

UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD

FULL BOARD MEETING

Surface-Based Dry Drilling
Underground Testing Program

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1 address some of the issues that they call to our attention.
2 So, I expect to be at the Board meetings whenever I can be
3 and be interacting with the Board on a steady basis.

4 Thank you.

5 DR. CANTLON: Thank you very much.

6 Ed, you can take over?

7 DR. CORDING: Thank you.

8 I will be this morning chairing the session and
9 then in the afternoon we're going to have again a round-table
10 and we're very interested in input from all of you in that
11 session this afternoon.

12 I wanted to make a few comments in regard to our
13 session this morning which is focusing on the exploratory
14 studies facility. I think one point, before we get into the
15 exploratory studies facility, we must recognize, even though
16 the way we have divided these sessions yesterday and today
17 and the way a lot of our plans in the program are developed,
18 there's a separation between surface-based and ESF for
19 underground testing and, certainly, we need to be aware and
20 we need to be focusing on the overall site characterization
21 problem. The two must go hand-in-hand.

22 I think just one brief comment in regard to that.
23 One of the things that we see with putting boreholes around
24 the site is the need to obtain information on lithologic
25 characteristics, the lithology at various depths, and then to

1 get some idea of variations. To me, that also needs to be
2 integrated with what we see underground. You can't get all
3 of the lithology, of course, with a horizontal drift at one
4 lithologic location, at one elevation, but certainly you can
5 obtain a sampling in that lithology of local variations. And
6 so, all that sort of information, I think, has to be put
7 together and, as we look at the program, recognizing limited
8 budgets and the two shouldn't be fighting against each other.
9 The surface-based versus ESF, that should not be versus, but
10 a cooperation of the two programs.

11 I wanted today, though, to focus on another
12 integration issue and that's regarding ESF construction and
13 ESF testing. In a program, such as this that involves
14 cutting edge science and major, major heavy construction,
15 this is obviously a major challenge and one that requires the
16 best thinking and resources of everyone in the program. We
17 have a recent report out on ESF in this last few days which
18 addresses some of these issues and we're looking forward to
19 further discussions with DOE on that. The title of the
20 report is Underground Exploration and Testing at Yucca
21 Mountain, a report of this Board.

22 Until very recently, the ESF strategy involved
23 multiple excavation operations and testing principally from
24 the north portal and this became increasingly compressed,
25 this testing and excavation schedule, as funding continued to

1 be delayed or not meet the expectations and these were
2 compressed in order to meet the licensing goal of 2001. The
3 increases in the annual budgets did not materialize to allow
4 this goal to be achieved. Now, we're looking at a more
5 extended program for the underground exploration and testing.
6 Certainly, simultaneous operations that interfere with each
7 other can be detrimental to schedule and to cost and one
8 needs to minimize those sorts of things so that the program
9 doesn't suffer. Once the main loop is excavated, however,
10 there's going to be opportunity for more, much more, access
11 to the underground for multiple operations in terms of
12 testing, testing opportunities, and further excavation
13 operations; starting, for example, another 18 foot machine,
14 another machine which would be a smaller diameter machine to
15 do further excavation. And, if these opportunities aren't
16 taken in a timely manner, then, of course, the cost and
17 schedule of the program will also suffer. And, we really do
18 want to see the momentum that--and much of the progress that
19 has been built has been gained in the last two years--for it
20 to continue and for the program to be able to move forward.

21 I think we're very interested in learning more
22 today about how we tie together testing and the construction
23 and the exploration. We know much about the test plans that
24 have been described and are being updated, but we would like
25 to learn, I think, today not only about what is the test

1 plan, but how is it to be sequenced? How does it tie into
2 the excavation and construction?

3 Late last year, the project office at Yucca
4 Mountain published a report entitled Planned Exploratory
5 Studies Facility Tests and this document described 42 tests
6 and the locations, in general, with ESF. The test plan at
7 that time described 88 alcoves through the ESF in a core test
8 area which would be approximately 9,000 feet of tunnel. In
9 examining these 42 tests, we grouped them--I was able to
10 group them into four different categories. There were tests
11 associated principally with exploration sampling along the
12 lengths of the tunnel, 16 tests for that. Thermal testing
13 involved five tests. The hydrogeologic chemical testing was
14 12 and then geomechanical and the engineering type testing
15 was nine. This seemed to be a breakdown, at least, that
16 allowed us to look at the program and be able to assess more
17 how they might be tied in with the construction.

