northern location.

At that time, as Ted mentioned, what we call concerns -- you can use whatever word you want -- we can't use a word like issues because we've already used those for certain things -- there are some concerns which

we had tried to address from the NRC, some recommendations from the Board, some comments from the State of Nevada, as well as some concerns within the Department of Energy about things that could be evaluated and done differently to refine, or as Ted mentioned, as traceable bases for the Title II design.

Given those two things, all we really have to do is come up with what we call revised ESF configuration. That configuration, which I will discuss a little bit, really answers questions like what is the access method, what is the construction method?

We will be doing additional testing and we'll be getting additional testing from EPRI, and is a facility perhaps a different location. That is kind of a decision. After that decision is made though, part of the same task is to establish the thing we call the design base, and that's a lot of work.

That's a formal process where you actually document and provide for the design architect engineer at a fairly comprehensive design basis. That is what we are trying to establish before the resumption of final design for the exploratory shaft.

I notice one thing different about what we all seem to be doing, what you heard yesterday and what we are doing today is that normally you spend a lot of time

evaluating information to make decisions, then you make decisions, and I think we add one more thing. We spend a lot of time explaining decisions.

We're going to be talking to you today, explaining how we're going about making decisions, then we'll meet again explaining how we made the decisions, but even after that, there's a lot of work to be done. We'll try to lay that out for you.

Let me remind you again about the basis schedule that we re dealing with. This alternative evaluation or exploratory shaft study, as I mentioned, consists of these two things -- making this decision; making a recommendation to DOE on what the configuration will be; and developing this design basis.

That really starts the process of final design, so no matter what we describe for you today with respect to the exploratory shaft or Calico Hills, we'll be going into a final design stage which will be issuing construction packages next summer.

The first construction package will be one dealing with the site, the surface features and the initial construction. The second one will deal with the shaft or ramps, whichever that turns out to be and that will be on the order of a little over a year from now.

The activities we'll describe for you on

getting information in situ will begin no earlier than a date something like November 1992. With that perspective, I'd like you to view today's activities as though they provide information to go into about a year of detailed refinement in what the actual design will be.

I'd like to remind you of a couple of things dealing with how we're going about this process because they relate not only to the questions the Board has but also questions that we have from other parties.

I think you've seen this before but let me mention a couple of key points. All the studies which you've heard about these couple of days will have employed some form of formal decision aid and methodology. That's a common theme which is running through these activities which will, we think, in the end tie them together in a way that they represent an integrated basis for DOE's decision process.

We have to address in addition to the concerns which I mentioned earlier, we have to be concerned that when we do this design that we can document that we have an adequate set of requirements, particularly those which incorporate 10 C.F.R., Part 60.

Today you will hear a little discussion from Al which is to relate to you the activity we are going through to make sure those NRC requirements are really in

our design and our design basis.

Another point which I will comment on later is we felt we should approach this decision in a broad way. In fact, we had comments from the NRC which indicated that the decision on the exploratory shaft facility was closely tied to subsequent decision on a repository. I'll address that specifically.

What it does for us is cast a broader theme on this evaluation and it requires us to look at a much more comprehensive set of criteria to make this decision and a lot more information on how we layout configuration with the ability to accommodate a subsequent repository, so I'll comment on that.

We are doing and we will hear today the process that we go about in implementing the decision methodology and that involves quite a bit of effort to be sure it's a QA controlled process, and we plan to incorporate in the latter stages of the study an independent review looking at all the activities and documentation which occurred so that we get this element as part of the QA process. We think if we go through this we'll end up with this well-established basis for a recommendation.

What we're going to describe today looks something like this. A large set of requirements -- as I will mention later, when you allocate those out to the

subsystems, you end up with some 2500 specifications which have to be addressed and make sure we have covered. I mentioned these comments and concerns from different parties.

What we are going to be evaluating is something we call options. Yesterday you heard about tests, test strategies and things like that. We're going to use the word option to describe the things that we are going to be deciding upon.

We had to develop a set of options which we think encompassed the repository and exploratory facility configurations. We did that by looking back over history to see what had been looked at in the past. We developed some new concepts based on the concerns we have incorporated in the Calico Hills assessments, which you heard about yesterday, and come up now with a candidate set of options. We will go through and describe those for you.

Those are all input to this decision methodology which gives us this preferred configuration which we will recommend to DOE.

In presenting this information today, we'd like to use this chart to do it. This kind of describes this little flow chart which describes how we've gone about this process. I'll describe it for you briefly and then

each speaker will subsequently talk about what part they are going to play in describing this. We will cover most of this picture today.

I mentioned the requirements which represent one big effort to be categorized and organized and put into the study. I mentioned also the way of options that are generated and there was a screening process that brought us down to a candidate set of options.

At the same time and in parallel, we started out putting together a methodology for the evaluation. The way we did that was a team of us met and laid out a preliminary methodology which we thought encompassed the factors which needed to be considered and would allow a reasonable basis for the decision.

That was put together and we performed a pilot study. The pilot study was really a drill to see if we understood the process, if the process made sense, and if in fact the people who were going to participate could understand it and develop a familiarity with it which would allow them to participate in subsequent activities.

Finally, we then used the results of the pilot studies to hone in on a methodology which we think can be used. Given that methodology and the options, we can start the comparative evaluation which we have done and we're going to describe for you some of those things.

Given that comparative evaluation, we'll essentially take what will be 17 options and rank them 1 through 17. Out of that, we want to come up with a preferred configuration.

It's our intent to closely evaluate what we learn with these ranked options and ask the question, are there some refinements which we want to make to the methodology and to the observation of the rank options to come up with a preferred configuration. I'll have a few more words to say about this in just a minute.

This is the road map which I'd like to lay out for discussion this morning. Let me review a couple of things which I will cover and tell you what you're going to hear.

The options which we identified were a lengthy number. If you ask yourself the question, how many ways can I construct and locate the exploratory facilities, how many different ways can I combine it with a repository, and lay it out over the few square miles which is the Yucca Mountain repository identified block, you get a large number.

Well, we ended up with something like 52, if you recall, which we discussed with you in April that by some process, which we'll briefly review today since we feel like we have covered it with you in the past, we got

those down to 17.

We did that by screening out some 21 which didn't meet some minimum requirements, aggregating the remaining into some classes that we felt were representative and expanding the space in our final analysis to make sure we covered all the construction methods.

Al is going to lay out those for you. In fact, he's going to discuss some of the details of those options themselves.

What I will tell you, and I will not discuss those options, is the things the options considered. We think of the options as addressing three major components. The major components are the accesses to the exploratory facility, the main test level which is where the bulk and most of the 35 tests are conducted, and then finally, the repository which I will describe as kind of a reference configuration which fits with that exploratory facility alternative.

The options that we developed span the space of type of access and they really consider three types of access: there's two different size shafts which represent kind of the current case and a larger case; and there is a ramp at different locations which is a single size which we think is consistent with if the Yucca Mountain

site were nonaccessible, was consistent with building a subsequent repository.

The construction methods for the ESF accesses encompass drill and blast, bore machines -- shaft, boring machine, V moles, volume boring and raised boring, all the different construction methods have been addressed.

In the main test level where most of the experiments are actually performed, we really are at a current stage of development in which we use a buzz word for it called a Title II general arrangement.

That means that we have taken the place where we were last fall or late last summer, looked at that layout and given the name called Title II general arrangement.

As we've gone about these evaluations, we've modified that slightly and come up with different arrangements which allow for more flexibility, wider separation between tests, eliminating interference and things like that.

Some of the options, because of the way they are constructed, because they use the underground real estate, allow themselves to have a two level configuration, so some of the layout for the tests are now two level as opposed to how they were before.

For the main test level itself, we're looking

both at mechanical and drill and blast means. The mean test level itself is a series of small little rooms around different places, so there is some unique requirements for this facility as opposed to this facility. We are considering both mechanical and drill and blast.

We are looking at locations in the northeast, which is like the current location, and we are looking at locations on the other side of the block.

In terms of the repository, one of the givens for building a repository, if it were to be built at Yucca Mountain, would be to take the ESF and use it in the most appropriate way. We will add some shafts and ramps, whatever that combination turns out to be. We'll add the emplacement area.

A point I would make about that too. When we talk about repository construction, what's constructed in the repository before you start operation is a small part of the underground. I think in March we went over the construction sequence for the repository.

When you build the repository as we see it now, you would construct only one waste panel or two waste panels before you start waste emplacement, so up until the time in which waste emplacement actually starts, you will not have excavated the entire repository block but

you add in the design and emplacement area which would allows for the waste emplacement. There we have the same combination of construction methods.

This is the space we tried to span with all of the options that we have and Al will go through those with you. We're prepared this morning to go into whatever level of detail seems appropriate to the panel.

We will review a few of those and we will also talk about some of the design features. The thing we'd particularly add in this meeting today is we have incorporated the access to the Calico Hills and we're prepared to present and talk about that.

Let me tell you who has been working on this. Instead of using peoples' names, I'll use organization names. I think you heard Ted describe that the overall management responsibility is at Sandia, which is really embodied in Al Stevens and Al Danis (ph) who are the responsible people within Sandia.

This effort on requirements is being led for us by one of the project participants, TMSS which is SAIC primarily on this task, who are leading a task force within this task force to assemble and organize all these requirements.

I mentioned that we have on the task force both people in repository design and underground design,

Parsons and Brickerhoff of San Francisco. and Fenix and Scisson in Las Vegas.

The underground testing coordination is provided in the same way it's always been provided and had been coordinated through the SCP by Los Alamos in the Test Manager's Office in Las Vegas, also supported by the U.S. Geological Survey.

So we rely on information and culmination of all the testing requirements and the testing strategies on Los Alamos.

The surface design is Holmes & Narver in Las Vegas as well. There is some contract changing going on which I'm not totally familiar with but as of right now, the current A&E's are Fenix and Scisson and Holmes and Narve at the test site.

We also rely on REECO to provide consultation as the construction manager whether or not the configurations really are constructible or not.

This task force represents a marriage of a lot of folks. We think that's a plus because it provides a broad integration across all the different disciplines and different expertises within a project that is necessarily as broad as this, but we have also added into this study, some expertise in decision-making methodology which you'll hear from today -- Paul Gnirk from RE/SPEC

and Lee Merkhofer from Applied Decision Analyst.

We felt both of these individuals and organizations had experience in the type of broad decision approach that we think should be applied here, and they have been fundamentally involved in trying to establish the methodology that we have now, and, in fact, serve as the facilitator for the interactions that we have.

I think one thing I would encourage anyone to participate in is this facilitative process whereby a person who is kind of uninvolved and uninterested leads one through these very important topics and draws out information. It is a very important concept for anyone to have experience with and I'd recommend at any opportunity you take advantage of that if you can. So we rely heavily on them.

We'll also be describing for you some expert panels which we've been putting together from people across the program. There is a misspelling -- it's Agipito -- but there are several organizations, Agipito, Bechtel, DRI, EG&E, Livermore, _____ Weston, Burec (ph) and U.S. Geological Survey, all of whom provide panel members for a number of panels which we have put together.

Paul will describe these panels later and what

they do, but we've relied on each of these for specific expertise of both individuals and organizations.

MR. REITER: Tom, that's not a parallel relationship, is it?

MR. HUNTER: No, it's not a parallel relationship. We tried to make it as close as we could but it turns out that some of these people over here are just on several panels. We have, of course, the names of all the expert panelists and we have put all their information into this quality control system. In fact, I think almost every word is kept on transcripts which allows everyone to be sure they know what they said.

MR. WILLIAMS: I noticed you didn't have any universities listed on there.

MR. HUNTER: There are no universities listed on that list. That is correct.

MR. McFARLAND: Tom, those are all within the program, contractors all from within the program?

MR. HUNTER: All the panel members we have used at this point are contractors within the program. Some of them like RE/SPEC -- which is in the program -- and ADA probably is the one closest to outside the program that was brought in for the job, but in general, that's a correct statement.

We have configured the panels much like the

other studies from people primarily within the organization. As we finish up our evaluations, I'll talk a little bit more about how we are addressing the question of having an outside involvement.

With those people and that general mission, we have initiated the study and we have gotten to a certain point in progress. What I'd like to do now is two things before turning it over to Al.

I'd like to make a couple of what I think are key points for your information to observe as you go through the subsequent presentation. Then I'd like to talk to you about the flow of activities and where we are.

You've heard a lot about influence diagrams. The interesting thing about this marriage, all the repository developers are now closely wedded with these decision analysts and we have developed this almost common jargon on how to describe things.

One of them is the influence diagram, so we all seem to talk about these things now. I think they do represent a very good way to portray relationships.

One thing you hopefully will observe is when we talk about things like performance impacts, which Paul will go into later, we have in fact for all these studies -- the ones you heard about yesterday and today -- drawn

up the common basis in terms of influence diagrams to use that.

It is my hope that when we talk to the Board at a subsequent time about performance assessment itself, we'll use this same framework to describe how we go about performance assessment. So you only have to see it in one framework because you can cast it in many ways. We want to come out with a common language in which we can have effective communication.

The point I really want to make is that you end up developing something which we will describe either as probabilities or performance measures, and they are developed from a lot of factors.

In addition to those factors, there are a number of references which are provided. This really should be viewed as information that is given to expert panelists who operate above this line.

That information can be a number of things. In this study, it represents a fairly comprehensive set of analyses. It represents work by the architect engineers to do a lot of development of cost and schedule.

It represents work by Los Alamos and their team to try to look at compatibility of testing of different options with what is expected from the different test cases. It represents evaluations of how we can operate

such a facility.

It also represents evaluations and judgments of how these different features might perform. This is categorized, summarized and given to the panel. Also, as Al will describe, it represents a lot of correlation of all these different requirements that are put together and cast in the context of these influence diagrams.

Basically this information is provided, organized, put into the record and provided to the expert panels. The expert panel's job then is to look at the information and make a judgment whether information is going to be a part of his evaluation. He's going to make a judgment on the quality of the information and then he's going to put his expert knowledge into the evaluation and score -- when we talk about specific scoring or particular development of things like influence diagrams.

This concept of providing information in addition to just what the expert brings with him in terms of his expertise is something which we have employed and is a fundamental part of the study. That's one point.

The second point is that there's a final step which I had on my first schematic which we haven't fully formulated. We do not know in fact if it will be needed. It's that little vertical arrow that comes down and turns

to the right on the organization chart -- the organizing principle chart.

It basically says this, that we will end up with a ranking; we will learn something from that ranking; we will also end up with a knowledge of what are the important factors.

One thing you'll find out about this study is it's very comprehensive. It addresses a lot of factors. Some of those we feel are not very important and are not very significant in the final decision. We want to be sure that's the case and document that for the record. We will know which ones are the important factors.

We will also have observed some of these key features like shafts, construction methods and locations and how they have affected these rankings. We'll describe a little bit later how that comes out of the sensitivity studies. Based on that, a recommended configuration can be established.

The story that I tell which goes with it basically is -- and no one likes this story except me, so you might feel likewise when I'm done.

If you try and go buy a car and you sample a Cadillac, a Chevrolet and a Toyota, and it turns out the primary factor for making the decision when you're all done was gas mileage, probably you'd buy the Toyota.

But, if you observed in the Cadillac that you really liked those electric windows, and that's a feature you really wanted, you can just order the Toyota with electric windows.

We don't know how the ranking is going to come out yet, so we are going to be spending some time trying to figure out how that will be done and putting that together. That's one point I wanted to make which you'll probably observe when Lee talks and when Paul talks.

Let me mention another key point for this study -- this has a big impact on a number of things, physical configuration, schedule, both aggregation and aggravation, which we discussed yesterday.

That is, how do you tie together the Calico Hills input into this study? I think Max presented to you yesterday an overall, logic chart which shows the integration of the flow of information between surface based testing prioritization Calico Hills and the ESF alternative study.

The ESF alternative study really is going through this configuration development now. We will be doing final design and then construction. What we had one is provided a formal way, an output from the Calico Hills study, and put that into the ESF configuration.

As you heard yesterday, from our standpoint

they have said to us -- not that they are really different people, but it's a different chart -- that the characterization strategy which you should consider in your ESF alternative evaluation is this strategy II or V, which as you recall from yesterday is extensive drifting in the Calico Hills.

So we are taking this requirement, or this input, which is to do that fairly extensive drifting in the block and we're making that part of the options which get evaluated here. Al will show you how we have done those layouts.

What we then do is we combine that strategy with the options and then we evaluate the effectiveness of the combination of both of those in characterizing the site or this regulatory acceptance potential which we will describe in more detail.

The point is we are now going forth with a different set of options than we talked to you about in April. We are going forth with a set of options which include the Calico Hills recommendation.

MR. McFARLAND: Tom, I'd like to raise a point. In the discussion yesterday in the morning talking surface based testing prioritization, it was mentioned that the study evolved from scientific testing evaluation that's surface based and that the sub-surface base

testing prioritization would be part of the ESF prioritization.

With the Calico Hills impacting the testing requirements, where is it that you brought in the test prioritization that would lead into this whole effort?

MR. HUNTER: Let me address that. I don't think that's exactly what we concluded yesterday. What I concluded from the discussion, and what I think Max presented was, that the surface base test prioritization -- which is really now almost a misnomer -- represents a methodology to evaluate any kind of testing.

I believe the analog which was drawn by the panel was you're actually looking at waste package testing as another way -- it covers all types of testing, so that means it includes both surface base and underground or in situ testing. That methodology is being developed.

That methodology will not be applied in this timeframe to the tests which are in situ which means we will not determine whether any one particular test in the exploratory shaft facility is, in fact, more preferable than in others.

We will evaluate whether options provide the ability to get the most valued information from all the

tests that are proposed in our methodology but the actual detailed determination of the 35 tests, whether you do test 32, test 19, and in what sequence you do those, can be done during this period when you apply that methodology which we are developing that we described to you yesterday.

MR. McFARLAND: But didn't you mention in the previous presentation the testing, to a large degree, drove the construction schedule and the need to shaft, that it was key to the configuration that came out in the SCP?

MR. HUNTER: It is correct that the schedule for development of the exploratory shaft and the Calico Hills is strongly dependent on what assumptions you make about testing and test sequence.

What we are doing is developing a configuration to this point which accommodates all of the tests as proposed and we feel like this actual sequencing can be done in the final design and those decisions can be made in the final -- there are some perturbations which that can cause and we are just now looking at whether or not that will have a big impact on the decision or not.

We will, I think, talk to you during the discussion about the time between Calico Hills and repository level investigations and schedule and some of

the ties between those two.

Russ, really our intent is to allow that methodology which was described yesterday to work during this design phase to decide on the actual order and the actual conduct of the test.

MR. McFARLAND: But it will not be used to select a configuration?

MR. HUNTER: It will not be used to select a configuration but we are evaluating the effectiveness of the testing program and, as Lee will describe, both that and what we call the regulatory acceptance term, which is a measure of how well the options deal with that complete suite of information and in the eyes of the expert panels that we have, which ones provide the most useful and beneficial information, but we will not do a specific test prioritization.

MR. BLANCHARD: Russ, Tom is right in his answer and if there is some confusion left as a consequence of the presentation I gave yesterday morning, I apologize.

Our intent was to have the Surface Base Test Prioritization Task Force prioritize, first, using the methodology that was discussed by Bruce Judd yesterday morning; first prioritize the surface base program because it would get started presumably in January 1991 -

- it would get started before the underground testing.

Then they'd move to the underground testing but when they move to the underground testing, there has to be a test program adjustment for that which is now in the Topapah Spring and a new test program must evolve for that which would be conducted in Calico Hills. Presumably Calico Hills' test program would focus very much on groundwater travel time or hydrologic properties that are relevant to groundwater movement and geochemical properties that are relevant to ready nuclide retardation, whereas, the focus on the Topapah Spring test program would be more towards constructability, thermal-mechanical loading and things of that sort.

So there will be a test program for underground testing evolved as a part of that surface space test prioritization which Tom is expecting as input to his final design as shown on that figure.

CHAIRMAN DEERE: I still have a concern about that. Yesterday, I thought you said there would be prioritization of the surface base testing to get as much information as possible, leading towards site suitability analysis and that later, you will be doing the same thing with the underground testing.

I haven't heard a word yet that there will be a prioritizaton of tests that you'll want to do first, not

because they're part of the overall knowledge-seeking for final design, final performance studies, but is it as acceptable, suitable site?

This testing may be nothing more than driving a drift out to it and a few tests around the faults or something such as this, but that has not been taken into account?

MR. BLANCHARD: At this stage no.

MR. HUNTER: I want to be sure I catch your question, Dr. Deere. I think the statement made yesterday was basically that we are going to do prioritization of all tests and we're going to use the methodology we described yesterday.

Is your question how will we put an emphasis on sites suitability versus other kinds of tests and is that incorporated into our planning?

CHAIRMAN DEERE: We think that's the key.

MR. BLANCHARD: Yes. We are going to do it. You don't have the results here because we haven't done it.

MR. HUNTER: But the thing I think it is important for the Board to recognize is that when you lay out a construction sequence as complex as a couple of ramps or couple shafts, and then go down to Calico Hills and/or go to repository level, the decision about what is

the prioritization will impact how you layout that construction.

That we recognize and we have not incorporated that emphasis on just site suitability. We have done, in our test data sheets where we're analyzing the tests on the SCP, we've segregated the tests into two categories because there are as Matt said, two general categories.

One category is information you need if you're going to build a repository like design information that you need but others relate to site suitability. We have done that but we have not given the emphasis to say Calico Hills or Topapah Spring level to overline and saturated it. We've not given that emphasis but we are looking at that to decide how that might be done, but we recognize it will have an impact on things like schedule and early costs and things like that.

CHAIRMAN DEERE: There are certainly a number of tests that have been laid out that will provide useful information but you don't need them at all to decide whether the site is suitable or not. Therefore, it seems like the priority should be given to those tests that will really get you to the key problems as early as possible. If they still look good, the others come on line.

I can't see how that can be divorced from the

layout of the various facilities that you're studying right now.

MR. HUNTER: It's not divorced and as I said, we did make that separation of the 35 tests on the SCP into those two categories -- those which we felt were site suitability potential and those we felt were more design potential for subsequent repository evaluation.

What we have not done is made a general prioritization between Calico Hills' investigation and other overline -- that's exactly where we are in terms of our next step in terms of prioritization.

MR. BLANCHARD: We discussed for a while yesterday morning the fact that a tradeoff for timeliness of testing was confronting all these groups. It's just the topic you're addressing. That is, would you in the end decide that it was more important to get to the Calico Hills as rapidly as possible and in the process of doing that, give up a whole series of ESF construction tests and then go back and do them later after you were able to start tests in the vetric and zeolodic parts of Calico Hills?

We've not made that tradeoff study yet. Tom was saying that they're expecting they'll have to. We in the Calico Hills Task Force are also expecting we're going to have to participate in that. We don't quite

know how its going to come out yet.

MR. HUNTER: From a larger framework, the options that we're looking at by and large provide for all the accesses and all the tests to be done -- some better than others.

The only measure which will really be a strong driver in the way we're looking at now would be if there are tests that are proposed to be done and something about the construction, such as lining the shaft or something, precludes them being done at a later date.

In other words, if there is some evaluations that can be done in a ramp, for example, that is not lined, we can bypass and not do as we develop the ramp, then we can go back and do those later. We are looking at those evaluations in that particular schedule, but that's probably only an alterable decision which is in the process.

You can make the wrong decision if you overlook the test because you want to get to the bottom and you overlook some tests in the overlying unsaturated zone and could not go back and do that test.

MR. McFARLAND: But Tom couldn't you also be in a situation whereby in getting to the bottom, you find a feature that shows the site not suitable and therefore, the other tests become no need. If suitability is a

major purpose in conducting the ESF studies --

MR. BROCOUM: There is one other tradeoff I wanted to mention. There are some tests we had that as you were constructing you were going to do them immediately because you were trying to get some behavior of the rock as you were opening it up related to constructability.

If you defer those you may lose the ability to do those tests easily later, so the tradeoffs are not very simple, is the point I'm trying to make.

MR. CORDING: I think it's a very -- I think there's a lot of delay that can be built in to a shaft if one, for example, is intent on the first go-round getting a very accurate evaluation or good evaluation of say the strains in the rock mass, to go out there and measure strains and do those sorts of things. I think that's a very, very secondary type of piece of information.

It's something that is kind of close to my area but it's something that has not much to do with site suitability. You can get a lot of understanding, for example, of the strains and the mechanical fix of the mass by putting in some drifts later.

To have those sorts of things slowing the ability to get down to the repository level or down into the Calico Hills seems to me to be really the wrong

priority.

To me the site suitability questions are the ones which really are the things that should be driving the program. It seems to me that most of the rock mechanics types of studies, for example, should be targets of opportunity. Do them when they can fit into the schedule.

It's not that you can't do them. There's a lot of ways of skinning the cat but to have them driving the program is something that I think has been a major concern of ours.

MR. HUNTER: Within the context of what's described in the SCP, we address that directly by taking almost all those rock mechanics information and putting them into a category which we felt was not relevant to site suitability, and took all those related to hydrology -- but not just hydrology in the Calico Hills. It's one composite hydrologic system and you have to look both at overlying formation and underlying formation.

We took all those which related to what we thought affected performance related things, which is in fact suitability, and put them into another category. That information is part of the reference information given to the scoring panel -- that segregation between those tests.

MR. BROCOUM: Just one more point. That is a major change in our strategy from the SCP because our strategy in the SCP was to go down very deliberately in the shaft -- one round of blasting, one round of mucking, one round of testing, that kind of strategy -- so some of those things are a major change from the SCP.

MR. CORDING: We recognize that. It's been a concern of ours for over a year. This opportunity that's arisen to reevaluate the program to us has been, in some respects, very fortuitous. We've been able to have more interaction with you on it.

There are ways of being deliberate and getting information at higher levels and at the same time, getting down and getting the prime site suitability questions answered. Because you need information at higher levels doesn't mean that you have to take a shaft down and spend a year or two years to do it.

You can go down with different types of access down there, start getting the information that's really critical and come back, put another shaft in, or put another slope in, or drive off a slope. It's very easy to do, to even operate out of a slope and put some side drifts off, and get out into fresh country.

Horizontal drifting is one of the things that I think if of major importance. The shaft is really a

large borehole. You can get down it and see it but it's another vertical piece of information that you are already doing with your borings.

To be able to get out horizontally and see what's going on out in the mass -- in other words to find those vertical features that are going to be controlling a lot of the groundwater flow conditions, I think, should be another primary emphasis.

So there's things that can be done that enable you to get a lot of information and not to destroy your opportunity to get information at higher levels. At the same time, you have gotten down at the lower levels and I think those are the things I'm interested in seeing coming out of this study of the ESF configuration.

MR. HUNTER: That's a very good point. That's why we try not to be too defensive about our base case, whatever we call it, our original ESF.

MR. DOMENICO: Will the classification of tests be made available to us? Is that possible?

MR. HUNTER: There's no reason why not, Larry, is that correct? The answer is yes, we have it. That does not address a fundamental question like, is the information on Calico Hills with respect to hydrology more important than the information on overlying formations with respect to hydrology.

MR. DOMENICO: No, but you mentioned that you classified the tests into two groups?

MR. HUNTER: The tests that are in the SCP have been classified in two groups, that's correct.

MR. DOMENICO: I would like to see that if that is possible.

MR. HUNTER: Okay.

CHAIRMAN DEERE: And then the test in the second group would not come in when you're laying out your -- would not come into controlling the driving rates or things such as that?

MR. HUNTER: The current plan is we would accommodate all those tests -- those which do the suitability questions would score higher because they address the suitability questions, but we would not give priorities.

The current plan did not say we will give priority to Calico Hills hydrologic testing over hydrologic testing that might occur at the repository level or above, which would mean we would take the time to do the evaluations necessary in the overlying formation, in the current plan.

If this study had a basis to emphasize one or the other, we can accommodate that, but to accommodate if it's really something like do only the Calico Hills, and

don't worry about anything else, if that really is the basis one ends up with, then that will perturb our cost and schedule evaluation.

All options will accommodate doing them. All options and all configurations will accommodate doing them.

MR. REITER: Tom, I'm listening to the questions and seems that many of the questions have to do with the interrelationship between the studies. Some of the studies encompass both areas of investigation of the Calico Hills and Topapah Springs or methodology such as priorities for construction options.

I wonder if you had to do it all over again, if you had one integrated study which looks at all the construction priority options, that all these things could be balanced back and forth and you could make your choice in that way?

After having spent 6 months or so, it's always a good thing to reflect upon to see how you would have married things that were more integrated, if you will, and in doing one's study.

The practicality of it is though we need to make progress on three fronts at the same time, so we pushed -- as Max described yesterday -- ahead three areas with the time between them such as I've described here,

and the batons do hand off. You get a baton when you can carry it which is what we did here.

There are ways one can go back and reformulate the problems so it's all one big comprehensive thing, but I'm not sure we could have gotten to the point that we are today in doing that, schedulewise.

MR. BLANCHARD: Tom, could I make sure I understand what your current plan is? It sounded to me that what you indicated was that the current approach prioritizes tests in the underground that are related to waste isolation from those that aren't.

To the extent that the Calico Hills tests fall into that category, there will be a prioritization there. What the current plan does not do is establish an a priori for those in the primary barrier, that is, the Calico Hills over other tests.

MR. HUNTER: That's right.

MR. BLANCHARD: That is something we'll have to deal with later on.

MR. HUNTER: That's right.

MR. BLANCHARD: Or put it into the plan.

MR. HUNTER: I think Max just wanted me to make sure I made my point directly and that was, what we have done, we are asking panelists to evaluate the effectiveness of the testing program, and in doing so,

we're providing them information on two categories of tests from the SCP -- those which we think address suitability and those which we think are more related to design and subsequent things. That, we are doing.

We are not, within those that relate to suitability, drawing any priority over any overlying repository level or Calico Hills.

MR. McFARLAND: But you are prioritizing those tests within that category that there is suitability above or below?

MR. HUNTER: No.

MR. McFARLAND: No prioritization?

MR. HUNTER: The extent of what we're doing is we're providing that information to an expert panel and asking them a couple of questions like, does an option, given this suite of tests which have to be addressed, provide you an effective testing program or is not an effective testing program? Or, does this testing program provide you a basis for potential licensing success? That's what we're asking them to do.

MR. McFARLAND: Tom, would you come back to the question of what purpose will you put to these panels? You just mentioned two -- to maximize testing, to meet regulations.

Way back in the original presentation, you had

a set of ESF alternative study purposes?

MR. HUNTER: Yes. We're going to go through each of those today.

MR. McFARLAND: Would you enumerate those three or four?

MR. HUNTER: Well, there's more than three or four. When Paul presents the objectives of the study that we have, they address -- I think it's best addressed in those panels which you saw -- Post Closure Health and Safety, Pre-Closure Health and Safety, both Radiological and Nonradiological, Environmental, Testing Effectiveness, Regulatory Effectiveness, Cost and Schedule.

MR. McFARLAND: And you've expanded the objectives of the study to about eight, you're saying?

MR. HUNTER: There's some major objectives and some specific objectives. I think the number which Paul described is 15 or so of major objectives, when you break them all down.

Really, I think the best time to discuss that is when Paul presents those objectives but each of those are being addressed and we can describe how each one is being addressed.

I think this question that you have raised -- and Max is exactly right. We are now at the point of

given the information we have in the Calico Hills, and given the information we have on how the approach to test prioritization will be done, of trying to be sure we can accommodate all those, but we have not stated nor will we assess a specific priority on those suitability type tests to see if Calico Hills is more important than other tests, for example.

MR. BLANCHARD: Unless as a consequence of this meeting, we decide to modify the plan, right.

MR. HUNTER: Yes, and we envision we can do that. Our current schedule does not allow for that to happen. So we would end up with a set of options which would allow you to do whatever sequence someone else at a later time were to prioritize. We could change the prioritization tests to accommodate that. So we're basically capturing by a flexible set of options.

Dr. Deere, would it be reasonable to bring the subject up again when we talk about the specific objectives and tests?

CHAIRMAN DEERE: Yes. I think so.

MR. HUNTER: It's a point we recognize and we're now trying to decide whether or not and how to incorporate it in our planning.

Let me finish with a couple of points. Many times people ask the question, why are you looking at the

repository at all? What you're really doing is trying to decide if the site is suitable.

The second part of that is correct, we are only looking to see if the site is suitable at this point, but we are, in fact, recognizing that there's an obvious tie to the repository. In fact, one of our concerns expressed by the NRC was that we do consider them as a set and look at the consequences as a set.

So we are evaluating options in this study which look both at the ESF and the repository. We think, and as Lee lays out the methodology, that is the most effective way to really get a comprehensive and accurate estimate of these very important measures which we think should be satisfied by the system.

We can evaluate then, certain regulatory and performance requirements which you could not evaluate without looking at that. One of the major concerns expressed by NRC and incorporated in their requirements has to do with minimizing the total number of openings.

So we've tried to estimate what would be a total number of openings with a given configuration. We think it is only reasonable to do this because we don't want to specify an ESF configuration which precludes an effective development repository at a later date should that be necessary.

The fact is that the final repository configuration will be determined at a much later date. In fact, I think I described the design sequence and I'll try to recall it from memory.

The final design is done essentially 4 years before the license application, the last 4 years before the license application, so the final design is done at that time.

The final configuration is only constrained by the ESF to the extent that it's there and constructed. In other words, it's there, you have to accommodate it somehow, so that's the only real physical hard tie that will ultimately be established but we're trying to do the evaluation looking at both now.

We have, in this study, established special performance measures which differentiate between repository impacts and ESF impacts. We really want to be sure that the decision is driven by the decision we're really trying to make which is, what is the ESF configuration? You'll see more about that when Al talks about the options.

Let me discuss schedule. This was only supposed to be a brief introduction. (Laughter)

We laid out for you in April a logic chart. Al Denis presented this information which says what we're

going through and I will not repeat in detail what that logic chart said, but some important things I think you should be aware of.

One is we laid out getting options together and developing methodology and then we ended up saying we're going to do something called score the options, which means get the expert panels together and ask them to develop measures and probabilities using influence diagrams and the reference information. Paul will describe what a score means and how we do that.

Our original intent was to start that about the first of May. I mentioned that we had to incorporate the input from the Calico Hills because we thought that to be a primary thing. It turned out their schedule for their recommendation was such that we had to delay this date until we actually got started on this date in a planned way in the end of June.

In a planned way means we're able to take those factors which didn't really impact -- were not impacted very much by the Calico Hills and start the scoring. That's what Paul will describe.

The real scoring on things that are impacted by Calico Hills isn't going to start until after this meeting, so there's a couple of big schedule perturbations.

One is that we waited until the first of July to get Calico Hills' input. The second is we wanted to be sure an give an appropriate amount of time to this meeting, so we waited until after this meeting to start our scoring process. After this meeting, we will begin scoring on those non-Calico Hills-related factors.

Do not draw the judgment from Paul's presentation that we're overemphasizing the things that we have scored. Those things that we have scored, which we are going to use as examples, are things that we felt like were important to have a comprehensive set of evaluations factors, we think the real meaty ones are yet to come.

Basically, that scoring of options will conclude on the order of the early part of September, the scoring will be completed. It will take some time to do this aggregation roll up of things and we expect that to be done in our current plan by mid-September.

There are a number of things which can perturb this schedule. The thing that Max just brought up and raised would perturb this schedule as well, even beyond this.

At that time though, it's our current plan to go forth with the recommendations in early November to the Project Office in Las Vegas and the schedule

milestone that Ted will talk about is mid-December for recommendation to John Bartlett's office. Then finally, it's just complete and review the report.

Ted will capture this in terms of milestones, but the way to read this chart is the old date is shown here without being an influence diagram and the other ones are circled.

Let me then introduce who is going to say what. This is the flow diagram that we showed earlier about the study. We are going to have three presentations. The first presentation is going to describe this process of getting information together, getting options together, telling you what the options are, and going into as much detail as you think is appropriate about what the description of those options are, their current state, including Calico Hills. Al Stevens will do that.

Then Lee is going to come forward and talk about how we got to the point where we are in the methodology by describing in detail the pilot study and some aspects of the methodology.

It's our feeling particularly after our interactions with the Board what we'd really like to talk about is how in fact the methodology is applied and some experience we have to date, and Paul Gnirk is going to take that methodology and essentially walk through

examples of how this has been applied to get to these ranked options.

So after one, two, three, we'll address general questions about the study as a whole. Let me introduce then, Al Stevens and we will proceed.

CHAIRMAN DEERE: We'll take an coffee break first.

(Brief recess)

CHAIRMAN DEERE: Sorry for the early coffee break.

MR. STEVENS: I think Tom has stolen a lot of the thunder from the discussion I was going to have. I appreciated that discussion.

Let me start off by just apologizing to you for my gruff voice. I've had a bronchitis problem for some time. Three weeks ago the doctor gave me a bunch of pills and told me I was getting better, unfortunately he gave me pills that cured the problem at a fly swatter rage and I would really have preferred the sledgehammer rage. So I'm still suffering a little bit from a gruff throat and will periodically cough.

In looking at this slide, I'm always attentive to the formalism that accrues to these announcements. Now you know why I go by Al.

Tom used this figure as kind of a road map and

told you that I would be talking about a number of things. I want to spend some time now on the matter of requirements.

The vuegraph that he showed you earlier, he touched on 10 C.F.R. 60, the 30 C.F.R. 57, the MSHA requirements, and a few others. In fact, we have looked at many requirements. I can guarantee you that the list here is pretty long.

In fact, he mentioned a number of 2500. There's a little bit of inflation in there in that we have taken a number of those requirements you saw on the previous vuegraph and in our requirements documents, the ESF requirements document, we have allocated those requirements to the subsystem of ESF and that has inflated them some.

However, about 250 of these were determined to be discriminatory and let me explain what I mean by that. I'll use 10 C.F.R. 60 as the example.

In previous discussions between DOE and the NRC, there has been some agreement that of all the requirements in 10 C.F.R. 60, 57 of them are of concern to the ESF. Some of those are what I would call procedural. One of them, for instance, is the development of SCP to describe the plan for conducting the tests, as a basis for conducting the tests in the

ESF.

That, procedurally, is applicable to all of these options that we will consider and the procedural act of preparing and submitting the SCP in and of itself is -- we don't expect that to help us discriminate between options.

So, while that requirement is very applicable, it is not one that will help us discriminate. So we found it important that we go through all of those requirements and decide which ones will be strong discriminators, which might be on the fence, and which would not be strong discriminators.

We have done that and I won't belabor that with you today but that has been done.

I will spend a little time now on this third bullet to tell you how we are cross-correlating these requirements with the influence diagrams. I'll turn again to 10 C.F.R. 60.

I will start with this influence diagram and you'll see a much broader set of these in Paul Gnirk's talk. This one I want to use as the example of where we hang some requirements on particular bubbles here.

This is an influence diagram that comes out of the testing area. I doubt you can read these little tiny words at the top but the top level says, "The likelihood

of accepting a site that is not okay," and that's one of the assessments that will take place to establish that likelihood for each option. There will be much discussion about that later and I'll let Lee and Paul carry that weight.

What I want to point to is two of these bubbles here, number 13 and number 15, to point to those factors. Sometimes we talk in the vernacular -- bubble -- that is the statement of factor that will influence the determination or the estimation of that likelihood.

Here I've shown you one of the requirements, 10 C.F.R. 60, 15(c)(3) which requires that "exploratory boreholes and shafts in the geologic repository operations area are to be located where other shaft pillars are planned."

We took that and applied or connect that with various of the factors on influence diagrams. The influence diagram I had on the board is this one right here, the likelihood of accepting a not okay site. If you would take out your pencil and scratch that word "at" out of there, I'd really appreciate it. Sometimes in the rush of getting these vuegraphs together, little things like that sneak through.

On that influence diagram, factors 15 and 13 are the ones to which we have attached this requirement.

As you read on the previous vuegraph, 15 had a title of "Shaft/Ramp Numbers and Locations," and 13 had the title "Inadequate Physical Space."

All of this says that one of the factors that might adversely impact getting information out of that site is that we don't locate the shafts and ramps properly and have the right number, and that we don't leave physical space sufficient for doing the testing, for instance, at the main test level.