18 The tests associated with exploration, some of
19 which would be conducted during excavation and others after
20 the excavation walls were exposed, include geologic mapping,
21 sampling of perched water, testing across some of the major
22 faults. The second area, the thermal testing, was certainly
23 a very high priority issue that we are very concerned gets
24 started as soon as possible and it's the thermal testing
25 particularly for the evaluation of the groundwater vapor

1 transport issues. Further discussion on this needs to be
2 done and we need separate sessions, perhaps, for that. But,
3 certainly, there's a--you know, it's important that
4 underground thermal testing be started as soon as possible.
5 It certainly provides a major driver to the way the
6 underground facility is to be opened up and plans developed
7 to allow that work to start.

8 The other area, the hydrogeologic or the
9 geochemical type testing, this area with particular emphasis
10 on tests in the unsaturated zone and the unsaturated zone
11 percolation test plan have been also--also, really are high
12 priority tests. These tests are described as being conducted
13 in the alcoves throughout the ESF and in the core test area.

14 I hope that the discussions today will focus on
15 what the objectives of these tests are, how these tests are
16 to be conducted, the timing of the tests, and the manner in
17 which they are integrated with construction. Certainly,
18 there needs to be flexibility in these programs, but I think
19 some outline of how these things will be tied with the
20 construction would be of interest to us.

21 The geomechanical engineering testing, the fourth
22 area that I described, makes up the remainder of these 42
23 tests we described. And, it's certainly important to perform
24 these tests to develop appropriate rock support systems,
25 evaluate long-term stability, to evaluate design and

1 construction issues for the repository, as well as for the
2 continuation of the work in the ESF. But, for the most part,
3 these items on geomechanical and geoengineering are not as
4 closely related to site suitability issues as are the
5 hydrogeology or geochemistry tests. I think with careful
6 planning that many of these tests can be conducted as add-ons
7 to the thermal testing, for example, when we're concerned
8 about the thermal issues and many of these tests also can be
9 conducted as targets of opportunity during the excavation or
10 behind the excavated areas in the exploratory studies
11 facility.

12 With some of these thoughts in mind, I'd like to
13 begin our presentations today. Our first presenter would be
14 Ned Elkins with Los Alamos Labs and he's going to be
15 reviewing the ESF program.

16 Just briefly, as Ned gets up here, we're going to
17 have a review of the unsaturated zone percolation tests by
18 Mike Chornack from the USGS, and then after the morning
19 break, Dale Wilder from Lawrence Livermore Labs will provide
20 an update on thermal testing.

21 So, Ned, we're looking forward to your
22 presentation.

23 MR. ELKINS: Thanks, Ed.

24 I'm going to break our discussions today, at least
25 from the test coordination standpoint, into two primary

1 components; one, I will talk about for a few minutes here at
2 the beginning of the morning and then, at the end of the
3 morning, I'll come back. The first of these talks will be
4 somewhat of a review of the preliminary test planning
5 process, the current status of our ESF test program, and then
6 at the end of the morning would like to spend some specific
7 time talking about future test programs, specifically in the
8 environment of the TBM, post-TBM testing.

9 Some of the questions, I think, Ed, that you raised
10 will probably be addressed during some of the discussions
11 given during the morning, as well as some of them I'll come
12 back to, I think, in the second presentation. But, if you'll
13 bear with me and, in fact, you've done a better job of
14 describing breaking this test program up than I could, I
15 think, and maybe even got me where I can shorten up this
16 first presentation some. But, what I did want to do is back
17 up and go over very briefly with you what the initial test
18 planning process has been and where we currently stand with
19 our testing.

20 The steps that we go through, not in sequence
21 necessarily--in fact, most of this is an iterative process--
22 but the steps in developing our test program underground,
23 beginning at the time that we picked our new configuration
24 coming out of the alternatives study, has been an initial or
25 preliminary definition of testing and ongoing effort to

1 consolidate and prioritize the test program underground and
2 incorporation of the high-level test criteria requirements
3 into facility designs and construction plans. Then, detailed
4 test planning, sequencing, preparation, take these test
5 activities in the field, and lastly, field implementation and
6 iteration.