My point in showing you this information is to show how a particularly 10 C.F.R. 60 requirement is attached not only to this influence diagram, but the other one of the two that come to play in the testing as well as a post closure performance influence diagram, the nonradiological worker health and safety influence diagram, radiological public health, radiological worker health, and ESF cost -- I apologize for these editorial changes.

My point is that factor comes to play in a number of these. The reason for doing this cross-correlation is to make available to each panel member as he comes to the panel meeting for scoring on whichever one of these influence diagram, the fact that one of the factors he needs to pay attention to is this 10 C.F.R. 60 requirement.

So that's part of the backup information.

That kind of correlation will be made -- I won't go through these next two. They are just continued examples of that.

The objective is that when the panel members come to that process of scoring that they have armed with them all of the reference information and related information appropriate to help them understand all the matters that bear on the individual factors.

The next three vuegraphs here are again somewhat repetitious of what Tom stated. In addition to the requirements, the concerns of not only ourselves, as you've expressed them to us in earlier settings, but also in your report to Congress, the concerns of the NRC as expressed in meetings with them and in their site characterization analysis, and the concerns of the State of Nevada as they have expressed them to us, are all accounted for here and are attached.

Primarily -- in the case of the NRC -- they come in through 10 C.F.R. 60 and in terms of the Board's concerns, those factors will show up in the influence diagrams that you see as pointed factors that need to be paid attention to.

I think I said those kinds of things back in early April, so this is a bit repetitious.

This vuegraph expresses a concern that's been made to us. Basically, why don't we approach this process by looking at each one of the options on a feature and then decide which features are best, and then put those all together to make one preferred option?

We, in fact, looked at that pretty carefully and concluded that the particular design features or factors are not independent. An access feature, for instance, has a number of impacts -- schedules, testing opportunity and so on.

Because of that lack of independence, you can't evaluate them separately and linearly add them. So it's necessary for us to put them together as part of a broader option and evaluate them in that manner and head for the preferred option through that path.

That question had come up and I wanted to address it with you and that assertion here.

The other factor having to do with requirements is basically testing requirements. There was some considerable discussion earlier during Tom's talk, and I don't want to belabor that much more, but I want to give you the benefit of some notes that I had written to myself earlier.

I went back to a look at the 35 tests that exists in the SCP. Of those, 14 have some bearing on the

construction phase. The other 21 are all at the main test level. Primarily they are of the rock mechanics nature and don't really impact from the standpoint of interference between construction and testing, really don't bear on it.

Of that 14, six are primarily hydrology. The other eight are conversions tests, overcoring to look at in situ stresses.

In our process of establishing the sequence of testing and construction, be it down a shaft or down a ramp, we have paid primarily the strongest attention to the hydrology questions.

What we have not done, as stated earlier, we haven't weighed those tests against surface-based tests addressing the same information, nor the Calico Hills tests. That, we have yet to do.

The impact on our process here then is that we will be addressing the flexibility to do those tests, do them all, and I will be identifying the construction time separate from the testing time and all those accesses, and have that separate information so when we get done, we will pick a preferred option that will allow all that work to be done.

Perhaps before we get to the design phase, we will come back and prioritize that.

MR. LANGMUIR: Will you have the panel experts in hydrology, rock mechanics and so on involved in those decisions of what to prioritize?

MR. STEVENS: I expect we will, but --

MR. HUNTER: During this study where we actually go through and evaluate the testing effectiveness?

MR. LANGMUIR: No. You said, for example, you're going to maintain priority to all hydrologic tests as a group, but you're presumably going to have to go within them and select from among them the most important tests from top to bottom, from the top of the system down through the Calico Hills.

MR. HUNTER: I was merely clarifying whether you meant when DOE does its broader prioritization program or in the ESF study we look at evaluating the suite of tests.

MR. LANGMUIR: I'm talking about right here.

MR. HUNTER: Within this study?

MR. LANGMUIR: Yes.

MR. HUNTER: Okay.

MR. PETRIE: Within this study, they will not be prioritizing the tests with respect to how they affect suitability. We do expect that prioritization to be accomplished before any construction starts.

MR. BROCOUM: It's the only way to stay more or less on schedule. I think Tom said earlier that we would prioritize during the design phase. I think at that point, we will decide how we'll do it but it seems to me the reasonable way is to get all the specific experts together to help us prioritize and then factor into the design.

We have about a year and a half from start of design to the start of construction to accomplish that.

MR. HUNTER: I was merely trying to clarify the question.

MR. LANGMUIR: That's fine.

MR. STEVENS: Now, let me turn my attention to the discussion of the options. I want to refresh your memory on the process we have gone through. Tom did that a bit with a vuegraph.

The next vuegraph in my cycle, you'll recall this figure from my April 7 discussion where we took the historical options for the ESF and for the repository, and some new options that were developed in response to the requirements and their concerns, which put those through a screening process using some key requirements as the basis for that screening and developed a set of 17 which are now headed toward this evaluation.

Those options at that point did not have any

indication of the Calico Hills access in them. What we have done between now and then is to add the Calico Hills' access and drifting into those figures, so I will soon launch into a look at those options and some of it will be old hat to you, but the Calico Hills' addition will be new.

The next vuegraph is one that Tom showed you and stating that we did get to 17 options. I want not to go through all of those figures, all of those 17 options at all. I just don't want to do that. I expect that most of you are familiar with that from the meeting in April.

What I do want to point out here is that you have this figure in your notebooks with the Calico Hills in addition. I want to just draw attention to this level of detail at this point.

Behind all those figures is that magic table, that big table of all of the options. You might desire to pull that up. This one talks about Option A1. The left column has numbers 1 through 17. That's the simple and straightforward look at it. It doesn't have all the code in it that those of us working this use.

We used the second columns, the A's, B's and C's in our process and there's a code in that. A is the code which says that those configurations are developed

by conventional methods. As we discussed in the past, conventional means drill and blast.

There's a little bit more to that code than just that. It basically harkens back to the repository configuration that exists in the SCP, Chapter 6 and its reference document, the Conceptual Design Report, where the development of the repository was in kind of the clockwise direction around here.

Two panels would be developed to start with and then as the mining development advanced to the third panel, emplacement would start in the first panel. That two steps ahead, development emplacement cycle just proceeded on around this whole block over the operational life of the repository.

That kind of a layout puts some pressures or was the basis for the numbers of openings that existed. If you look at that final wrap-up table, the righthand column has the number of openings that existed. So there is some rationale for having that information in there as a basis for comparison.

That gets back to the point Tom made earlier, while we are not at this time going to establish what the repository configuration is, we must consider various options for that repository so we know what the necessary number of openings might be and pick a subset of those

for use in the ESF. There's the motivation.

The set of options starting with B, are all mechanically mined and by and large there, the mechanical mining proceeds back and forth across the whole block and it is advanced retreat mining, if you will, with advanced emplacement behind it. The whole thing marches across this way.

If you look at those figures, you will see such emplacement drifts going all the way across. So that's the basis for the B configuration.

The C configuration, as you look at them, they look like quite a different cat. In point of fact, on the figures you have, the Ghost Dance Fault is shown there and the C configuration, by and large, leaves us the opportunity of developing blocks of territory that are on one side or the other of that fault, not putting the repository across it.

Furthermore, it develops the mechanically-mined layout in such a way that because this slopes upward from this end to this end -- if you take a crosscut through here from east to west, you see that -- and it slopes up quite a bit.

The A&E's developed the techniques for steps in the repository configuration so that each one of those blocks is much more horizontal, much flatter.

Operationally, it has some real advantages. From the standpoint of those structural features, it may have some advantage too.

So those are some of the facets of the various options that we have to look at. I hope to just motivate that from using this figure only. I would be happy to -- I would prefer because I want to go through the total set of figures there now just one after another.

My motivation here is to bring you all up to speed on what that notation means, some of the factors. What we have in those options is a different variety of accesses. This one shows one shaft and one ramp. The dotted line means that one was either the ramp for bringing the waste in and the subsequent repository operation.

You will see a variety then of locations of the ESF, a variety, two. Either the main test level is laid out in a rather large, dedicated area on this end or it's down at this end, or in some cases, where there is access, both at this end and this end you have the center drift which is a potential area also.

I don't know that there is a whole lot more to say about this except after these were prepared in my own lack of giving some directions here, you'll note that on each one of these it talks about intersecting the drill

hole wash structure -- if there is some structure there -- drifting down to the embrocate fault area, and as it is shown here, it intersects the Ghost Dance Fault at least once.

We also have plans to come out here and intersect the Ghost Dance Fault, I believe, and that's not shown on any of these figures, but there is that opportunity for at least intercepting the Ghost Dance Fault twice. You'll see that opportunity more than once in the subsequent configurations which show the Calico Hills.

You heard yesterday that the Calico Hills passed us the recommendation of either their Strategy 2 or 5. Their Strategy 2 looks like that. It had an access on the northeast end and a good deal of drifting in the Calico Hills area. The subsequent figures that I show you will have those structural features shown on there.

What I want to do is get to the combination of this information and what I just showed you which you have -- at least the people around the table with big notebooks have -- in colored pictures and probably really show things a lot better than the little bit we colored.

If I take that now and overlay this on it, that gives the picture you have in your notebook. So what we

have then -- this shows only one access down here. In the notebook, you'll find double access. But I hope to have done now is to motivate how we got from where we were in April to where we are now.

Very simply, I've shown you one access, just an extension of this shaft down to this level. If I go to another option which has an access to the south end in that same block -- that's our Option B-4 -- there's that drifting that's going back and forth in this "B" mode in the repository.

If I take that, if I look at the Strategy 2 that was given to us, which had one access at this end, same layout in the Calico Hills, and I overlay that onto B-4, I get that. So what I'm showing you is how we have gone ahead and developed this.

These two are pretty simple. There are other cases where this Strategy 2 with this one access all the way from the surface didn't really match, so we had to work somehow to get from the Topapah Springs level down to here.

Have I motivated that sufficiently so you see how that's done?

MR. HUNTER: Al, just a point. We were given 2 or 5 with no preference between the two, so basically in all cases, we took whichever of those would fit, and

basically all amounted to the same thing at the Calico Hills level anyway. So they actually fit pretty nicely with the layouts that we have.

CHAIRMAN DEERE: Incidently, these drawings are very, very clear, beautiful.

MR. STEVENS: No credit to me. That's our friends at F&S, Fenix & Scisson that did that. You guys can take the bow. There are just a lot of people that have been really working hard. These figures are just one indication of that, Dr. Deere.

What I would like to do now is step through each one of these if that's your desire. I can do one after the other. They will offer some opportunity for questions, I would entertain those, and I will probably say help to some of my friends in the group here.

Base case, here you see right off that we now have two accesses from the main test level down to Calico Hills. We think that's in keeping with the requirements of 30 C.F.R. 57, MSHA requirements.

In this case, that table will show you that the base case has 12 foot shafts. This shows now the access out to the embrocate fault loan. It doesn't quite make it with this Ghost Dance Fault but there is potential for drifting across that end, and to the drillhole wash, and that same opportunity down at this level.

In the passoff to us yesterday, you heard words that said a minimum of 12,000 feet of drifting. When we went about doing this, it comes out to about 19,000 feet. That is there in all cases.

MR. McFARLAND: Al, terminology. Base case, you mean a baseline that you would be working from?

MR. STEVENS: Let me explain that base case. The base case was essentially our starting point for this study. The base case really amounted to the design of the repository that existed in the SCP or the associated conceptual design report, the large report, and the layout of the ESF and the shafts that reflected the adjustments or changes that had been made to the ESF in response to comments from primarily the NRC, but also concerns within the Department.

In point of fact, the SCP showed in Chapter 6 a 12-foot shaft and a 6-foot raise bore. Back in Section 8.4 of that same document, with proper attention to referring back to Chapter 6 but in 8.4, it had two 12-foot shafts which reflects a natural evolution of designs.

Those shafts had been located in a location outside of the potential flood plain and that was a point of concern. The extent of the main test level had been broadened to be absolutely sure that we had no test to

test or test the construction interferences, the sure quality data, a number of such responses like that, so it was not the SCP design, it was the SCP repository with an improved ESF.

MR. REITER: Is that modified Title II? Is that what you called modified Title II?

MR. HUNTER: Yes, we use that word, modified Title 2.

MR. REITER: Is that what is equivalent to that?

MR. HUNTER: Yes.

MR. ALLEN: Our diagram is somewhat different from this. Is this a modification or just a difference in alignment in the way the thing was xeroxed?

MR. McFARLAND: We show another drift through Ghost Dance, for example.

MR. STEVENS: At which level?

MR. ALLEN: At both levels and that lower level, the configuration is somewhat different but it may be a problem in the way the things were aligned in the xerox machine.

MR. STEVENS: May I look at your's for a moment? I'm going to holler, help. Bill?

MR. KENNEDY: Al, I think what you got is a little bit earlier version than what is showing on the

vuegraph.

MR. STEVENS: Do I need to fold up this and move over to -- thank you for pointing that out.

I think I've said all want to say about this phase. In point of fact, we expect the evaluations of this one to show that these 12-foot diameter shafts will not support all of the drifting; it will be ventilation limited.

MR. McFARLAND: What is the relative amount of drifting in the repository level versus the Calico Hills?

MR. STEVENS: The groundrules that we've had in terms of testing requirements for drifting to the major features, as that we impose load on the accesses, is that we want to be able to support 10,000 feet of drifting.

MR. HUNTER: In the repository level?

MR. STEVENS: At the repository level and 19,000 down here, the addition of the Calico Hills exploration has a significant impact on that part of the whole design.

Configuration A-1 is number two in your lefthand column, and is very much like the other one except the access to the main test level is one shaft and one ramp. It's a tough ramp which has a pretty good slope to it and therefore, the second access down to the Calico Hills is a shaft which I believe is supposed to be

constructed by raised board? Yes. You see some of a little bit of that ramp down there.

MR. McFARLAND: Your upper configuration would have that drift into the Ghost Dance?

MR. STEVENS: Yes.

MR. McFARLAND: You mentioned earlier?

MR. STEVENS: Yes. I apologize for that. That drift should always show access to the Ghost Dance Fault there. The dashed line says that the access down here is quite a ways away, but the capability to drift down to that second access to Ghost Dance Fault is indeed there in terms of ventilation support.

Recall that all of the A series are constructed by the drill and blast technique.

This one is A-2, essentially identical to the base case but with 16-foot shafts.

MR. HUNTER: Al, could you comment on the gut feeling about affecting this as a bigger shaft?

MR. STEVENS: Even the 16 footers will find some burden in maintaining the ventilation requirements I believe for simultaneous work at all levels. Is that a fair assessment Bill?

MR. KENNEDY: Those calculations are going on right now. (Inaudible - response from audience)

MR. STEVENS: Please read Bill's comments to

say that we are in the process of assembling supporting data sheets, we call them, which have a complete description in them of just such matters as that, information to be readily available to the assessment panels as they evaluate these options.

MR. REITER: Al, maybe I missed this, but why is it when you have the ramp in A-1, there is no drift to the Calico Hills?

MR. STEVENS: There should be. Let me do it this way. Let me get a black pen and cure that problem. It is true in all cases, that there will be such a drift.

MR. REITER: I said Ghost Dance, I'm sorry.

MR. STEVENS: You were referring to the one at the repository level?

MR. REITER: Yes, I'm sorry.

MR. STEVENS: In all cases. You don't see that on your figures but it should be there.

A-4 is an option that may address some of these questions of haste in getting down to the Calico Hills level while still leaving the opportunity to do some deliberate testing along the way as we come down from the surface.

By that, I mean this one has three accesses. You can roar down to them and then do your deliberate testing in the third one. That may offer some

significant advantages.

I'm not sure that there will be a good deal of value to this third drift that goes from the main test level down to Calico Hills but that will be a factor evaluated in the process.

Here is a figure that shows the ESF main test level in the south end with a ramp and shaft down at that end, and the comparative accesses to the Calico Hills being from that same end. That offers us the opportunity to assess the merits of this testing down at this end as compared to up here and look at both the benefits and penalty for having the accesses down at this end.

Let me give you a little hint on that matter. This configuration would put a head frame pretty much up on the ridge. Lest you think that influence diagram having to do with aesthetics is irrelevant, in point of fact we believe it's important to the Department to deal with the matter of the public reception of having not only that head frame up there where it would be visible, but in some nice, cool, winter morning when the vapor is coming out, you'll have a plume, I suspect and the public might find some value in not having that at that location.

So those are matters that we need to pay attention to and I hope in these words I've motivated

some of the reasons for our rather broad look at this whole matter.

We've had some folks pick on us a little bit for looking at some irrelevant things but I think, at least from past interaction that the DOE has been through, those are not irrelevant.

Here now is another option which shows a ramp going down to the Calico Hills, basically a two ramp access to the main test level and then an extension on down the shaft and a ramp to get to Calico Hills, again, part of the various options, features for evaluation.

MR. PRICE: Does that ramp intersect Solitario Fault or is that just the way it looks?

MR. STEVENS: No. Solitario Fault is out to the west. Drawing in isometric will do these things to you. The distance from this ramp over to that fault is actually quite a ways.

This is B now, a configuration of one shaft and one ramp access and to the shaft's raise board going on down. From the standpoint of configuration, just plainly looking at it like this, it doesn't look much different from one of those in configuration A, except that the repository interfacing with it is different now, this being of the B category.

The next four of them -- B-3, Rev 3, 4, 5 and 6

-- are the same configuration and it is this set of five where we look at the different mechanical means of constructing the shaft -- drill and blast, raise bore, blind boring, shaft boring machine, and V mole.

If you go back to the sequence of screening and establishing the 17 options, it was expansion of that option to consider each one of those mechanical means that evolved from the screening and review process.

Unless there are questions, I will just get through that set.

MR. McFARLAND: Al, a point of curiosity, maybe terminology. What is the difference between the shaft boring machine and blind boring machine?

MR. HUNTER: Blind bore, we use a surface drilling rig.

MR. McFARLAND: You mean a large hole drill?

MR. HUNTER: Large hole drill, yes.

MR. McFARLAND: You mean the shaft boring machine is a blind?

MR. HUNTER: Yes, that's right.

MR. STEVENS: We don't give much credibility, at this point, to the large hole drilling because of the necessary liquid involved. Nevertheless, we wanted that in our database.

The configuration you've seen where the access

is at this end and coming down and in this case, mated with a B configuration repository.

This one has the feature of access at each end and the ramp from one end or the other, both at this level and at this level and questions of sequencing of that both to get down there and to make contact to establish the complete ventilation.

It's not clear to me and some of the others where we access the Calico Hills from one end just one kind of practical complications that's going to have on us in terms of drifting all the way to the other end.

MR. McFARLAND: Al, in response to your comment on the sensitivity of the configuration to the 10 C.F.R. 6015(c)(3), which is preferential path, can any of these configurations be modified such that you have no vertical access on the block to Calico Hills but a drift into the Calico Hills from off the block or drift, as you've shown here -- to drifts -- as opposed to a drift and a shaft?

MR. STEVENS: At this point, one of our configurations show two ramps into the Calico Hills. As part of the evaluation process, that may be one of the factors that we're called upon to pay attention to, as Tom alluded to, in establishing that final recommended configuration is something we need to pay attention to in this methodology.

MR. HUNTER: Russ, this option I think is the only one that eliminates any critical pathway to the surface. It does not eliminate between the two levels.

MR. PRICE: Does that ramp intersect the drill hole wash fault? It starts to the right of it above and then goes down to it?

MR. STEVENS: There is an access at this level, the drill wash, and this would access it down to this level also, if indeed there is that feature down there. I don't think that's as sure of a matter as Ghost Dance is.

Again, it turns out the features at these two levels are quite similar to what you've seen before. In this case, this access goes out into Solitario Canyon. That makes this configuration markedly different than anything else.

All other configurations have this facility out on the other end. This would put a wastepile out in Solitario Canyon.

MR. ALLEN: But is there any configuration where the waste ramp goes in the other direction?

MR. STEVENS: No.

MR. ALLEN: That's been ruled out.

MR. HUNTER: It could be done in the final design. You're concerned with Midway Valley questions? Yes, it could be done in the final design.

MR. REITER: Al, your example of the three cars in the beginning, you said you might get three options and you said you picked the Toyota with the electric windshielf wipers. In that case, the choice of windshield wipers is independent of the car that you get.

Al indicated earlier that these options, the various ways you configure these options, the elements, were not necessarily independent, and that you had one option that wasn't necessarily the same.

You didn't pursue a feature-oriented evaluation alone. You had to look at it in the context of options. There's a little difference from your car, but now, and I want to make sure, you indicated that will there be a capability of looking at -- does the fact that the features are not independent of the option prevent you, in the end, from coming up with an option which is made up in such a way that you don't see here?

MR. HUNTER: That was really the point of my one slide and the little analogy which I used towards cars because some method of rolling down the windows is required in every car, and you can only test drive a car.

Basically, what I was trying to indicate is every option is complete and incorporates the features. We recognize at the end of our evaluation, we can look at what we've learned about the importance of those features

and if necessary reconfigure an option with those desirable features. That's what that last phase on the chart is.

MR. REITER: Even though the features are not independent?

MR. HUNTER: Right.

MR. STEVENS: Now, I want to say a few words here at the risk of being totally wrong looking at Lee, but I think the facts are that since we do not have independent measures influence diagrams for all these features, any construct of a subsequent option or alternate configuration will have to be based on a judgment of people involved in this process, if the case evolved that we would run that constructed option back through the same process.

MR. MERKHOFER: That's correct, Al. In fact, the flow chart Tom showed that indicated the sequence of steps has a dashed line from a box that we call methodology to the step that you're talking about to indicate that it may not be just a simple matter of combining some features.

What we will have to do in addition is mostly likely actually run the methodology again to verify that particular combination of features is in fact a good one.

MR. REITER: It's like an iterative process,

but you're not limited by the fact that they are not independent. You have a way of overcoming that?

MR. MERKHOFER: Absolutely correct.

MR. HUNTER: And you may be able to do it with a limited number of factors, if that's what your evaluations tell you.

MR. STEVENS: Now I want to step to the set of options starting with C. There I said some words earlier which indicated that the layout of the repository was such that the repository was laid out in horizontal or level blocks of positions such that in spite of this configuration, I think at the outset we had this, if I'm correct -- Dick Herrig -- none of these blocks laying across the Ghost Dance Fault?

MR. HERRIG: That's correct.

MR. STEVENS: That has some advantages. It has some operational advantages in the more horizontal configuration from the standpoint of mechanically mining these levels. It gets us out of the standoff problem of placement holes relative to that drift if we can just stay away from it so to speak in the total block, and offers us some different looks on access.

We'll find, in your previous information, that the main test level may be proposed as two test levels. There's both good and bad news there -- an opportunity to

look at more of the emplacement horizon but also a call for some more tests which we may not want to run in a duplicative way.

This configuration shows the raised board shaft down to this level from that. I don't think that any of these show drifts on down to that level. It's not clear to me at this point why one or the other of these C's was not accessed by a ramp. Can you clear me on that, Bill Kennedy?

MR. KENNEDY: Well, we took the same approach that we did in some of the other options. We took the first access to Calico Hills would be provided by extending the shafts -- and the second access would provide raised boring -- shaft backup between levels.

In that regard, it's similar to Option 8.1 and many of the others.

MR. STEVENS: Okay. That may be another feature that we would want to consider in the alternative.

This C-4 is very much like C-1 except the southern location as opposed to the northeastern location.

Finally, back to a number which doesn't fit any of the ABC's, it's called R-11. That is the one option, older historical option, that has made it through our

screening process.

This looked very much like the B set. In other words, it's a TVM layout completely for the repository and the advanced mining all the way across with the follow-on emplacement. This, as I pointed out, is the one total option that made it through that original screening process from the historical set, that plus the base case.

I've walked through these giving you time to kind of follow them with your eyes. I don't know whether you have any questions that you'd like to talk through at this point or not.

You heard most of this discussion in April but without the Calico Hills addition. It's a fairly lengthy set of options to have to put through the methodology. We have sorely tried our consultants' patience with us.

The scoring process is going to be long and laborious with this number of options. Any questions I can field?

CHAIRMAN DEERE: Perhaps a comment and maybe there's a question that goes with it.

The Board has looked at two or three possibilities on their own and I just have had an opportunity to speak with two or three outside people from the Board about this possibility.

It would appear that within the design phase, once you have a selected option, we can do certain things around a shaft or around a Tuff (ph) that will allow you to accomplish some prioritization or perhaps more comprehensive testing, or more comprehensive looks at certain things.

I would agree they would probably be at the design stage where you're looking at your preferred option and then sort of tailor that a little bit to maybe get more information probably at a little bit greater cost.

MR. STEVENS: I will get to the point just a little bit later, Dr. Deere, when I come to the matter of supporting data for use by the evaluation team, but I attempted in each case here to -- well, let me be much more specific.

The formal, dedicated testing area, defined testing area, for that subset of the 35 that will be done at the main test level really constitutes a relatively small proportion of the total dedicated testing area available. That comes under the word flexibility.

We've got room to do a lot more tests at that level or in particular at this point.

The question of the tradeoff of tests in the accesses, be they shafts or ramps, is something that we

will investigate.

MR. PETRIE: Just a minute, Al. Did you get your question answered, Dr. Deere?

CHAIRMAN DEERE: I think so. I had spoken very briefly with Tom about it and he sort of nodded his head.

MR. PETRIE: The answer is yes, we concur with what you said.

CHAIRMAN DEERE: Yes, I think so. The question that came to my mind is, is there an additional option that should be thrown in and looking at the presentations you have made, the feeling I had that the concerns that we have be able to fit the variety of options that are there, so it could be handled in a design phase, I think.

MR. HUNTER: I think a couple of summary points. At a minimum, all the 17 you've seen seem to intercept the Ghost Dance Fault on the order of five or six times at two levels and provide on the order of 30,000 feet of drifting in all cases which at first blush, is a difference than what was described, so you can see the impact already of the subsequent evaluations.

MR. CORDING: That seems to me to be very important. The key thing is explorations and exploration facilities, you need to get across significant blocks of the fault in order to do that. I think that's key.

The concentrated tests at one location can be

useful but to me they are not the first priority as getting across the site and seeing what the features are and what their hydrologic characteristics are throughout large reaches of the site.

In some cases, are the tests being performed in the concentrated block, for example, are they being used to try to understand basic phenomena or to characterize the site? To some extent we will be learning more things about the basic phenomena like heater characteristics of the rock and all that.

It seems to me if we have a lack of understanding of the basic phenomena we ought to be doing that work as much as possible before we get in there so that most of what's done underground is characterizing the site, not trying to figure out what's really going on with certain basic phenomena.

Characterization of the site seems to me to be obviously where we should be going and significant horizontal drifting to get to these features is something as we see it developing here is very good to see.

MR. BERNARD: Al, in that slide there where you show Option C, you have an upper and lower block. What's the vertical distance between the two blocks?

MR. STEVENS: Help.

MR. KENNEDY: About 300 to 350 feet.

MR. McFARLAND: In trying to back off so that the third party understands, which this whole process eventually go out and trying to simplify, I'm trying to understand the need for these 17 options.

Let me hypothesize that if our difference of opinion, our concepts on the mapping was not there; if, for example, USGS came in and said, I need a couple of discrete sites to do this mapping and how I get that three dimensional is not an issue, would the distinction between mechanical and drill and blast disappear? Could you eliminate seven options by eliminating that distinction between mechanical and drill and blast which I believe is three dimensional mapping?

MR. STEVENS: Certainly, the difference in time to get from top to bottom, the differences there would show up.

MR. McFARLAND: But you would still carry 14 options which are identical except by the method of construction, seven mechanical, seven are drill and blast, A and B. Your only distinction with A and B is method of construction and I'm guessing that distinction is brought about by the mapping issue, if the mapping issue was not there, could you eliminate seven options?

MR. STEVENS: I don't think so for a variety of reasons. One is the numbers of accesses as appear to the

repository differ --

MR. McFARLAND: Between A and B?

MR. STEVENS: Yes. I believe that's true. If you look in that table to the right, I think that's the case.

MR. HUNTER: Could you clarify whether the difference in A and B is construction method alone first?

MR. STEVENS: That's the principal difference. Dick?

MR HERRIG: That's the fundamental difference. There's a fundamental difference. The A case, your mine development is counterclockwise and you're developing along and coming around, so from the standpoint of flexibility, there's a difference.

In the B case, as you develop across the entire block, in advanced case, when you've done that in the northern corridor, you've kind of blocked yourself in from any flexibility of going to the north farther.

So there is a distinct advantage in the clockwise development rotation.

MR. McFARLAND: Is this the development of the repository?

MR. HERRIG: Yes.

MR. STEVENS: Which is not the principal concern here.

MR. HERRIG: Not principal concern but there is another difference, Russ, between the two methods, not just the mechanical --

MR. McFARLAND: I understand. Then the A case is the mechanical development of the repository and B case -- A is drill and blast development of the repository and B is mechanical development of the repository, and in the ESF.

Do you feel that a drill and blast development of the repository is a real option?

MR. HERRIG: Yes.

MR. McFARLAND: Fine.

MR. HUNTER: To clarify Russ' question a little further, then the second question is the drift law mapping question, the principal question on construction method.

MR. McFARLAND: Exactly.

MR. STEVENS: The answer to that is as it stands right today, that is the principal difference. However, we're attacking that question also. There is a meeting to be held next week to address that.

From the standpoint of methodology, and our QA records and so on are following the game plan that we have set out. It would probably be less of a burden on us to proceed treating all those than it would be to

change direction and throw some of them out.

CHAIRMAN DEERE: Yes. I think I would like to take a minute, if I could, Tom, and just mention the possibility that we would be proposing to look at during your design -- a possibility.

Could we go back to your Option C-1 as an example. This would be a good one, I think.

Here we have the access by the ramp, plus one shaft, is that correct?

MR. STEVENS: Yes.

CHAIRMAN DEERE: In order to give highest priority to hydrogeology and access for geochemistry, if the shaft is being sunk, and say for instance, by blasting, the boring that would be put down first in the area of the shaft which would determine very nicely for you the stratography, would probably show you also the strata in which you would like to have your best joint information and a horizontal picture of it.

So, a possibility would be to sink it by any method you wish but at a given depth, say 200 feet, to stop, bring in a road header -- which is not a blasting method now -- drive across whether it's a 50 foot distance or whether it's 150 foot, would be a variable to be discussed.

What that does is give you a very early picture

of three dimensions of that first 200 feet. Then when you get in your 150 foot depth or 100 foot depth, let's say, you meet a 10 inch hole that has already been drilled from the surface. Since you have a hole there, obviously you bring in your raised boring head down the shaft, take it over the drift, put it on and in a day you have raise bored to the surface.

Now you have two shafts available, a cross cut between them. You have done all of the work in going horizontally with the road header or the boom cutter which we saw operating in the G tunnel; you have a raised bored surface of any size you want within reason. It doesn't have to be the kind a fellow saw in Mexico that I think was only about 6 feet across; it can easily be 10 or 12 feet, whatever would be appropriate.

Then, after the muck is brought out from the bottom of that shaft, it's just following down across the crosscut and up the shaft, then the shaft goes on again and that shaft can go for 200 or 300 more feet by whatever method is employed.

Meanwhile, your geologists have an opportunity to map, to test, to drill, from the auxiliary shaft which is also a safety shaft if you wish, and some additional ventilation.

At a given depth, say 500 foot depth or

wherever they have found the candidate horizon or strata that they want to investigate, come out again and repeat the process.

In that way you have a definite set of stops which might be 6 weeks or something at predetermined depths, but I do believe that is something that could be worked into a design phase, but to me it would be a much more complete picture in the three dimensional case for the hydrogeology.

I would like to have this in the back of some peoples' minds when they are looking at this and discussing as what can be done with the one shaft configuration. What we are really trying to do is do a second shaft as a purely exploratory tool in conjunction with the other shaft.

It's more expensive but maybe the additional information would be considerable.

MR. PETRIE: There's no doubt in my mind that these things can be considered. We must keep in mind when we do these that we need traceability to the basis of these decisions and keep in mind the regulations associated with penetrations of the repository block, and continue to assure ourselves that we meet those regulations.

Consistent with that, certainly these things

can be considered during the design phase.

MR. HUNTER: It could be done as well in the Calico Hills.

CHAIRMAN DEERE: In the Calico Hills as well, yes.

MR. STEVENS: Unless there are further questions, let me get on --

MR. REITER: Just quickly. Are your C options predicated on finding a certain configuration or width of the Ghost Dance Fault? If I understand, the C configurations assume that you find the Ghost Dance Fault and want to break it up, is that correct?

MR. STEVENS: That we know where it is in depth so we can --

MR. REITER: You're breaking it up at various levels. Is that predicated on certain assumptions of what you're going to find there? Could this be thrown off if you find something radically different?

MR. STEVENS: I had another one on the vuegraph here. This configuration shows this drift running along here which would let us explore the influence of that feature out into the formation more or less all along it.

MR. HUNTER: I believe Leon's question was --

MR. STEVENS: I understand what he's asking, I think.

MR. HUNTER: Is there some criteria that we would have in terms of the value of Ghost Dance Fault which would lead to going to Option C?

MR. REITER: I just want to know is this thing predicated on one existing configuration or characterization of the Ghost Dance Fault, and if you went out there and found something different, this would really be altered?

MR. STEVENS: I think that the repository layout in this option could be moved around to accommodate whatever we found but this particular opportunity and this particular configuration affords the greatest opportunity to explore that all the way along.

The A and B configurations have the intent of crossing that in the total repository and then standing off from the fault in those access drifts by whatever distance is determined to be necessary.

The difference here is that this configuration using these blocks would a priori need to find out where that feature is and standoff in toto from it.

MR. HUNTER: I think this highlights the purpose of doing an event excavation because it's exactly the kind of thing you would do when you determined the characteristics of that fault, any concern you had with it and where it was at several levels. Then you would

design the repository around it, if that was a necessary thing to do.

MR. STEVENS: Let me step on through the rest of these.

Now we have some candidate options identified and we're heading into the evaluation process. I want to talk briefly about supporting evaluations or supporting information to carry into that evaluation process.

There will be a good deal of information put together by the A&E's and the test community to support each one of the options and you've seen some of the configurations here in isometric view. There are also being developed plan views of that, a good deal of information on the interface between the repository and ESF, more detailed ESF main test level layouts than you've seen here today, a look at the stratographic columns that will be cut by whatever access means is used and a description of the surface disturbances, the buildings, the muck pile and so on, that goes along with it.

All of that information will be used in the evaluation process. In addition, there are word descriptions about the ESF and the repository, details about the specific features that are being addressed, the accesses, the matters of constructability and operability

and selected quantitative values that will go along with that. I will give you some examples of that in a few moments.

A good deal of cost, schedule and staffing information, in particular the cost and schedule information on the ESF, the details of the construction times that re necessary, and the testing times that are necessary, and a breakout.

If it takes 150 days to construct and you intercept that construction by 300 or 400 days of testing, those will be broken out separately so that we understand what they are from the repository perspective. It's a simple total life cycle schedule and costs.

The data will be laid out in tabular form and some of this you see already on that one table of options from the ESF perspective, what are the two accesses. In one case, we have three accesses, where are they located, how are they constructed, what's their cross section? In the case of the ramp, what is the grade? That's a grade I don't know has been constructed before in the large way: the length of them and the function of that access.

Here I wanted to point out that the used area in that main test level is 853,000 square feet. The available area in the total area dedicated for such work is considerably larger than that, so there is room to do

that additional testing or whatever would come up.

Just some information on water and other materials usage for questions of what impacts those might have in terms of potential impact on waste isolation, for example, and a detailed breakout of the schedule, this shows it in bar chart form but the total construction time and testing time will be identified in number form to break those out for each one of the options.

I think the stack is probably on the order of an inch thick of supporting information for each one of those options that will be made available to the evaluation panel members, a good deal of information.

MR. ALLEN: Before we get too far away from it, could I come back for a moment to the question Leon just asked on a little different material?

Am I right in thinking that the C options where the fault is used to separate repository blocks at different levels and so forth, it has no advantage in terms of dealing with the fault over the A and B? In either case, you can step off just as far as you wish to?

The only advantage to the C option may be in the mining activity itself being on level plains, is that right? In either case, you can step away from the fault just as much as you wish to?

MR. STEVENS: Well, let's look at a B case.

There you see the emplacement drifts move back and forth across that, so each one of those drifts crosses that fault and the emplacement of the wastes in those drifts then will stand off from that fault some distance yet to be determined.

The difference between this configuration and the C configuration is that those emplacement drifts do not cross it in the C configuration. The blocks are all one one side or all on the other side of that major drift.

MR. ALLEN: So it entirely has to do with economics of the operation and so forth and nothing to do with the dealing with the fault itself?

MR. HUNTER: In the B case, there would be a drift which would connect with the emplacement drifts which did intersect the fault. If the fault were, say, a concern about flow in the fault, it would be in the manmade connection between the fault and the emplacement drift.

In the C option, you have the potential of avoiding that.

MR. CORDING: You're really trying to isolate the fault so the flow can't come to the canisters. In this option, you don't hit the canisters but there's a possibility that water could communicate?

MR. HUNTER: I wouldn't respond to that because I don't know if there is flow --

MR. CORDING: I'm saying if there were flow in that --

MR. REITER: Tom, the question was is that separate configuration somehow limited to what you can find in the fault -- if you find a wide embrocate zone of the Ghost Dance Fault, would that eliminate that option or eliminate --

MR. HUNTER: Eliminate C? I think how you actually do C, which is done years from now when and if you design the repository, would be done based on what you learn about that fault. So if you need a big offset, and you judge that to be the case, you would --

MR. REITER: The critical thing is you're not tied into some preconceived notion of what the Ghost Dance Fault is that you're going to find?

MR. HUNTER: That's correct.

MR. STEVENS: I think what I want to do here is not go through the rest of these slides but merely to point out that additional information will be provided to these panels which has been developed in the form of assessments of these repository or ESF features and their potential for impacting the ability of a site to isolate waste, 10 C.F.R. 121 evaluation --

MR. PETRIE: Al, I'd like to speak to Don and the Board. Do you want us to try to speed things up? Are you happy with the pace at which we're going? We are going to be a little bit late.

CHAIRMAN DEERE: Yes, I think we would like to try to get into the next talk this morning if we could, so maybe could speed this up a little bit now.

MR. STEVENS: I propose to just sum the final set of vuegraphs up here with just using this one to say that we've done some evaluations of the various features that show up in the options and will provide those assessments to those panel members. The panel members can use them in the process of evaluation in their estimation of the value of those factors for each of the options.

That is again part of the total package of information, that reference information, that Tom's talked about for each of the options.

I think I've probably taken enough of your time.

MR. HUNTER: Could I add two things for the record?

One is that in all cases at the repository level, the drifting does include going to the Ghost Dance Fault and we would like to reinsert our complementary

remarks for getting those vuegraphs ready on such notice to F&S.

The next speaker is Lee Merkhofer who will talk about the methodology development.

MR. PETRIE: Dr. Deere, this may well go into 1:00 or 1:30. Why don't you cut us off when you feel like it?

CHAIRMAN DEERE: Fine.

MR. HUNTER: For the panel, Lee's talk has two major components. Lee, is it conceivable to break for lunch at the break between the two components, between the pilot study and the methodology?

MR. MERKHOFER: Yes, absolutely. That's what I would suggest you do.

MR. HUNTER: Great.

MR. MERKHOFER: As Al indicated, I'm Lee Merkhofer. I'm associated with a company called Applied Decision Analyst, Inc., located in California. Lest there be any doubt after reading the name of our company, my area of specialty is decision analysis.

I'm one of two decision analysts from our company supporting this effort. The other is Phil Beckhew. Phil, could you raise your hand in case people want to ask you some questions?

As we just indicated, I've been tasked with

covering two topics. One is to give you an overview of the decision methodology and I'll try to go through that quickly right now. The second topic we can try to get to after lunch is a quick review of the pilot study that was a prelude to the development of the methodology.

In terms of the flow chart that we've already seen a couple of times, this initial topic will address this component which is one of the methodologies that's used in the study.