7 As I mentioned, following completion of the ESF
8 alternatives study, the first thing that the underground test
9 community did was to go back and take a look at the SCP, the
10 SCPB, and scrub that against the general configuration of the
11 ESF and the opportunities that we believe are going to be
12 present in the ESF for fielding this test program. We then
13 developed a preliminary test plan, Test Planning Package #91-
14 5. That's the base of the information that Ed mentioned a
15 few minutes ago. The input to that document was prepared by
16 the U.S. Geological Survey, Sandia National Laboratories,
17 Lawrence Livermore, and Los Alamos who were the primary
18 participants in the underground test program.

19 Immediately, upon finishing that test planning
20 package and getting an idea or an arm around the entire
21 underground program, we began two processes; one of which is
22 certainly still ongoing and the other which will be revised,
23 as necessary. The ongoing activity are evaluations to
24 streamline and sequence our underground test program. Forty-
25 two activities were identified in 91-5. Of those 42, the

1 vast majority, 85 or 90% of those activities, are multiple
2 location activities underground, either continuous or at
3 various points of opportunity underground. Very few of those
4 tests are single point tests where you do that test one time
5 and one time only. Primarily, those tests are the very
6 large-scale thermal tests as they are currently planned.

7 The process of getting that preliminary test
8 program into a design basis where we can begin to integrate
9 our construction design activities with testing began
10 immediately upon development of Test Planning Package 91-5
11 through the complete revision of Appendix B of the ESFDR
12 which is the exploratory studies facility design requirements
13 document. Appendix B test by test goes through the high-
14 level design requirements, what the facility must provide in
15 order to field these activities. So, we use the basis of 91-
16 5 in preliminary fashion to go through and provide a high-
17 level look at all the design requirements underground for the
18 test activities. As a part of detailed test planning, what
19 we do then is go back and take each of these activities in
20 sequence and do a detailed test plan which includes detailed
21 design construction support requirements prior to taking
22 those activities into the field.

23 As Ed very capably summarized, 91-5 defined 42
24 tests. These ranged in complexity, if you will, from
25 something as simple as going down and taking a bulk sample of

1 rock out of this facility, just basic sampling type
2 activities, through small-scale test activities which require
3 perhaps a single borehole or a small niche in order to
4 provide some space or application forecast to very large-
5 scale in situ programs, the largest of which--and, current
6 plan--certainly is our large-scale thermal test program,
7 waste package environment test, a Lawrence Livermore
8 activity, which will dominate, if you will, the core test
9 area in the ESF. The results of this test planning activity,
10 preliminary activity, are fully consistent with and
11 represented by site characterization program baseline, the
12 SCPB, and have been reported to the NRC in Semiannual
13 Progress Report #4.

14 Currently in the field, in the ESF, five test
15 activities are underway. The first of these, geologic
16 mapping, actually began before we went underground. We did
17 detailed mapping and geologic summarization of the slot & box
18 cut area. We're taken that mapping program underground both
19 through photogravimetric processes, as well as actual mapping
20 of fracture surfaces and the beginning of our line surveys.

21 Perched water, we have in the field as a
22 contingency. We're prepared, if we encounter any saturation-
23 zones of moisture in the ESF, immediately to begin
24 characterization and sampling of perched water.

25 We have a consolidated sampling program underway,

1 as well; primarily, at this point in time, emphasizing the
2 mineralogy and petrology elements of a program and water
3 movement tests which we've initiated. This consolidated
4 sampling effort, I think I'll talk about a little more in
5 detail in a moment. But, it's one of those efforts that we
6 have gone through to consolidate and try to streamline our
7 test program by taking essentially nine of these 42
8 activities and combining them into a single field activity
9 whose only real purpose is to allow for a design, support,
10 and construction support that lets us go in and take samples
11 for these nine activities so they can be taken to
12 laboratories and various analyses.

13 We have initiated construction monitoring
14 activities, both tied to site characterization plan, as well
15 as an additional component of construction monitoring by our
16 test community to support safety analyses and ongoing support
17 of design.

18 Fran Ridge large block experiment is underway in
19 terms of the setup of that activity. We've done experimental
20 saw cutting from a block at Fran Ridge, are currently
21 drilling and blasting in preparation of defining a single
22 large block that will remain in place at Fran Ridge as part
23 of Lawrence Livermore's developing test program, and that is,
24 as I say, currently in its setup stage.

25 In addition to the five that are currently in the

1 field, two additional tests are fully planned and are ready
2 to implement in the first alcove that's being developed in
3 the ESF and that alcove is under construction currently and,
4 in fact, the first of these test activities have been
5 initiated and that's the hydrochemistry test program in
6 Alcove #1. That test activity will actually look at pristine
7 gas samples taken immediately after round firing and mucking
8 in selected rounds as we develop the alcove. Ultimately, the
9 marquee test in this alcove, the large test, will be the
10 radial borehole test, the first of our radial borehole tests,
11 certainly, and this is a non-contact or in an anisotropic
12 radial borehole test to define the upper Tiva Canyon.

13 Three additional test activities are in final
14 planning and preparation and we will initiate these test
15 activities almost immediately upon beginning TBM excavation.
16 The first is tied to the contact at Bow Ridge Fault when we
17 reach that point. Hydrologic properties in major faults, a
18 USGS activity, part of their percolation of ESF study plan.
19 We will begin in earnest to incorporate Sandia's thermal
20 properties program into our consolidated sampling test at
21 that point in time. And then, lastly, we will expand our C₂
22 design verification activities to include excavation
23 investigations. The main element of our excavation
24 investigation will be the beginning of our convergence
25 testing or large-scale access convergence testing program.

1 The test program underground is sequenced and is
2 currently in a process of sequencing--this is an ongoing
3 iterative process--that sequence being based on a strategy
4 and a prioritization the Yucca Mountain Project Office
5 endorses in going through. And, I've broken the efforts that
6 we used to prioritize this program into three primary
7 components here. The first is an ongoing integrated test
8 evaluation process. We're in the second phase of that
9 process at this time. The ITE gives us a good basis, an
10 integrated basis in our surface-based and underground test
11 programs; priority, which of those activities do we need to
12 be putting early emphasis on.

13 The second, we have a long-range characterization
14 program planning effort and a long-range plan on the project
15 under which on an annual basis the primary of these
16 activities is the YMP annual planning, the near-term
17 prioritization and resource planning process. And, this
18 annual planning process, again, incorporates both surface-
19 based and underground testing and we use this primarily to
20 define in near-term bytes, given the next fiscal year coming
21 up, what tests we need to be putting maximum emphasis on the
22 planning of to get those programs in the field.

23 Final prioritization of our underground program,
24 however, has always been based primarily on a three phase
25 process. They ask the question of irretrievability or the

1 retrievability of data. If we have one of our test
2 activities that the data from which cannot be retrieved if we
3 don't do it at the time of early excavation during
4 construction, then we feel that the test must be put in place
5 at the time excavation is there. We do not want to lose
6 data. Therefore, irretrievability is the first concern or
7 the first issue we raise on a test. If the data is
8 retrievable, we at least have a candidate for a deferrability
9 or for deferring to that test until such time as a window of
10 opportunity allows without any impact to ongoing construction
11 program. We always try to maximize our ability to field this
12 test program with minimal impact on our ongoing construction
13 activities.

14 If a test is basically retrievable, however, is
15 very key to our determination of site suitability. Those
16 tests tend to be those that we prioritize most highly. We
17 feel it's very important to field those tests that give us an
18 idea of suitability of the site as early as possible and the
19 determination of site suitability as evaluated through our
20 ITE process and that's being reviewed annually through our
21 annual planning process is the basis on which we make that
22 prioritization call.

23 And, lastly, some of our tests, even if they're a
24 design related test or an engineering test and may not
25 directly feed site suitability, if it has an extremely long

1 fuse, if it's a long-term activity, given the fact that we're
2 trying to meet our milestones in testing and we would like
3 certainly not to have a test that must have a six year
4 duration deferred until the end of the test, we allow that
5 concept to come into the planning process to where we may
6 prioritize the test activity simply because its duration is
7 not compatible with a long-term deferrability.

8 Basically, the first part of the talk is
9 encompassed by that. I wanted to show a couple of best
10 available pictures. These are drawings the test coordination
11 office essentially keeps and updates. Just very briefly to
12 give you some idea of the upper region of the north ramp, our
13 Title 1 design, our early design process, preliminarily
14 identified potential locations for alcoves. These locations,
15 some of them, are shown in your packet. You'll see several
16 potential alcoves. In our Title 1 design process, we looked
17 at a maximum field of test program where we looked at those
18 potential points of opportunity where we felt that we may
19 need to field underground tests; the purpose being we wanted
20 our early conceptual design to be fully capable of supporting
21 the maximum test program. These should never be looked at
22 and read into that there will be a given number of alcoves in
23 a given reach of tunnel or in a given reach of the ramp; only
24 the fact that this was our initial planning currently for
25 Package 2c which is the north ramp design or Title 2 design.