There are other methodologies, of course. For example, there was a methodology that was used to conduct the screening of options but the particular aspect of the methodology that I'll be talking about is the methodology that's used to take the candidate options, the 17 options Al just spoke about, and conduct a comparative evaluation that leads to the ranking of those options.

My overview of the methodology will address three topics. First, I'd like to say a little bit about what seemed to me to be the distinctive characteristics of the methodology. What I'll try to address are what is the distinctive feature of the methodology relative to the decision analysis methodologies that we heard about in the other studies yesterday, and then also, what some of the similarities are between the methodologies we use in here and the methods we heard about yesterday.

Secondly, I'd like to quickly outline what seemed to me to be some of the key concepts that are important to the understanding of the methodology and finally, I will outline the steps we are undertaking in order to develop and apply the methodology, the actual detail on where we are now, what specific aspects of the methodology we've already implemented, and the particular inputs we've already felt. Paul Gnirk will go into that in more detail after lunch.

With respect to some of the distinctive characteristics of the decision methodology, first of all, I think it's worth pointing out that the approach we've adopted involves explicit consideration of the impact of the ESF choice on several key downstream decisions and events.

Tom has already alluded to this to some extent. In thinking about the ESF option, we recognized very quickly was that particular choice, the choice of an ESF option, has a fairly broad range of implications. It's not simply limited to the issue of an assessment of what the releases would likely be from a repository at Yucca Mountain, but other issues as well, including more complex issues related to regulatory approval.

The ESF facility itself involves fairly significant physical changes at the site. We have to

address the implication of those changes in terms of such things as worker safety, environmental impact, costs, schedule and that sort of thing. So there's a wide range of impacts that we explicitly had to address.

The major effect of that, in terms of the methodology, is on the decision tree that we're using. As you'll see, when I display that decision tree, it involves a wider range of factors than were necessary to be looked at in the other studies that we talked about yesterday.

Secondly, as in the other studies, we are relying quite heavily on professional judgment to provide the basic inputs to this study, but I want to emphasize here informed professional judgment is something we feel is very, very important in our study.

Both Al and Tom have alluded to this already, the fact that in addition to taking a lot of care in selecting the participants so that their field of expertise match the particular types of questions that we need to have answered, in addition, those individuals are tasked with reviewing the information base that is provided to them and conducting appropriate analyses, runs of models and so forth so that they have the informational foundation to provide the informed judgments that we require as the inputs.

Extensive documentation of the process and we recognize the importance here of taking care not only to insure that the individuals who provide these judgments have the qualifications to do that, but that we have to document very carefully the reasoning that underlies those judgments and also the process by which those inputs and the analysis is conducted.

In addition to providing very detailed written descriptions of the logic underlying the various components of the analysis as Tom Hunter mentioned, we have a court reporter who is transcribing all of our meetings with our various panels and within the core group so that we have a thorough documentation of everything that goes on as part of the study.

MR. McFARLAND: Were these meetings ever advertised? Do you ever have observors at the meetings?

MR. MERKHOFER: Let me defer that question.

MR. PETRIE: The meetings themselves are not advertised in the sense that you're thinking of I'm sure. They are documented within the project.

MR. McFARLAND: You don't invite the State to watch?

MR. PETRIE: No. There are observors from other parts of the project who are independent of the actual work going on but again, I don't think that would

be in the sense that you're thinking of.

MR. McFARLAND: Thank you.

MR. MERKHOFER: The fourth key characteristic that I wanted to point out here is the use of formal decision analysis logic, very similar to the other studies with the addition that we are relying on an additional component or element of decision analysis, namely the use of what's called multiattribute utility analysis as a vehicle for dealing with the multiple objectives that are associated with the choice of ESF option, the multiple things we would like to try to accomplish.

Warner, yesterday, referred back to a study that I think most of you are aware of that was conducted around 1986 which evaluated alternative sites for the repository. That study incorporated or used MULTIAT utility analysis and in fact, we are borrowing a fair amount of the basic machinery of the analysis from that earlier study.

As some of you know, because I know some of you were involved in the National Academy of Science Board of Radioactive Waste Management Review of that application, the DOE asked the Academy to review the use of MULTIAT utility analysis.

The Academy, among other things, concluded that

they felt the use of MULTIAT utility analysis was a vehicle for accomplishing that part of the analysis dealing with the multiple objectives was an appropriate and useful way of addressing this kind of problem.

I guess it's also worth pointing out that the Academy also pointed out -- which we all feel very strongly about -- the decision analysis in general and the MULTIAT utility analysis in particular -- are a vehicle for aiding the decision-making process. This is not a methodology wherein we simply turn the crank and out pops the decision.

I'd like to address now some of the key concepts that are critical to the understanding of the methodology.

The first involves the overall philosophy or logic for the study and that logic involves two key phases or two key steps. The first is an effort to identify what possible end consequences are of selecting each of the ESF options.

I point out here that I've edited the slide a little bit to highlight what appears to me to be an important distinction between the two steps. The first one is to identify what the possible consequences are and to gain some understanding of how likely those various consequences are.

We have to worry about range of possible consequences and likelihood because of the uncertainty that's connected with the process. So the first component is essentially what you might call a consequence assessment where in we take as a given each one of the ESF options and then attempt to estimate as best we can what the end consequences of that choice might be.

The second step is an effort to determine how desirable these possible end consequences are or more specifically, these possible probability distributions on these sets of end consequences. So that's a desirability assessment.

That allows us to translate these estimates of what the consequences might be to some overall major of how desirable those consequences are and then how desirable that particular ESF option is.

I mention the editing here being motivated by the fact that this separation offers what I think is an important advantage to the methodology, namely this part of the effort, this consequence assessment, is primarily technical in nature. We need to rely on technical judgments or judgments of fact and information whereas this component of the analysis involves value judgments, judgments that are primarily policy type judgments.

This distinction has allowed us to basically organize the effort of the analysis in such a way that we rely upon technical groups to help us with this part of the analysis and we rely on DOE management or DOE policymakers to help us with this part of the analysis.

This separation is something that's been recommended by the National Academy of Science, the Environmental Protection Agency and others, so that's point one, the overall philosophy of the logic underlying the study.

The second key concept is the use of decision trees. You heard about decision trees probably more than you want by this point.

This particular decision tree happens to be the basic tree that we're using to represent the possibilities and the downstream decisions and events that are being considered in the study.

I should point out right away that this is about the simplest decision tree that we could construct that we felt captured the key elements of the problem, the factors that had to be addressed in the analysis.

Throughout this study we have tried to walk the line between the desire of keeping this whole methodology simple enough so it's understandable but at the same time, sufficiently comprehensive to capture those main

factors that might be affected or influenced by the ESF choice.

This is very definitely a gross simplification but our hope is that it captures enough of what's relevant here to allow us to reach some useful conclusions.

Again, a decision tree is basically a chronology and reads from left to right. The first thing that happens, according to our model here, is a choice from among the 17 ESF options. At that point or after those options have been implemented and testing is conducted, some results of testing occur.

We've represented those results in the simplest way that we could imagine. We said, in effect, that after ESF testing has been completed, the results of the tests have been analyzed, various performance assessments have been run, there will be a conclusion reached and that conclusion, in the simplest form, will be one of two things, either the conclusion that the site is effectively okay, or that it's not okay.

We have a precise definition of what we mean by that. Basically, by okay we mean that the best judgment is based on the information we collected, if we construct a repository at that site, it will meet the EPA performance standards.

So it's the same kind of plot that Bruce Judd was showing earlier wherein we looked at an assessment about what the certainty of a release would be and if those releases lie to the left of the requirement, the EPA requirement, then the conclusion would be that the site seems to be okay. It's okay to move to the next step.

Our notations with the quotes mean that's the result of testing, up over the top means the inverse, it's not okay. So the two possibilities are, it's okay to go to the next step; there's a problem with the site in which case we assume, further simplify the model, that in that the case, the site would be abandoned.

Following that, there are a number of regulatory authorization steps that are necessary. We basically lumped those and again, modeled this in a very simplified way.

We said that there are really two possibilities at this point, either regulatory approvals will be granted or they won't be granted. Again, the assumption is if they are not granted, the site will be abandoned.

At this point, the repository is constructed and operated. I've explicitly noted that in the tree to come back to a point that Tom Hunter made earlier and that is the connection, the assumed tie in this

evaluation between an ESF option and a repository configuration.

The selection of an ESF option constrains to some extent the repository design and certainly influences the kinds of repository configurations that seem most appropriate or most compatible.

The analysis that we're conducting assumes that for each option there is a particular repository configuration which is connected with that option which is described as part of the option which would be our best guess to what that subsequent choice would be.

That doesn't rule out, of course, the possibility that when you get to this point, other options may at that point seem superior but for the purpose of the analysis, the analysis assumes there was a particular repository configuration that is specified as part of each option.

Then finally, there is the uncertainty regarding whether the repository will in fact be closed. There is some possibility of course that it will be necessary to retrieve the wastes.

That like the other nodes and branches that are represented in the tree is something that potentially can be influenced or affected by the choice of the ESF option. So again, what we've attempted to do here is

include in our tree all of those major downstream decisions or events that are potentially affected by the choice of ESF options.

The other thing to point out, as I mentioned earlier the analysis is based on the idea of first estimating the consequences of the choice of each ESF option and in estimating those consequences, it's important to recognize the tree lays out a variety of different scenarios.

There is a scenario, of course, the one that we want is the top one here that leads to a closed and functioning repository, but the analysis also recognizes there are these other possibilities.

We need to be aware not only of the consequences that would be associated with each of these but also how the choice of the ESF option affects the probability of being on these various scenarios which lead to different kinds of consequences.

I mentioned that the methodology involves the use of Multiattribute Analysis or MUA. This slide is designed to give you a very quick introduction to what it is that MUA tries to do and what its role is in the evaluation.

It's purpose is to translate the various consequence estimates into a common measure of

desirability. It's technically in the literature, utility or UTILS.

While accounting for two important things, the two things that MUA attempts to account for is first the relative desirability of doing well versus poorly on a particular performance measure. I'll come back to that in a moment.

The second one is the relative importance of each of the performance measures. This one, I think is probably fairly intuitive. This one perhaps not so intuitive.

What we are doing here is again we have various consequence measures, things like a level of health and safety, a level of environmental impact, costs, and so forth.

When we define these measures, of course we try to define them in a reasonable way. We try to define a way of measuring the level of impact certainly so that a higher level of impact reflects a higher level of underdesirability or perhaps influence, so there is an ordering obviously that's important.

We don't know for sure when we define these measures that a unit change from say a very high level of adverse impact, say a 10 percent reduction of environmental impact, is just as desirable as a 10

percent reduction in the environmental impact from a relatively low value.

What I'm getting at here is we don't know for sure that these measures of impact have a linear relationship to a measure of desirability. We have to account for the fact that maybe on a defined 1 to 10 scale, they are going from a 10 to a 9 on that scale may be more or less desirable than going from a 3 to a 2. We have to check whether that's the case.

The particular way you do that mathematically is worry about developing these translation of scaling functions -- in the technical literature, they are called single attribute utility functions -- to account for the fact that it may be worth more or less for a unit change at one point on the scale than it is for that unit change on some other point.

Of course the second part of what MUA accounts for the relative importance is in a simple fashion, a matter of establishing a set of weights to these various measures that account for the relative importance of those measures.

MR. REITER: Would you relate back to your point about technical and policy?

MR. MERKHOFER: Yes. Remember the earliest side of the concept made that point about separating the

technical from the policy or value judgments. Our primary tool for the technical side, or at least one of our primary tools, is the decision tree an the various inputs that it requires.

This part of the analysis is based on the help and inputs provided from our technical panels. All of this part of the analysis which relates to value issues is the responsibility of the managers, DOE policymakers who are contributing to the study.

MR. REITER: Both levels?

MR. MERKHOFER: Both levels, yes. I guess I should qualify that a little bit. Sometimes when you're dealing with an issue, an environmental one is a good example.

As you're going to see later with Paul, there are several different scales for environmental impacts. Sometimes it takes some very detailed technical understanding to understand exactly what it means, what the implications are of a particular level on that scale.

Sometimes there is an importance to having some technical based information to assist in the process but the final decision would be that of the managers.

One more key concept I want to get across has to do with a slightly different role that we are requiring from influence diagrams in our study. This is

an important point.

We are using influence diagrams and other analytical tools in the study to relate the inputs that we need for our decision tree to more specific, concrete evaluation questions.

What I've displayed on this slide is a particular example. There are actually about 100 different detailed evaluation questions that are represented by factors in the various influence diagrams that we've already alluded to.

Each of those factors implies a specific evaluation question that must be applied to each ESF option. Here is one out of about 100 examples.

One of the factors that's in actually several of our influence diagrams is the following. Does the ESF option that's being considered employ a construction method or an approach to construction that will adversely impact the conduct of natural barrier tests? That is a specific question that must be asked of at least one, actually several, technical panels because of its bearing on components of the analysis.

In fact, the example here points out that there is an influence diagram that has to do with the quality of capability of testing. Specifically, there is an influence diagram that relates to the likelihood that the

testing will incorrectly lead to a conclusion that the site is okay when in fact, the true conditions of the site are that it's not okay.

In fact, we talked a bit about this yesterday and I think it was Hollis who made the point that when evaluating testing, studies show that it is easier and more accurate for people to make assessments on this quantity -- that is, how well does the test do in identifying true conditions than it is the reverse quantity which is given that you have an output of a test, test says for example the site's okay, how likely is it the site is in fact not okay.

That's a very difficult thing to estimate. This is also difficult but easier but the mathematics, in particular Bay's Law (ph), allows us to make that translation.

Going back again, we have an influence diagram for this factor which is one of our basic inputs, and this is one of a large number of specific evaluation questions that must be addressed before that assessment can be complete.

There are then calculations -- in this case, Bay's Law -- that allows us to do the inversion. Here that particular quantity which is the residual -- you might think of it as the residual possibility or

probability that the site is a bad site, even though your testing says it's okay, that quantity is then translated through additional calculations to several key inputs in the decision tree, namely the test outcome probabilities -- that was one of the branches I showed you in the decision tree. That's calculated from this number and some other numbers.

The estimated likelihood of regulatory approval is a function of a number of things, including this residual probability. Our post closure release estimates, whether releases are going to be low, high, best estimate or more generally what that probability distribution is, is a function of that quantity.

My point again on this slide is that whereas the ultimate figure of merit is expressed on a very high level, there is a tie that through the decision tree and ultimately some very specific evaluation questions.

I have one more slide here before the break. As I mentioned I just wanted to outline what the key steps of the methodology are and Paul is going to go through in much more detail about where we are with regard to the steps.

The basic steps, there are ten of them altogether establishing the objectives for the decision. The importance of that is to insure the measures that we

identify are in fact reflective of the key objectives that we want this decision to satisfy.

That gives us a foundation we need for identifying performance measures, for quantifying the consequences of the ESF option choice, then we split here and do some work on the value side working with DOE managers.

We have to worry about verifying certain independence assumptions to make sure that the aggregation equation that we used in MUA is a reasonable one. We have to develop those scaling functions that I mentioned. Again, they are called Single Attribute Utility Functions and we have to develop these weights for scaling factors. So that's the value side of the logic.

The consequence assessment side includes constructing the decision tree, developing the influence diagrams for the various elements of that tree, actually estimating the consequences, and probabilities. Again, we have used the shorthand terminology of saying that's what we mean by scoring. We mean by scoring estimating the consequences and probabilities.

Finally, using the MUA process to aggregate the scores, conduct the analysis, perform sensitivity studies and then finally, based not only on the output but the

insights we've generated, rank order the options.

Are there questions on the overview?

(No response.)

MR. BROCOUM: What time shall we reconvene? We are a little behind schedule, I believe.

CHAIRMAN DEERE: What's about the most rapid you can get lunch and get back, about a hour and 15 minutes or can it be done in little over a hour?

MR. BROCOUM: Let me just suggest, it's going on 12:10 p.m., why don't we just make it 1:30 p.m.

CHAIRMAN DEERE: 1:30 p.m.

(Whereupon, at 12:10 p.m., the meeting recessed for lunch, to reconvene the same day at 1:30 p.m.)

A F T E R N O O N S E S S I O N

CHAIRMAN DEERE: On the record.

MR. HUNTER: We were asked to provide the list of our segregation of SCP tests in the suitability and design, we have that list and we're making copies now and we will provide them to the panel.

CHAIRMAN DEERE: Fine.

MR. MERKHOFER: You'll recall that the next scheduled presentation that we have is to describe this pilot study that played an important role in helping us design the methodology and also gain some understanding of what the methodology entailed.

Since we are somewhat behind schedule, I'd like to suggest that we go through these slides quickly and certainly I'd be delighted if some members of the Board are interested in hearing more of the details as to how the pilot study was applied, and I'd be very happy to go through that.

The presentation of the pilot study is set up to address six topics. Again, I'll go through some of these quickly.

The role of the pilot study, I'll just outline the options that were considered, the components of the decision tree that was used in the pilot study including the scenarios, costs and benefits considered, the

performance measures, uncertainties, the analysis, sensitivity studies that were conducted and the conclusions.

With the role of the pilot study, it had three major functions. The first was to test the feasibility of the approach. We weren't at all certain when we originally considered using this formal decision analysis approach that we could in fact apply it so we wanted to verify that.

The second was a very important role to determine the elements of the methodology likely to be most significant in determining results. As you've already gathered, I'm sure, it's a fairly comprehensive in the sense of a lot of factors are being considered.

We wanted to give some sense of which of those factors would be most important in determining the ranking of options. We found in the earlier study I mentioned, the Evaluation of Alternative Sites for the Repository that a pilot study we conducted in support of that analysis proved very useful in helping us to focus effort. We hoped the same thing would occur here.

The third role was to demonstrate what the analysis would include and the types of outputs that could be produced.

One important deliberate omission on the slide

is to indicate that the pilot study had any role in producing defensible results. That was not the goal of the pilot study and I want to emphasize the numbers you see as part of the pilot study are illustrative only. They are not meant to be defensible estimates of the options that were considered.

To test the pilot study, we took a look at four representative, hypothetical ESF options and I'll let you just take a look at those for a moment as you can see the options involved -- different access methods, different construction methods, different layouts and different geometry.

Again, because the study is more illustrative than anything else, the important point is to note a variety. We wanted to be sure we considered a representative sample of the types of options that we expected at that time would be subjected to the full analysis.

If there are no questions on those, we'll proceed to the decision tree. Let me point out as the pilot study, this was conducted before we had the good sense of what ought to be in the decision tree, so this decision tree, the one that was used in the pilot study is a little bit different than the one I showed you earlier.

The two main differences are of course we are only looking at four options here in the pilot study, that in addition to the factors I showed you in the official decision tree we're currently using, we had in addition a node in the tree and some branches to indicate the results of surface space testing and other non-ESF considerations.

We originally recognized that there was a possibility that the results of non-ESF testing alone could produce an identification of a problem that was sufficiently significant to lead to scenario five which you will see in a moment.

It turned out, as you'll see in the pilot study, that the probability of this outcome really has no significance whatsoever in terms of the ranking of the options.

I guess the only other difference in it is the tree I showed you earlier I had drawn in just for the optics right in between here, the results of ESF testing and regulatory authorization, a branch that I labeled repository to reflect the fact that we are associating a particular repository configuration with ESF. Other than that, it's pretty much the same.

I mentioned a basic concept of the methodology was to estimate the consequences associated with the

choice of each ESF option. At this point in the pilot study, we distinguished two basic types of consequences.

One type we called social costs. These are the potential adverse impacts that the construction of the ESF repository and subsequent closure or retrieval might produce, adverse impacts on human health, the environment and so forth. Those are the things that we referred to as social costs consequences.

In addition, we needed to recognize that the scenarios, these various paths of the tree represent or reflect different what we call benefits. The most important one, of course, is that top half through the tree, the one that results in repository closure has associated with it the fact that you've got a permanent operating repository. That certainly is a good thing and is motivating all of the work.

So we have to account for the fact that particular scenario through the tree is very definitely a preferred one because of this major benefit.

The others are similar in that they result in no solution to the waste problem. However, we did want to recognize that the path through the tree where you construct the repository but you have to retrieve the wastes produces waste that's located at Yucca Mountain whereas the other scenarios wherein you abandon the site

prior to the placement of the waste, the waste then remains -- at least that was the assumption for the analysis.