1 The test community is actively working to define early or
2 critical alcoves necessary. The final number of alcoves
3 post-construction in the north ramp is something I can't
4 answer right now, but our best current basis for that
5 approximation or for our best guess for that is still our
6 Title 1 design. And, these are the alcoves that are shown
7 here.

8 The first 1,000 foot section of the north ramp,
9 I've shown blown up here and the test planning packages and
10 job packages being developed for those activities. Again,
11 you can't read them here, but in that first 1,000 foot reach,
12 two alcoves, the one currently being constructed in the
13 starter tunnel and the second being the Bow Ridge Fault
14 alcove complex that we intend to put in upon passing through
15 with the TBM this fiscal year.

16 I will throw this--it's in your package. I'll put
17 this up, but I want to come back and spend more time with
18 this later in the morning when we talk about our test
19 program, sequencing of that program, along with construction.
20 This is just a little bit of the stylization of the cartoon
21 that Russ showed yesterday of the TBM and its setup and I do
22 want to spend some time talking about how we will use the TBM
23 capability to gain some early test information and how we'll
24 sequence some of our testing behind that. But, if you don't
25 mind, I'll defer that discussion until the second phase of

1 these talks.

2 And then, lastly, you may have seen--at least,
3 taken a glance at this one yesterday. In your package,
4 there's a set of drawings that show the primary test activity
5 in Alcove 1 which is in an isotropic radial borehole test.
6 You can get an idea of the size and configuration of our
7 first alcove that's currently being excavated. In fact,
8 yesterday, we shot in that alcove and are now essentially 28
9 feet excavation depth in on this alcove. We have a design
10 depth on this alcove at about 65 feet. The final depth will
11 be determined with the U.S. Geological Survey at the time we
12 pass through a shear zone which runs through and is
13 identified by our mapping activities across the ramp and
14 across this alcove. We want to pass through that shear zone
15 because this non-contact test is a test that we don't want to
16 be in a shear zone or an anomaly at the time that we run this
17 test. You also will get an idea of the configuration,
18 spacing, orientation of the primary core holes that will be
19 drilled for this activity. I'll talk a little bit more about
20 the radial borehole test activity and fault properties
21 testing that I just wanted to talk about.

22 Ed, with that, certainly, any questions you want to
23 have at this time, recognizing we'll talk in a little more
24 detail about the test program later in the morning.

25 DR. CORDING: Okay. Any questions from the Board?

1 (No response.)

2 DR. CORDING: Ned, in describing the second test--or the
3 second alcove, you described as being in the Bow Ridge and
4 that's the second one that's shown on this sketch, this
5 cross-section. You say that would be done right behind the
6 machine or is that to be done later? How are you planning
7 that now?

8 MR. ELKINS: At this point in time, Ed, we have not been
9 able to determine whether or not we'll do it immediately
10 behind the TBM or whether we'll do it some distance behind
11 TBM. It's an open question. We would like on the first of
12 our fault tests to get that alcove in just as quickly as we
13 can. One of the reasons--as well as the first alcove, Ed,
14 one of our main drivers for getting that first alcove in and
15 for wanting to have the first ramp--or for the first fault
16 property test as quickly as we can is we certainly have some
17 question about the deferrability of some of our hydrologic
18 permeability tests. We need to get some of those tests in
19 and we need to collect the early data from those to help us
20 determine what impacts or effects waiting one month, three
21 months, six months, a year after primary ramp excavation will
22 have on the collection of these data. It could modify the
23 test plans, it could also modify our construction approach.
24 Our concept is that some of these tests, certainly we believe
25 we can defer for no other capability by just constructing a

1 little deeper alcoves and getting out of the influence of the
2 ramp. However, it's very important to us that that first
3 alcove for the first fault property test be put in just as
4 quickly as we can with the TBM.

5 So, the construction community, as well as testing
6 is working day-by-day to define what that best window of
7 opportunity is. Certainly, our Title 2 design process is
8 maximally looking at ways to get alcoves started behind TBM
9 without large-scale impact to construction where the machine
10 has to sit down and sit idle for long periods of time. We
11 believe there are ways to at least initiate our alcoves as
12 the TBM passes through and then construct and complete those
13 alcoves soon after excavation.