We then had to come up with a way of measuring performance or measuring the level of these social costs and benefits. As this slide illustrates, for the pilot study there were eight separate quantitative measures defined for the various preclosure, impacts and one variable for post-closure -- post-closure being radionuclide releases expressed as a fraction of the EPA standard, the same as in the other studies.

I want to give you just one example of how the consequence assessment was conducted. This has to be the case for worker fatalities and as I already mentioned, we borrowed from this earlier MUA a lot of the basic machinery that was used to conduct the consequence assessments.

What we've got here is the various options defined and this table simply lays out the simple calculations that were used to estimate the expected number of worker fatalities that would occur under each option wherein all we've done is recognize that there may be an inherent difference in the worker safety associated with drill and blast versus tunnel boring machines.

So we've used simply statistical fatality

rates, coupled with an estimate for the number of manhours of activity in each option to produce an estimate of expected fatalities. Again, we've separated our estimate of expected fatalities into the three basic phases of the repository which is important because the scenarios, those five scenarios through the tree, represent different combinatios of this.

Abandonment of the site before construction would only result in these numbers of expected fatalities whereas, closure would consist of these plus these and a scenario that involves retrieval was assumed to involve approximately the same number of additional manhours as emplacement so that you double these numbers to get entries for the retrieval scenario.

CHAIRMAN DEERE: We probably could add some information to your database if it's not there, and I doubt if it is since it's very recent, on deaths with tunnel boring machines because they have just finished the four mile project near Homer, Alaska without any fatalities. They are now just about 60 miles of tunneling in the last 12 months at the English Channel.

At the moment there are nine machines running and they have a total of six fatalities for 54 miles of tunneling, 24 hours a day, seven days a week for 12 months. So those are pretty impressive figures.

MR. MERKHOFER: Yes. Thank you very much.

Of course the analysis we are doing now for the full scale applications attempting to use a more sophisticated logic than this but that kind of data is exactly the sort of thing we need.

That's the consequence assessment part and just as in the full methodology you have to also worry about value judgments and coming up with a way of aggregating these various consequence measures to some overall measure of desirability, we have had to face that same problem with the pilot study.

The simple way it was done in the pilot study was to assume an equivalence between and a social cost expressed in economic terms and a single case of statistical worker fatality.

In the pilot study, you can see the assumption was an equivalent, economic social cost of $1 million assumed for each case of a statistical worker fatality. That allowed us to translate this measure into dollars. A similar approach was used for the other measures.

Let me skip now ahead a ways since you've got the general idea and show you the decision tree with the numerical inputs assigned for one of the option, for Option 1.

Now the tree not only shows the structure but

we have the lower part of the slide -- I'm sorry, this is page 28. The lower part of the slide summarizes the aggregation to come up with measures of equivalent social costs. This is the component from the adverse effects category.

We've got a similar column for equivalent benefits and I should point out I had an earlier slide that talked about the benefits versus the social costs. For this particular calculation, we have made more or less an arbitrary assumption here, but I'm going to eliminate that assumption a moment.

The arbitrary assumption is what is the benefit of having a closed repository. For the numerical calculation, we assumed $50 billion.

We do a sensitivity analysis to that quantity and it turns out that as long as you assume the benefit of the closed repository is at least as large as the total social cost of coming up with it, the ranking of the options doesn't change. If you think about that, it makes intuitive sense.

For the purpose of the numerical calculations, we had to assume something in a base case and that's the number we happened to assume.

I should point out one other thing on the slide. Again, remember these numbers here are all pretty

much illustrative at this point. The particular one that probably is worth giving you some explanation is the computed probability of the results of ESF testing being okay versus not okay. Again, that calculation involves Bay's Rule (ph) being applied to some more fundamental aspects regarding the ability of the package of tests that need to be conducted, when conducted with that ESF option, estimates then involving the likelihood that such tests would in total correctly identify conditions that either the site is okay or not okay.

The surprising number is that this is relatively low. It looks here as though it's just a little bit higher than the flip of a coin that ESP testing will show the site is okay.

Those are the results of the pilot study, however, what I need to point out is since doing the pilot study we recognized or realized that we had some problems in how we defined okay versus not okay.

We do not at this point expect that probability in the full study to be that low. Expect to estimate a higher probability in the ESF testing.

MR. ALLEN: What is the background here? Do you have a team of experts?

MR. MERKHOFER: We had about two or three individuals who we asked to give us representative kinds

of estimates, but we did not go through any of the formal assessments and analysis that were we're conducting now for the full-fledged application.

The next slide I want to skip to is No. 30 and I think gives you a good sense for most of the conclusions we derived from the pilot study. What this shows is the results of the base case analysis for each of the four options.

In particular, it tells how those options would rank depending upon which of the criteria are considered, so there's a whole lot of criteria that are collectively considered in the analysis, but the question is, suppose you only considered a subset of those criteria, how would the ranking look under those cases?

It's useful to examine this kind of diagram because it gives you a sense of what are the drivers in this analysis? In fact, you can see that the ranking of these options varies depending upon which subset of factors you consider, so the implication is that -- at least as reflected by these illustrative assessments -- the options are viewed as being better or worse in various dimensions. There is no single option that's better in all aspects. They tend to differ in which dimension they are better.

It is interesting to note, first of all, with

respect to the consequences, let me point out it's not clear on your side, so I've added these arrows, that from here to here, we're looking at the ranking assuming that the repository gets constructed and that it is closed.

These are the rankings assuming just that one scenario through the tree. What I wanted to point out is notice that the ranking that considers all factors is almost identical to the ranking that considers only those factors that relate to cost, direct costs and schedule.

So as far as consequences go, the option that is best from the point of view of schedule and total cost is when reflected against the various weights that were assumed here, is the dominant factor, so cost and schedule tend to dominate the ranking when you look only at consequences and you assume that the repository is in fact constructed and closed.

On the other hand, if you ask the question how do these options compare in terms of the likelihood that they lead to a closed repository, and basically the answer to that question can be obtained directly from the decision tree.

The question I'm asking is how likely is it that the option leads to this path? Since we know the probabilities of each of these branching points on the tree, the probability of being on this path is the

product of these probabilities. That is how that last column was filled in.

The interesting observation is that the option that led to the highest probability of a closed repository is when you consider all paths to the tree and all sets of consequences, also the option that comes out with the highest overall ranking.

So the implication, or at least how we have interpreted this, is that there is a suggestion here that the drivers are very likely to be -- the determining basis for the ranking is very likely to be the extent to which the option promotes a successful conclusion -- that is, promotes successful results, good testing results, regulatory approval and minimizes the likelihood of retrieval, which in effect says the most critical factor associated with ESF options is not such things as environmental impact or worker health and safety, it's the quality of the tests that are produced and the extent to which that option will be compatible with regulatory requirements.

Let me summarize that perhaps a little more clearly by showing you the full array of conclusions from the pilot study.

We concluded the methodology was feasible, we were able to get through it successfully, and it appeared

to be potentially acceptable subject to several identified revisions which are reflected in the differences you saw in the first part of my presentation with what we did in the pilot study.

I mention here the ranking of the options is the same basically for all values of K. K was the measure that we used to indicate the benefit of the proposed repository, so as long as that value is assumed large enough to motivate building the repository in the first place, that turns out not to be a critical judgment.

It's just fortunate because we felt it would be very, very difficult for us to come up with a good estimate of what the overall value in some sense of having the repository is.

The ranking of the options seems to be pretty much insensitive to several things, totally insensitive to the probabilities of surface space testing results.

We assumed in the pilot study that the probability of closure was the same for all options. We have relaxed that somewhat based on the conclusions of the pilot study.

If they are all assumed to be the same, then the particular probability you assume that you are able to close the repository has no real bearing whatsoever.

Incremental value of having the weights that Yucca Mountain relative at the reactors, if you recall we had to distinguish between the scenarios because with retrieval, the waste was physically at Yucca Mountain whereas if you abandon the site prior to that, it's toward the reactors.

It turns out that assumption of what the difference is between the relative benefit or disbenefit of those two cases has no bearing which is also good because that would be very hard to estimate.

Those things didn't seem very important but again the critical factors were the effect of the option on testing accuracy, and the likelihood that a particular ESF option would be both compatible with regulations and produce the kind of testing accuracy and confidence in release estimates to produce regulatory approval.

MR. CARTER: Can I ask you a question, please?

In the third bullet, the incremental value of having waste at Yucca, could you look at whether that waste -- does this include used fuel elements or only high level wastes?

What I'm interested in is whether you looked at it both on a retrievable and a nonretrievable mode?

MR. MERKHOFER: Can somebody here help me?

MR. HUNTER: The assumption here was that the

repository would be as the basic design is, that it would have both high level wastes and spent fuel, and that both would be retrieved if that were necessary.

MR. REITER: In this pilot study, did you allow for false positives?

MR. MERKHOFER: Very definitely, yes.

MR. REITER: Will you tell us what's the likelihood of that and did you assume that you always discover it before closure?

MR. MERKHOFER: We did not assume that you would always discover it. This slide shows the summary of the -- this is No. 25. Actually there is a whole set of slides in the pilot study that summarize how these calculations, the false positives and false negatives are conducted, using Bay's laws to illustrate that and so forth.

Obviously because of the time I didn't want to go through all that. It summarizes some of the basic assumptions. It was assumed, for example, that our prior probability that the site is okay, prior to doing ESF testing would not depend upon the option and the assumption there was about 64 percent probability that the site really is okay.

One of the assumptions that's needed to assess the accuracy of the test program is the probability in

this case expressed as a true positive, we're actually thinking in the formal methodology of expressing this in the converse way, what is the probability of a false negative and a false positive which we think is quite natural.

You can see that different probabilities were assessed.

Bay's Law was then applied to derive the reverse probability, the probability the site really is okay given that testing says it's okay, so you can see that the numbers are not identical which just points out the need for doing this calculation.

The probabilities then that actually appear in the tree, which is the probability that a given test, an ESF option, will produce a suite of tests that when analyzed will indicate the site is okay.

MR. HUNTER: It might be a good time to ask the Board with respect to time of the presentation, Lee did skip a number of the points. Is the proper approach to maybe go back and pick up some of those points or what is your pleasure?

CHAIRMAN DEERE: I think in general, we'd like to move forward.

MR. MERKHOFER: Have I answered your question? I'm not sure I have.

MR. REITER: Which option has the highest probability of a false positive?

MR. MERKHOFER: Of a false positive. We have here the probability of a -- this would be a true positive, so it would be the reverse. It would be 1 minus this number, so the highest probability of a false positive would be Option 1.

MR. REITER: To what extent did the public health effects of a false positive have upon your final results?

MR. MERKHOFER: They are considered, of course, because the releases that occur will be higher if in fact the true situation is that you've got a false positive. There really is a problem with the site even though your testing says it's okay.

MR. REITER: How significant is that factor?

MR. MERKHOFER: It was not significant at all as indicated by that table, this table here, because this number indicates essentially the assessment of the releases, but the ranking that looks solely at releases, does not match very well the ranking that looks at all factors. It's driven much more by this probability.

MR. REITER: Why wouldn't one, which you have the highst likelihood of a false positive, always give the highest probability of post -- releases?

MR. MERKHOFER: Well, it is in that case. That means it's third in the ranking. This is the preference so in fact, you're right, it would give the highest probability -- the highest level of estimate of releases.

MR. REITER: I assume when we get the results we'll be able to deaggregate to these very important subquestions that people are asking and not look at some final black box at the end.

MR. MERKHOFER: Absolutely. In fact, that's a very important point because reflecting on what I said earlier, we recognize that this methodology, even though there's a lot of assessments involved in it, is far from perfect. There's a lot of very rough approximations involved.

So we don't view the final number or the final ranking that comes out as being the real -- the critical output of the study. We believe it is the full array of results that are produced that will be most useful.

As Tom indicated, we're concerned about going from the ranking of these 17 options to a final recommendation. It may involve adding the electric windows to it and to determine whether or not to add some feature we've got to know what does that specific feature do and what dimensions does adding or subtracting that feature -- what aspect of the problem does it affect.

MR. REITER: One last insight question. What is it about Option 1 that makes it the highest likely to give false positives?

MR. MERKHOFER: What is it about Option 1?

MR. REITER: Yes, that makes it have the highest likelihood of a false positive? What can we learn from this exercise vis a vis false testing and false positives?

MR. MERKHOFER: We have to go back and look specifically at what the logic of the panel is, but clearly the problem with Option 1 is that its affect on the testing accuracy, there's something about it --

MR. REITER: What is it? Do we know what that is?

MR. MERKHOFER: You might be able to tell us precisely in the full application, of course, we're requiring the panels to document exactly what it is that reflects their logic. I'm sure we can go back to the transcripts, actually even the pilot study had transcripts, and find out whether it was the construction method, the location, ramps, shafts or what it was.

MR. REITER: Very relevant information.

MR. MERKHOFER: Yes.

MR. HUNTER: If you go back and look at the option page, I think you'll note that it's the one that

did the least amount of exploration. I think that's correct.

MR. GNIRK: Tom, you're absolutely correct. What drove that was the fact that of the four hypothetical options that were looked at, Option 1 looked at the least amount of real estate underground.

CHAIRMAN DEERE: I think that's a good conclusion, let's move forward.

MR. NORTH: Could I ask a summary question?

As I understand, this exercise was done quite independently of Calico Hills in terms of the assessments on this issue which has to do with the accuracy of the tests broadly conceived compared to the real state of the repository.

We saw the data yesterday on Calico Hills where there was a much more formal assessment of judgment and I wonder if you would comment to the degree you feel the insights from that exercise coincided with the insights you've got at the bottom of conclusions slide on this exercise, namely that the ranking of the options is most sensitive to the impact of ESF option on testing accuracy and likelihood of regulatory approval?

MR. MERKHOFER: Yes, I would say that they are definitely consistent conclusions. It's more difficult to compare them one to one because the Calico Hills study

looked at a subset of factors that we're looking at.

If you recall the Calico Hills concluded that whereas they were able to distinguish among the strategies in terms of their ability to avoid false positives and false negatives when they reflected that ability against estimated performance levels, the quantitative part of the analysis concluded the benefits were very, very small.

However, it is true that they were able to see a difference among strategies and that, as I understand it, was at least an important part of their logic for ultimately chosing strategies 2 and 5.

Our study is showing, at least the pilot study here showed the same thing, that it was possible for the participants to distinguish among the ESF options in terms of their effect on the testing, there was a quantified difference.

Furthermore, we were able to reflect that quantitative difference through the analysis because of the effect both on regulatory approval which was assumed to be a function of residual uncertainty that there's a problem, as well as through the part of the tree that looks at whether you will be allowed to go on to the next step, the okay branch of the tree. Does that address question one?

MR. NORTH: Yes. I guess the point would like to get your comments on is, is there any degree of difference that you feel was significant between these two exercises on this point, namely what it is that's really important in driving this analysis and for what needs to be done very carefully and refined as you go from your pilot exercise to your full scale exercise?

MR. MERKHOFER: Again, I think we were fortunate to have done the pilot exercise because to be honest with you, we were also very reluctant initially to try to undertake an analysis wherein we were attempting to estimate something as difficult as are you likely to obtain regulatory approval.

We knew that modeling that part of the problem was going to be very difficult. The pilot study suggested that was a critical motivation and the logic again is that if you have an ESF option, it allows you very accurate persuasive testing, that allows you more confidence in your prediction, and this confidence is an important consideration or is believed to be an important consideration for whether or not you obtain regulatory approval.

It basically reinforced our confidence, I guess, that we needed to explicitly look at that part of the puzzle because that was going to be an important

factor with regard to accurately assessing the merits of the alternative options.

MR. HUNTER: Just a reinforcing point on that, not only was it important, it was important to have it be in there explicitly. That I think is Lee's point.

The other thing which is consistent between that final set of conclusions with what you heard yesterday on the Calico Hills is that the performance impacts are low in general, and the conclusions tend to support that is the case, and that's obviously consistent between the two and reinforces the bottom line that Lee has on his summary chart.

MR. NORTH: You haven't been explicit as to what is the criteria by which the approval is going to be given in this illustrative exercise. You've told us that you thought the probabilities given in your illustrative exercise will go up as you go the full scale limitation.

Will they go up to the level we saw in Calico Hills or is it going to be somewhere in between is not on the table at this point.

MR. MERKHOFER: We have been very explicit in the full methodology about how to define those various events and what the relationship is.

MR. NORTH: So all that is in the area of coming attractions as opposed to what we want to talk

about today?

MR. HUNTER: No, coming soon, because the next speaker will talk about it. I think he has in his package the factors which go into that regulatory approval probability assessment which if the Board chooses, we could discuss.

MR. NORTH: Fine. I think we'll take all the insights from real data that we can get at this point. The issue I was raising that it seems to me where we're talking about something that's illustrative, that's already been superceding, we probably shouldn't spend much time on that.

MR. GNIRK: This is always the interesting of the presentations because the last person is the person whom everyone has promised will answer all these questions that were passed down the line, particularly questions that Warner asked and the various people.

There is only one more person and whatever I miss, then Ted has to take over.

(Laughter.)

I want to talk a bit about the methodology, its implementation and its current status and in our overall diagram here it's the portion in red, the part that eventually leads to ranking the options.

The general topics I have here are just so we

know something about the current status, where we are today, and something about these expert panels. I won't go into great detail so I'll only say a few words about that.

The objectives hierarchy that we were talking about and then two rather brief examples of involvement by the technical panel in developing and using influence diagrams to score the ESF option for one case, just to show you how it works because the next time we have a meeting like this, you will have gone through it and have an idea of how we go through the scoring, then you could get to the more precise details.

Similarly with the Management Panel, in particular how a utility function or single attribute utility function is developed and how you use a utility function to tradeoff to obtain what is called weights or scaling factors as we call it.

The weights are of interest to a number of people and I want to show how that process is done because it's a process that is more precise than I think people think. It's just not flipping coins and so forth. It actually has a real rhyme and reason.

This is a diagram that Lee showed earlier of the implementation of the ESF alternative study. The only difference from his diagram and this particular

diagram is it shows the responsibilities of the people going down on the left, and across the top.

The diagram, as he said, is broken into such a fashion that what you see on the right -- it says "DOE S&L Management Panel" -- that is the policy side. What goes down vertically is basically the technical side and of course you keep things separated as you go forward between the policy people and the technical people.

Where do we stand as of today? We went through these objectives a number of times beginning in January when we laid out everything and looked at these objectives more in February.

WE met with the Management Panel in May and did a completeness review of the objectives and probably will look at them one more time to make certain we have everything into the study based on meetings like we're having today and further considerations.

We've got all the influence diagrams except one completed. Performance measure scales by and large, we're done with those except for post-closure health and safety. Those are the scales and those are the evaluation factors that people must use actually in going through the scoring process. It's a little more than just a scale in some cases.

Utility functions, we've got two of those

completed with the Management Subpanel for two of the environmental aspects of the study.

Scaling factors, we've got scaling factors or the crossover weighting factors between two of the environmental concerns and preclosure radiation dose, that is doses to workers in particular.

Scoring, we went through the scoring on the environmental aspects, some of the environmental aspects and some of the worker safety aspects. By and large the reason we could go through those scoring activities prior to the completion of the Calico Hills activity was these particular aspects are objectives we do not think will be impacted by the Calico Hills decision.

We wanted to go through the process to develop our techniques in part and to see how it worked and get the experience. These were things to do.

The people that are composed in this, of course we have a lead group from Sandia which is Al Stevens who spoke earlier today; Al Banos (ph); Larry Costin and Steve Bauer who are in the audience.

Really it takes a group of people out front because there is a tremendous logistic problem with people and activities, and everything coming together. When we talk about it, it's hard to visualize unless you're actually in this process to see how it all swirls

around.

The Decision Methodology Group is Lee and myself and we're helped by Phil Beccue from ADA who does all of our graphics during our elicitation process because we have live graphics to help people develop these influence diagrams and get turned around. David Paris from RE/SPEC takes these detailed notes and converts them into written notes later, along with the transcripts.

The Management Panel consists of actual 10 people, six people from the DOE, three people from Sandia and as of Friday, Steve Brocum became a part of this panel. So we have roughly 10 people.

It's very difficult to ever get all these people together at the same time so by and large we work with subpanels of these managers in developing the utility functions, scaling factors and back and forth. One time we got almost everybody together, I think.

The expert panels, we have roughly eight but then we've broken them down into subpanels at different times and for different reasons and combined them in some cases.

The numbers range from a subpanel of maybe two or three people; the entire panel may be eight or 10 people.

Prior to initiating a study, Lee and I advise Sandia as to what constitutes an expert so they can write the QA qualification so that we have a consistent basis for choosing the experts. The experts were selected, as I said, throughout the program. In some cases, Lee and I requested certain people we felt were very good at doing certain things for various panels.

Additionally, I've designed support groups that support these activities in the elicitation processes and the scoring process. These are people who are involved in actual design, the surface features, and the underground and understand all of this to provide that input at the time we do either developing influence diagrams, performance measure scales or the scoring.

These are the highest level objectives of the study and they are consistent with what Lee talked about but I just wanted to say something aside from this.

The objective that requires the maximized value of information from characterization testing, which is a means objective, requires elicitation of three probabilities, two expert panels for each and every option, so that's three.

The center objective, which is maximizing compliance with applicable regulations, that requires elicitation of two probabilities from one expert panel.

The third objective, which is the value or fundamental objective, minimizes adverse impacts attributable to an ESF repository configuration and requires a scoring of ESF options against 15 performance measures by six expert panels, plus the development of these utility functions and the scaling or weighting factors of the Management Panel.

So we have 15 performance measures or objectives plus two probabilities, plus three probabilities which gives us a total of 20 different quantities that have to be elicited, evaluated and estimated in one fashion or another. So this gives the problem 20 dimensions.

Each one of those dimensions basically is unique by itself which allows the type of thing of looking at a single dimension and seeing what the range of scores, for example, would be for particular options or grouping them together in some fashion or another, or aggregating the entire study in with all the scores from all the performance measures and looking at the sensitivity that might occur because of differences in the probabilities, differences in the scores, perhaps differences in the scaling factors or the weights.

The objectives hierarchy for the righthand side of that previous diagram looks like this. Actually this

is very similar to what we did in 1985 and 1986. Warner and Clarence were part of the NAS panel at that time which reviewed this work. This was the general objectives hierarchy.

It had some other features at that time having to do with transportation of waste which is not on this diagram because it doesn't provide any discrimination between ESF options, and this diagram has more detail under the objectives for cost and schedule, particularly as they apply to the ESF.

This turns out to come about because of our elicitation with the Management Panel. There's a concern about the early dollars, the early schedule points that can be met in this process. So they become identifiable objects in one fashion or another.

The data sheet that Al Stevens showed you will breakout information in accordance with that so the Cost and Schedule Panel can make those evaluations for the purpose of the scoring activities.

There are 15 objectives here that area active, as I said before. Two of the objectives, socioeconomic impact and impacts on the biota, were determined to be nondiscriminatory.

That was not our judgment, you understand. That's based on the judgment of the expert panels that

were involved with these particular aspects. In the case of the socioeconomics, we did about a 3 or 4 hour elicitation with those people and determined that a change of 10 to 20 percent of personnel for an ESF configuration one to another was not going to impact the area in and around Las Vegas and the site area from the socioeconomic standpoint. There was no basis for discrimination.

From biota, we spent perhaps three sessions, 6 to 8 to 9 hours and eventually arrived with that panel at that point that there was no basis for discrimination between and among options on the basis of the biota.

MR. HUNTER: Paul, that biota includes the desert tortoise habitat and things of that nature?

MR. GNIRK: That's right, all the animals, the flowers and so forth, there was no basis, in their judgment. That, of course, is on the transcripts and is carried through the system. It's not an arbitrary judgment and if people are interested, they can read the elicitation in which we went through the examination of all these different factors to arrive at that, and which it was arrived at.

The expert panel and how does it work, what does it do? I'll give you some notion here. We started off by assembling the panel of experts for a particular

area. They must undergo the quality assurance training that is provided at Sandia in order to be qualified from a QA standpoint.

Then we proceed forward to construct an influence diagram and develop the performance measure scale or the basis for evaluating the performance measure against the options leading to the scoring of the options.

We have the designers who are involved in these meetings who provide support to all of this; we have this reference material that Al Stevens talked about; and what Lee mentioned earlier, that goes into this process and then we have this rather complete documentation that tracks through the system consisting of transcripts, the notes and diagrams, and eventually there is a final report on all these specific things.

I think it is very well documented to see what the reason is and so forth to make certain we covered all these points. It behooves Lee and myself to facilitate these sessions to make a tremendous good faith effort to introduce all of these factors into the process for consideration, be it the concerns from this group, be it the regulations.

We have to keep tracking that and to make certain that the panel considers those aspects and we

just do not dismiss an aspect arbitrarily. There is always a discussion as to its impact, and if it goes away, the reason why.

The example I'm going to show you for the influence diagram, the performance measures scale and the scoring has to do with the environment. In some cases, people may not consider this to be very important.

This is the influence diagram for a set of properties for the environment. When we developed this diagram, we started with a large group of people who were experts in the environment including experts in the area settings and eventually narrowed it down to just the people in the settings.

By and large, you start out by asking the question, what impacts the settings? What are the factors? You list the factors on a blackboard; you begin to assemble these factors; you work with the audience to eventually develop a diagram that says there are two important factors which influence the settings -- one being the visibility of the impact, the people, the population, and secondly, the magnitude and location of that impact.

One other point I want to say is that all of the bubbles on this diagram that are double-bubbled were considered by the panel to be factors that could provide

discrimination between and among options.

If you look through the diagrams that you have in your collection, this presentation, you'll see all these diagrams that are in the vuegraph collections will have certain numbers of double bubbles. Those double bubbles emphasized were determined in the elicitation process to provide a basis for discrimination between and among options -- the highlights.

What you'll see in the next step here on the performance measures scale, which is a constructed scale, is that we'll take these principle things and these double bubbles and build it into a scale, a scale which the panel can use to judge the various ESF options, or score those options.

I go through this process but it's much similar to all the other performance measures and other things we do. We have this diagram. We've developed these key factors and these are the factors the panels must take into consideration when they score an option or when we obtain the probabilities.

It's our role to make certain those things are considered and discussed in those particular evaluations. Then there are a number of subfactors that lead into the principle factors.

After we have the diagram completed in this

particular case, you develop this very wordy performance measures scale. It has to do with visual impacts, but by and large, the worst portion on the scale is 0, the best is 12.

This is known as a constructed scale because you have to construct it in terms of two things -- vantage points from where you can see these impacts and the magnitude of the impact.

By and large skyline structures are the highest degree of visual impact, skyline structures being the headframes you could potentially see or things associated on the skyline surface.

The moderate impacts are those that are structures, some sort of building facilities, muck piles and things of that nature. Minor impacts are road cuts, and certain traffic patterns you could perhaps see from the various highways.

You develop this scale, constructed scale, the worst case being where you can see all of these impacts from many places, the best being where you can't see any impact from any of these highways or population bases.

This scale is the scale that will be used in scoring each of the 17 options against the setting properties arriving at a score. This is the next step.

Once again, this performance measures scale was

developed with this panel, working with this panel, using the influence diagram as a basis. We went through the scoring activity and the scoring activity is very structured.

The panel has been formed but you meet with them in a formal meeting; you go through a final discussion on the influence diagram, performance measures scale, any questions they may have, explain what will be done, construct how it will be done, the designers go through all the aspects from the surface point of view, things leading to the visual impacts, and then you ask the panel members to vote or construct their score for each and every option, to construct their best judgment score and their high score and low score, optimistic and pessimistic score.

By and large an optimistic score is one in which there is 1 chance in 20 that their highest score, the conditions could be even better than what they think the highest score would be.

From the standpoint of aesthetic properties, you can think perhaps there are ways to camoflouge the buildings, and that may seem sort of odd, but if you go north of San Francisco to the geyers areas where they generate electricity, you see these camoflouged buildings that blend into the vista, what you see in the mountains

there and so forth. Anyway, you arrive at scores.

At the end of the session, you go through each option in the final time and get the panel's final judgment. In this case, the judgment of the panel gave a unique value for best judgment, optimistic, pessimistic for each option.

It turned out there was one, two, three, four, five, six, seven, eight, nine, ten, eleven options ranked at the same high score of 8, their best judgment with a high of 9 and a low of 8. Two were ranked very low with a 1, meaning skyline structures visible from mobile managing points and basically, the reason being as follows.

These options are up in the northwest, essentially hidden on the other side of the mountain from the highways, from the community that could see them. The B-4/C-4 options are down on the south. You talk about this skyline structure or this headframe that Al Stevens was talking about in one of the pictures.

We want the optimistic and pessimistic scores to give us a range to use in a sensitivity analysis. We will hopefully take all the optimistic scores for all of the performance measures or all the pessimistic scores and we can do a wide range of sensitivity analysis. That completes that.

I just want to say a couple of things about the performance measures scale and the diagram for post-closure health and safety which has taken a lot of our time, a lot of discussion.

You saw a very similar diagram yesterday, the influence diagram, pulled this all together into four pieces called health effects, transports the natural barriers, transports through engineered barrier system and scenarios of expected disrupted conditions. This is for post-closure.

What I want to show you here is that many of the concerns expressed by this Board, many of the things we must look at in Part 60 of the regulation are included in the bottom part here, clear down at the bottom. The things having to do with ESF, the construction technique, the connection of the ESF with the repository, on and on, that will be down in this lower diagram.

The panel then has to sit knowing their perception of what sort of impact it would cause on the repository in the long term, then work up to the entire system to arrive not necessarily at health effects, but in this case, we're dealing with releases to give us an estimate for a particular option. It's a very complicated diagram.

I'm not going to go through these diagrams. It

takes a long time to go through them and it's sort of like looking at fault zones. Don Deere's looked at most of them in the world. Roy Williams is pretty close to seeing the rest of them, but I'm one engineer that's seen a lot of influence diagrams.

(Laughter.)

This is way down at the bottom of that influence diagram for post-closure. This is on page 17 in your notes. When you get down to the bottom, we've got the ESF part, we've got the repository part, you see these double bubbles.

On bubble 7273 -- you have to look on your own diagrams in the handout -- and you'll see all these factors that must be considered -- ESF connection with the respository, nature and extent of the Calico Hills penetration; fluid material usage; ESF construction method; ESF type of access; and so forth.

All of these things have to be considered when a panel looks at the perturbation, so to speak, of a particular option on the long term performance of the site. These aspects of construction, location and so forth must be taken into consideration.

Whether or not they provide big points of discrimination is one thing. I don't think in the long term they are big points of discrimination but they must

be considered.

I'll just say that the performance measure that we use for post-closure which is on 18 and 19 of my diagrams are releases to the accessible environment. We went through an elicitation process to determine the range of releases which we did, what could be conceivable for the range of options that we were considering, along with the range of conditions or construction conditions, all these things that went into the options.

We got the high release, the low release that goes from roughly 1/100ths of the EPA standard and the absolutely worst case the panel could envision to one part in a million of the EPA standard. Once again, it's based on expert judgment backed up by some assessments that go into developing a basis.

Unless there is some real interest, you'll find in these diagrams I've included a diagram for license approval, which shows all these factors that must be considered by the Panel on Regulatory Approval or regulatory requirements when they go through the process, the process of eliciting the probabilities, all these factors that must be considered.

MR. HUNTER: I believe page 20 is the one Warner asked about earlier, what actually made up that probability estimation.

MR. GNIRK: Warner, if you look at that quickly, page 20, it will perhaps answer his questions, but I'll be happy to explain it. I know he's seen 100 times more influence diagrams than I have in my lifetime.

MR. NORTH: I've seen a lot of them too and we don't have the time to go into the detail here but I think at least some of that detail may turn out to be quite critical.

I hope at a future meeting when we have found which elements in this very complex framework are the real drivers in terms of the discrimination among the options, we will then take the time to go through those details very carefully and critically.

Clearly if you take the time to explain even one of these diagrams to the assembled group and explain the thinking of the expert panel that led to that diagram, we will be here for many days and we don't have that time.

MR. HUNTER: Let me add one comment on the post-closure performance. It's important for the purpose of the ESF study to recognize that the key thing which has to go into the decision is not so much what the performance of the system is, but that we identify the performance impacts of building the facility and our decision will be based on that discrimination.

So many of these factors -- you know, an influence diagram is very comprehensive. Many things will be dominant in that evaluation. When we go through the process and then go back and evaluate the sensitivity, we hope to be able to distinguish that characteristic because that's the thing which really forms the basis for the decision, not whether or not the site, the system, and the repository that is built would really function.

MR. GNIRK: Thank you, Tom.

Let's talk a little bit about how the Management Panel is involved in the process. This is page 24 of your handouts.

I have included on page 20 of my handout the influence diagram for likelihood of license approval; page 21 is nature's tree which is the probability tree for the characterization testing part of things. Page 22 is the false negative diagram, influence diagram for false negative. That is the influence diagram for the likelihood of incorrectly rejecting the site that is okay according to Lee's discussion on the definition of those.

Page 23 is the influence diagram of the likelihood of incorrectly accepting the site that is not okay which is the false positive aspect. Then I have the diagrams in there for post-closure, all four aspects of

post closure and aesthetic properties.

We have these diagrams, as I said earlier, for all factors except the repository closure and retrieval.

How are the managers involved? We have this Management Panel and of course they have to undergo the QA training also. Nobody escapes this, we're all trapped in it, QA training.

As I said, the first meeting we had with the Management Panel in Denver was in May, I guess it was, and we went through a very detailed evaluation of the objectives of this study, all parts of it. In fact, if you read the transcript, you would see that Lee and I went to each and every manager and asked them for their feelings on what the objectives were.

We only asked them that after we had gone through much of the detail like we've gone through today on the objectives, on the information that we had developed outside of that group as a basis for instruction and then for their consideration, but went through in great detail.

Now, we're attempting to work or find the time with the managers to do these value assessments having to do with the identification of these conditions, independent conditions among performance measures, the utility functions and developing the weights of the

scaling factors.

By and large, because it's very difficult to get ten of these people together, we are satisfied if we can work with two or three of them at a time, and actually it's fairly efficient. Two of the people on the Managment Panel were members of the Management Panel that we had in 1985 and 1986 for the site selection process, Tom Isaccs and Ralph Stockton (ph).

Just to show you a couple of things here, this is a utility function. You may recall in Lee's talk he had one diagram in there in which he showed the performance measures, then down to these utility functions and leading down eventually to the assessments or wrapping up aggregatio of everything.

The vertical scale is utility from 0 to 100. The horizontal scale is the range of impacts for aesthetics. If you recall that verbal performance scale that I had with all the skyline structures, the surface facilities and so forth, multiple/single vantage points, that's the scale, so you have to refer to that.

When we go through this elicitation process, something like this is complicated and time-consuming, you walk back and forth.

By and large, a score of 12 is absolutely no impact; a score of 0 is everything under the sun.

Essentially what you're trying to do is develop a value function that represents a utility of arriving at a certain level of utility against the impacts.

What we do, and the long and short of it is, we look for midpoints, that is the degree of improvement by decreasing impacts that goes from a score of 0 to 4 is equal to the degree of improvement that you get going from 4 to 12. That is, it is a point of 50 which represents a utility of 50 and so you get an equal improvement from 0 to 4 as well as a score of 4 to 12.

You go through this process, you set up situations of comparing sites and you eventually elicit each and every point on this curve for this particular panel and that becomes a utility function. This one happens to be non-linear.

We did the same thing for historical properties. The scale on historical properties has to do with the area extent of historical properties that must be mitigated. So if you have no area to be mitigated that gives you utility of 100. If you have 70,000 square meters which is roughly 30 acres, 35 acres of area to be mitigated, that's the worst case, getting a score of 0.

It was a determination that went through this assessment for various reasons that this was a linear utility function. So that's two of the utility

functions.

The process you go through takes, in some cases, several hours of elicitation to develop these things. When you finally get the utility functions, then you've got to trade back and forth to determine what the scaling factors are, the weights between and among things.

As Lee Merkhofer tells me over and over again, the only way you can really learn this is you've got to go through the process. It's very, very difficult to describe.

In this particular diagram, the horitzontal scale is the aesthetic property and visual impact, a score of 0 to 12. The vertical scale is the historical property scoring from the worst case of 70,000 square meters to the best case of 0 square meters of areas to be mitigated because of historical properties.

You set up the scale and then you begin an assessment in which you ask for preferences of one potential site against a second potential site for various conditions. What you're looking for is a paired set of options, conditions for options to which an individual is indifferent. They are the same.

Once you have that, considering that the performance measures for all other objectives are at

their worst level, you really can only work these two, then you equate the utilities and you can work out scaling factors.

The scaling factors that we worked out in this case going through the elicitation said that the weight on aesthetics could vary somewhere between less than 1 fives times the weight on the historical aspect.

The reason we have that range is because there were two people involved in the panel and we went through and we could not get concurrence on what their indifference points were, so we got a range.

When we got through the next six or seven managers, we may get more range on this. This is really not as serious as it looks because for the following reason. You go through all these assessments and you get these tradeoffs in this fashion and all of these weights must add up to be 1. So you can eventually work out the exact value, what the W's are.

It's my feeling that the actual W's, the weights when we go through the entire process, these particular environmental factors will be relatively small -- the study that we did in 1985 and 1986 will be a small fraction of the total of 1.

The next time we meet we hopefully will have all these scaling factors. If you want to take the time,

I will go through a real down to earth example, give an elicitation and will elicit your feelings on some of these trademarks.

This is the process and what we are going through. Where are we today? I told you earlier where we were going. We've got roughly four activities to complete in the next number of months, we've got to complete the scoring, management elicitation activities, get all these scores, these utility functions, these weighting factors, we've got to aggregate all the score, perform the sensitivity studies, rank order the ESF options, and eventually select an ESF configuration to be recommended to the DOE.

That's it.

MR. McFARLAND: Warner made the comment earlier that there's a great number of iterations that are necessary.

MR. GNIRK: Yes.

MR. McFARLAND: To end up with a recommended configuration. I don't see any reference there to these iterations.

MR. GNIRK: That's right. You don't see it on here but it's in the back of my mind, Lee's mind, Tom's mind, and all the rest, because it's on that process diagram that Tom used earlier, and all of us used, in the

last steps down in the process where we took the ranked options, looked at the methodology and came up with selected configurations. That's the final iteration.

We have to get the results here to see how they come out; what the results are sensitive to. We may have the best ESF configuration you could ever believe of. A lot of time and thought went into this. We didn't just start with 17 scatterbrained options, these people sat down and put together a lot of things based on all the thinking and so forth, and different type of construction methods, layouts, Lee and I worked with them to set up some general screening criteria that screened down to these original 12, then back up to 17 to cover some of the ESF options, so there's been a lot of thought that went into it.

There's always the possibility we do have the best -- a more than adequate configuration in the process right now. We won't know that, of course, until we go --

MR. McFARLAND: Until you go through the whole thing once?

MR. GNIRK: That's right. We can then see probably, fairly certain, what the really big hitter factors are and if we have to repeat the process, we'll probably concentrate on the big hitters. We have to get through this to begin with. We'll get there.

MR. CARTER: Paul, could I ask you a question? What do you include as health effects?

MR. GNIRK: Health effects for post-closure releases to the accessible environment which we can convert to fatalities according to the EPA assumption -- the no threshold, linear relationship. Their basis for the rule was 1,000 fatalities for 100,000 metric ton repository. The table in there can be scaled, it's been done in the past.

On the precloser side, we're looking at doses in preclosure in terms of person ramps (ph), to worker individuals, and to members of the public. We know there are certain cases that have been established as to what you pay to avoid the person ramp.

MR. CARTER: So these are taken, basically, from 191?

MR. GNIRK: That's right.

MR. CARTER: Another question I had, in your work do you use surrogates in the process for health effects?

MR. GNIRK: In post-closure, the surrogate is releases, that's the surrogate, the proxy.

MR. CARTER: That's the only one?

MR. GNIRK: Yes, for health effects which, as I said, we can convert them to health effects if you want

to by the EPA assumptions.

Thank you.

CHAIRMAN DEERE: Thank you, Paul.

MR. PETRIE: Before we finish up the ESF studies, there were a couple of things that came up today that I wanted to discuss. We discussed this a little bit this morning.

The understanding I hope we all go away with is that all the ESF options -- full suitability tests and the design-related tests. The prioritization and suitability test is accomplished as a part of surface space testing prioritization study.

The prioritization of the underground tests with respect to early suitability determination will be accomplished prior to the start of ESF construction. That's our plan. You said that this morning and now I hope it's clear to everybody.

One other thing that came up was somebody asked us about the participation of universities and I just wanted to put on a couple of things.

We do have some contracts and agreements with the Colorado School of Mines, University of Nevada-Reno, and the University of Nevada in Las Vegas, there's a Research Institute and the Laboratories use some of the other universities in their work as well.

I just want to make it clear that we do, in fact, use whatever source we can find for the appropriate technical information.

One other thing I would mention is that in accordance with the requirements of Subpart G, you have to have independent review of essentially all the work we do.

Although Tom did not show them on his chart, there are independent reviews throughout that operation.

Just in summary, where are we, we've identified the requirements for use in the options; we've identified the 17 options; we've developed the decision-making methodology; we've incorporated the results of the Calico Hills risk benefits; and are now in the process of combining options to analyze, rank order, convert options to be selected. That goes on from here.

A little bit about the schedule. I think we showed it to you the last time and at that time, the triangles are original schedule. The "E" is the expected dates and these will develop prior to -- subsequent to our knowledge that the Calico Hills information was going to come in a little bit later than we had in mind, but prior to actually getting it.

Now that we've actually gotten it, we are reevaluating those and there may be some changes to those

things. So that's where we stand as far as the expected dates.

I think the date of interest to us is S&L completes the sensitivity analysis. We are saying here expected September 12. Let me go right into my next slide and the issue we want to talk about, which is when we want to talk to you folks again -- when should we talk to you, not when we want, it's a mutual agreement thing.

We would like to have our next meeting take place in October. I think about January or so of this year, we set up October 11 and 12 as the date for this meeting. We are saying mid-October, however, we would like to be able to confirm that with you by September.

Honestly, I'm a little concerned about the mid-October date; it may have to be a week or two after that.

This is what we'd like to do at the meeting --

CHAIRMAN DEERE: I just don't think that we would be able to get the Board together in that length of time, even if we tried to change it now, I doubt if we can slip it a week or two weeks with the schedules that people have, but we'll look at it.

MR. CORDING: This is a panel meeting?

CHAIRMAN DEERE: Yes. This is for the dual panels, same as this meeting. We're scheduled for that.

MR. BROCOUM: Of course we could meet on the

other three activities. The question is will we have the results from this activity on October 12?

MR. PETRIE: These are the two issues we'd like to discuss at the next meeting. Of course we'd like to have that meeting when we're prepared to talk about it. We don't have to make up our minds now as to when it is, but we would like to discuss this with you at some time.

MR. CORDING: Would this be after the iterations or would it be after a first run through this?

MR. PETRIE: After the first run-through, we would then have the rank order list of options at that point.

MR. CORDING: At that point, you're still in a process where there's going to be further work than checking of these options.

MR. PETRIE: There could be another iteration after this.

CHAIRMAN DEERE: Since it would be one topic, this would be a one day meeting.

MR. PETRIE: I would think so, yes.

MR. HUNTER: I guess it depends on how the agenda gets cast for the other two studies to discuss, for this group.

MR. BROCOUM: The 11th and 12th are still good for the other three areas. If would be shorter obviously

if you didn't do ESF at that time.

CHAIRMAN DEERE: By chance, is the 26th of October about the right period of time we're looking at?

MR. PETRIE: I would think so, yes. Can we leave it that we'll confirm this with you in the near future?

CHAIRMAN DEERE: Yes.

MR. HUNTER: One comment on Ted's discussion. I think we did circulate that list of the differential of tests in the SCP against suitability and design-related?

CHAIRMAN DEERE: Yes.

MR. PETRIE: Are there any other questions for me?

MR. NORTH: I'd like to offer a comment that I think in terms of where we go from here and our next meetings. I see some advantage to having a relatively short presentation on what has been learned in this exercise in mid-October or -- I'm not sure how easy it's going to be for us to agree on a date other than the ones we've agreed to.

What concerns me is that I think to go through in detail the things that we ought to be interested in, in terms of the supporting judgments behind this exercise, it's going to take us some time and we're going to want to see some detailed documentation of the kind

that you're preparing.

I thought it was a big exercise to go through the site characterization plan. This may be of comparable size in terms of its complexity and the degree of detail.

I suspect the way we're going to have to do it is we're going to have to identify which issues are the most important, the most worthy of careful review and then among the enormous mass of material we've got, focus in on those specific areas. I'm not sure we're going to be ready to do that or are you going to be ready to present it to us in mid-October?

I'd like to suggest an alternative, that in mid-October we get what amounts to a summary of your insights and conclusions and at that time, we design a very extensive workshop perhaps lasting the better part of a week to go through the detail at a subsequent stage when your documentation is prepared and all interested parties can watch and participate in going through this exercise in considerable detail reflecting the level of detail at which you've carried out this work.

MR. PETRIE: It's up to the Board to let us know what their wishes are.

CHAIRMAN DEERE: We will have to discuss it also.

MR. CORDING: I just wonder if there's some material that we could see and look at that would allow us to get a feeling for some of these things without having to -- before we come to a meeting, whether there is some documentation that can be reviewed so that we're prepared for it rather than having to do it all together in a meeting. I don't know precisely the form of the documentation or what we need to have, so it's just a question.

MR. HUNTER: There would be quite a bit. There's the research material given to the panels, the influence diagrams which they do, the results of their elicitations, the transcript itself, a lot of things to choose from to do this.

CHAIRMAN DEERE: Where would be the best place to have the meeting, the optimum place?

MR. HUNTER: Albuquerque is worth mentioning.

CHAIRMAN DEERE: I just don't know if we can find a date. We will sure check out these couple of dates and then see if there is some information that can be provided ahead, if we can get a date. We'll work on that and try to get back to you on it.

We do think that this particular time and the presentation of the last two dates has been extremely helpful to us. To be available in the middle of the

process, to get a little better understanding of how it comes to be able to ask our questions, to get the answers, have a chance to make suggestions, and now we're going to be talking amongst ourselves about some of these things.

MR. BROCOUM: And that's the intent of October, to get one more iteration before we finalize the report.

MR. HUNTER: Yes.

MR. NORTH: I'd like to commend everybody involved in what we've heard for the last day and a half. You've put in an enormous amount of work and I think provided a lot of very interesting material.

It's as yet undigested in measure, especially by us, and the communication of it is going to involve very, very substantial additional efforts, but I think in terms of providing the explicit methodology for planning and analysis supporting DOE's decisions, it's really an indication of a new era. I would heartily commend you for undertaking this effort.

MR. BLANCHARD: Thank you for your comment.

As we close off our presentation, there's a couple of points I think that we need to make. One was yesterday during the discussions you were wondering about the amount of information that was available for these experts to consider.

I wanted to call your attention to the surface space investigation implementation plan that a year ago we sent to you all, to your library. It's a big, thick thing.

I believe during the meeting where you toured the site, we also handed out a number of pages in the briefing book which show pictorially in red those investigations on the site that are planned and in black, those investigations that have already been completed from drill hole or bore hole, a trench or anything else.

If you want to peruse that at your leisure, or if you want additional copies, it covers all of the types of investigations we have. It's a series of maps. They are available for you to look through that.

CHAIRMAN DEERE: Now that we have an official librarian, we have new space, new office, we'd probably better start off by having you do a copy and then we'll be able to find --

(Laughter)

MR. BLANCHARD: Okay.

MR. BERNARD: Max, is that the one that's about that thick?

MR. BLANCHARD: Yes. We gave you two. We gave you a real large folder on it, it's an atlas that showed everything that had been done to the study, and then in

our planning document we gave you another one which had foldouts that showed you the assumptions, when they happened, and who did it. That showed you what's planned and what's been done.

CHAIRMAN DEERE: They were in my office on my desk before we moved.

MR. BLANCHARD: They're both in plastic, green, bounded documents.

To bring the discussion back to where is DOE going, as you remember, yesterday morning we indicated there were some things we had to do and that was initiate management reviews and hold some interactions with the Nuclear Regulatory Commission, particularly on ESF and Calico Hills issues, then begin developing an implementation plan, and in the process of doing that, to the extent that the decision warrants it, peer reviews will be considered.

As we implement any recommendations, we will have to involve reassignment of staff and need a budget for 1991 that accomplishes that, so we'll have to realign things that may be planned otherwise.

There may be a reassignment of people to do things and the consequence of things not getting done if we reassign them to something else.

Where is this management review going, in what

direction? I think Bruce Judd yesterday captured that pretty clearly and I'd like to use a vuegraph or two of his.

It seems if the managers of this program had their druthers, they'd like not to go into a license application with the NRC feeling that the Department was at these points when you plot the releases versus the CCDF.

In fact, indeed, given the druthers of the managers, they'd like to be well on that side of that point. In order to get on that side of that point, one needs to have a good test program and have high confidence that the test program is giving you that information.

We have expert opinion now, based on the available information that seems to suggest we may be on this side, but no one has advocated no tests to be conducted in either Calico Hills or in the Topapah Springs nor has anyone suggested that we not conduct a surface space investigations plan.

So as a consequence the test program will help us define where we are on this side, or if we're on this side, and the extent of that test program is going to determine how conservative, or how much confidence we have that we might be on this side of those points.

Indeed, we don't know that those are necessarily points yet.

40 C.F.R. 191 is not finished. It's still under consideration for changes and Bruce had used this as a decision line. His view was that as one considers the degree of conservatism and confidence you need in that conservatism, this graph that shows recommend versus abandon and looking at performance model output, that line is likely to be over on this side of that graph.

In order to get it there in an intelligent way, we're going to have to spend money and it's going to take time. There are a number of tradeoffs that the Department obviously will have to do. We think the inputs from these three task forces are ideally suited for management involvement.

As Lee mentioned in his decision model, he is incorporating management views with respect to conservatism, with respect to regulatory acceptance and that's the path we're definitely going in. It will lead us into the need to carefully look at what we get for our dollars, where we put the dollars, and what the impact will be in terms of timing for decisions.

From that standpoint, we think the task forces are right on line in terms of what they're tackling and the manner in which those recommendations are coming to

the Department for management consideration.

Carl, do you have anything to add?

MR. GERTZ: No, Max.

MR. BLANCHARD: This morning we had mentioned some open items that we saw from last night. To the extent that we were able, we tried to distribute the copies of the vuegraphs that were missing.

We have encompassed, I know, in our general approach for the Calico Hills risk benefit analysis, that greater level of detail, so I'm sure that will be in the draft report that will eventually be available to you.

We have not done that but we've made a promissory note to all to actually provide in that report what would happen if we had gone through an arithmetic averaging rather than a log averaging for the experts.

With respect to the items that were discussed this morning on your consideration for peer reviewing, the hydrologic part of the Calico Hills study, and some further review on the application of decision analysis, to the extent that you want information from us, we need to find that out. I assume that you will be letting us know.

I'm not sure that we picked up any other items that are open at this stage from the discussions today.

MR. NORTH: I'd like to recommend a rephrasing

of five. I think the issue is not so much the application of decision analysis as methodology. I think the issue is the marriage of the methodology to the substantive expertise.

I'm personally less interested in the management side. I'm only after the utility side. The part that I think is utterly critical for us is to learn our way through those influence diagrams toward those crucial probabilities having to do with the accuracy of the tests and the likelihood of regulatory approval.

As Lee Merkhofer said, those appear to be the critical issues from the pilot analysis. They appear to be the critical issues in terms of the judgments in the Calico Hills study that tend to drive the conclusion on the ranking of the options. I'm leaving aside the performance assessment phase of that.

I would like to see an opportunity for my colleagues and myself to be comfortable to have done due diligence or picking up the car example that we've all used several times, a real in-depth mechanical investigation of the automobile, not just kicking the tires.

I think about all we've had the opportunity to do at this meeting is look at the car, in one case I think we saw it drive around the block, and the other two

it's a car that isn't yet running, and we're being asked to accept a lot of things on faith at this point.

Our job is to delve into the details and I think we need a lot more time and more effort in order to be able to do that. So let's broaden the charter from decision analysis to essentially the areas of technical expertise represented on the Board.

MR. BLANCHARD: Sure. I assume that will play itself out in the development of the agenda for a subsequent meeting perhaps in Albuquerque, maybe in the October timeframe.

CHAIRMAN DEERE: With respect to item four in the peer review for the hydrogeologists, again I would offer this only as a suggestion, that we would be available to discuss it if in your deliberations over the next few months you feel it would be an asset.

There are other areas that might be more critical. We might also be willing or eager to participate in some way, so let's say that number four is simply an expression.

We feel that we have some expertise and can bring it together and if we are the appropriate group to do it, we would try to help. So it's only that, as an offer, we would be available and consider something. I'm not sure it would be number four necessarily. It may

appear that's not the critical, and the critical thing is to get underground there.

There may be others along the way that probably we could discuss at Albuquerque.

MR. BLANCHARD: Sounds fine. Carl?

MR. GERTZ: Just to assure you, Dr. Deere, and the panel that management is involved, we are looking at these things very closely and we are trying to set up with Dr. Bartlett the course we're going to chart for this program.

That involves talking to members of Congress who provide funds and are the genesis of the program, talk to the utilities who are also keenly interested in where we're going and the use of the ratepayers' dollars.

We've been very active in bringing members of the Congress up to Yucca Mountain to show them what we're doing -- staff -- and we're hoping to get actual members out there. We had six CEO utility executives out yesterday on an extensive tour, talking to our scientists like Bruce Crow and the USGS individuals.

So we are involved in weighing all the aspects of the program, including the value of the data obtained and how that fits into our overall program. I just wanted to make that statement.

CHAIRMAN DEERE: I again would like to express

our appreciation for all of the effort of doing the work, of coming here presenting it to us, because I know it does stop your ongoing work but it might be a good pause for you to stop and look at it, and have somebody else look at it.

I also would like to ask if there's anyone in the audience that would care to make a comment or ask a question?

MR. NIGELSKI: Thank you for the opportunity to ask a question and make an observation, if I could.

My name is Phil Nigelski. I am here representing Nye County, Nevada as a local government representative. In that capacity, I have a couple of questions that I think could generate quick response and did have an observation.

The questions had to do with the ESF discussion. Paul, I think it was your discussion relative to the socioeconomics as a discriminator. I just wanted to ask whether that analysis dealt strictly with worker population or did it take into account geological monitoring issues and/or the 10 C.F.R. 960 water disqualifier issues?

MR. GNIRK: It dealt with the first part which was the worker, labor or the population, the influx and so forth. Some of those other items are covered under

testing, some of the environmental compliance requirements and so forth are dealt with under the regulatory part.

The water issue we did discuss. We discussed the water portion having to do with the environment, I know, having to do with would one option take more water than another option, and would that have an impact, a discriminatory impact on our judgments with regard to which option to select.

I think the judgment was, based on the designer's estimates, there was no significant change in water usage between and among options. That's in our transcripts.

MR. NIGELSKI: So that was part of the discussion?

MR. GNIRK: Yes.

MR. MERKHOFER: Excuse me, if I might add, the Socioeconomic Panel that we had took great pains to emphasize to us, and I'd like to emphasize it to the audience here, that the fact that the socioeconomics was determined to be not a discriminator was not equivalent to a conclusion that there is no significant socioeconomic impact.

The existence or the possible magnitude of the socioeconomic impact is something that will have to be

looked at. The conclusion from our panel was that they could not discriminate the level of the seriousness of that impact across the 17 options.

MR. NIGELSKI: That would be interesting for us to be able to look at that transcript and understand that.

The second question had to do with kind of a logistics thing. In terms of the resource materials provided to the panels, how are those materials provided and really what use was made of them? I'm specifically referring to the TRB comments, the NRC comments, and State's comments relative to the ESF.

MR. HUNTER: Most of the panels that deal with that information have not done the scoring process yet. That resource information is being developed to be provided to them when the scoring occurs.

MR. NIGELSKI: My understanding was that the process -- at least to date -- had some of those concerns incorporated or will that be at a later time?

MR. GNIRK: Let me just say some other things. In many of these cases -- I believe socioeconomics is one, I know environment was for sure another one -- we provided, Lee and I provided information to these people via Sandia from the work we had done back in 1985 and 1986 as to all these factors. The work at that time was

based on the environmental assessments.

Subject to that, there was reference lists developed, as I recall, at various times and these people had access to those.

In the scoring activities itself, we had information, as you will see in the transcripts that come out, which we referred to directly in which I asked the questions "Are you familiar with this information? Have you read it? Have you considered it?"

So I can't remember exactly all the bits and pieces of information because we're dealing with 20 different areas, but we make an effort each and every time to try to insure that the panel has the benefit of all the most recent information, whether project side or where it comes from.

In practice, people who are informed with regard to working in this program and have been in this program for numbers of years, we expect them to have knowledge of a lot of this information.

MR. NIGELSKI: What I am specifically concerned about, again from Nye County, Nevada perspective, is that Nye County has relied upon the State's technical program to do the in-depth technical analysis and would want to, from a Nye County perspective, be confident that those comments that came in relative to the shaft were given

explicit consideration within this process, and would like to have some assurance that's the case.

MR. STEVENS: Let me make a comment. Just as I pointed out that we are identifying a direct relationship between regulatory requirements, and I gave you some examples in my discussion this morning of 10 C.F.R. 60 requirements being identified very pointedly with factors on those influence diagrams, we are also doing that with the concerns expressed by this Board here and by the comments we've received from you.

That process is just closing out. It's a matter of making those identifications and providing a base of information to give to the evaluation team. I would presume that could be made available in due time.

MR. PETRIE: Yes, in due time, not today certainly but when it's completed, it will be available.

MR. NIGELSKI: Again, we've made a conscious decision to allow the technical analysis to be done at the state level and have confidence in the work they've done in general.

I did have one other observation, if you'd like, that I could submit to the record or just give it to you right now.

CHAIRMAN DEERE: Right now.

MR. NIGELSKI: I don't know what your timeframe

is but I'll be real quick.

Basically, it has to do with the participation within these panels. I would like to comment that the county appreciates the direction the Department is going with this decision-aided methodology and see it as a very valuable exercise.

I'm a layperson, most of you are scientists, so I come at you from a lay perspective. I want to make just one observation and that is that while DOE is be commended for this decision-aided methodology as a tool for helping address very complex issues, the presentations that have identified the fact that the panels are I guess, with one exception, internal to the Department and that the scientific input goes into the panels, from internal to the Department.

The county is not in a position to know the rationale for this decision. Nonetheless, if the Department is moving toward an approach where scientific judgment is going to be used to compensate for this technical uncertainty or scientific uncertainty which is clearly recognized, using decision-aided methodologies, we feel that great care must be exercised in selecting those whose judgments will be relied upon.

The Department has many excellent scientists performing work for it. I personally have met a good

number of them, but the fact is, and I hate to state the obvious here, the repository program cannot exercise scientific judgment in a vacuum.

Affected parties like Nye County will also be making judgments, for example, about the technical representativeness of the panels upon whose judgment the effectiveness or decision-aiding methodologies must rely.

The reality is that it is not where you stand but where you sit. If the scientists predominantly who are participating in this exercise sit within the Department, those outside the program looking in are going to be concerned about the outcome of the process.

Let me quickly conclude by saying that I've expressed concern for the formulation of panels for applying decision-aided methodologies because, here again I'm stating the obvious, it is the panel's judgment which will guide the programs discussed in the past two days.

I do have some specific suggestions that I'll submit in writing which should be taken into account when future panels are established.

Finally, I'd just encourage the Board to continue this process, in a sense, a peer review of these decision-aiding methodologies. Thank you.

CHAIRMAN DEERE: Thank you.

Are there other statements?

(No response.)

CHAIRMAN DEERE: Meeting adjourned. Thank you for coming.

(Whereupon, at 3:40 p.m., the meeting was adjourned.)

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before United States Nuclear Waste Technical Review Board in the matter of: Panel on Structural Geology and Geoengineering and the Panel on Hydrogeology and Geochemistry

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

Official Reporter

DATE: July 25th, 1990