14 DR. CORDING: Will we have some opportunity maybe
15 perhaps to describe some of those possibilities? I know that
16 they're in the plan--I assume they're still in the
17 development stage.

18 MR. ELKINS: The ability to talk about what construction
19 has in mind for getting some of those started, Dan, I don't
20 know who might be here from design construction today if we
21 want to get into those in the free discussion in the
22 afternoon.

23 MR. MCKENZIE: Well, I think if you refer to the
24 briefing that I gave yesterday, the backup data, there's an
25 excavation study that's shown--I believe it's in Package 2b

1 --and that is supposed to contain an evaluation of what are
2 some of the ways of getting these alcoves started with a
3 minimal delay and indeed what process we ought to use to
4 excavate them. But, it's not here yet. 2b is--I think, 90%
5 review is on another month from now or two, but it is in
6 process.

7 MR. ELKINS: We had discussed that at various meetings
8 and workshops, if you will, what some of those methods might
9 be and I would imagine that we have enough people, as I see
10 looking around the room, that have been involved in those to,
11 at least, discuss some ideas and certainly to hear ideas that
12 you and your staff may have, as well.

13 DR. CORDING: Could we have some of those then this
14 afternoon? Perhaps, that might be a good time for some
15 discussion of that. I think that would be very beneficial.

16 Questions, John Cantlon?

17 DR. CANTLON: Were there any changes suggested in these
18 tests in the alcoves and so on after the pneumatic properties
19 impact question came up?

20 MR. ELKINS: No, sir. No change of the tests in the
21 alcove.

22 DR. CANTLON: Thank you.

23 DR. CORDING: One other, Ned, I'm sorry. The radial
24 borehole testing and the hydrochemistry testing in Alcove #1,
25 did you say you were going to describe later what that radial

1 borehole testing would involve?

2 MR. ELKINS: Yes.

3 DR. CORDING: Okay, fine.

4 MR. ELKINS: We'll talk about that a little more--

5 DR. CORDING: We'll talk about that later. Thank you.

6 Any other questions? Staff?

7 (No response.)

8 DR. CORDING: Okay, thank you. Oh, one? I'm sorry.

9 Russ McFarland?

10 MR. MCFARLAND: One question. Ned, looking at your test
11 Alcove #1, the drawing you presented, I'm curious that you
12 have an alignment to the nearest second of arc. What is the
13 basis for that accuracy needed for the turnout of that
14 alcove?

15 MR. ELKINS: It was a calculation of accuracy that's
16 shown on the drawing. We have no field requirement for that
17 accuracy to be met. But, this is a drawing that was
18 developed. This is not the design drawing. This is a
19 drawing developed in our own office. The reason that that
20 alcove is not a perpendicular alcove, Russ, is because of a
21 decision made in our design construction test integration
22 program where the original location for that alcove based on
23 preliminary mapping was to take off and be perpendicular to
24 the ramp at Station 1+50. And, at that location, given the
25 fact that we probably were not going to be continuing

1 excavation of the main, we had some gripper pad problems
2 right in that area in that we were too close to TBM
3 activities that would be putting stress on that area. We
4 didn't want to have an opening there. We backed up 10 feet,
5 but it was important to end up that alcove at the opportunity
6 that we saw from mapping. We wanted to be at that location.
7 So, we backed up 10 feet and came in kind of at a dogleg and
8 it's just a calculation accuracy that you see in that.

9 MR. MCFARLAND: Okay. Thank you.

10 DR. CORDING: Thank you very much.

11 John?

12 DR. CANTLON: I didn't see any mention of any in situ
13 corrosion tests for the study area. Are there none?

14 MR. ELKINS: The Lawrence Livermore study plan is still
15 being developed for their waste package program testing.
16 Dale Wilder is going to give a talk today. I believe that
17 there probably are components of that not only in ESF, but
18 probably as well going to be worked into our large block
19 program and laboratory program. But, I'd almost rather Dale
20 discuss those in detail.

21 DR. CORDING: Bill?

22 MR. CLARKE: I couldn't come up unless you called on me.
23 That's the protocol.

24 Yes, indeed, we have a full range of corrosion
25 tests planned for the ESF and also for the large block test.

1 In the holes that we were going to do the geochemistry, we
2 are going to put specimens down that simulate the current
3 design materials that we are working on with in situ
4 monitoring sensors for both corrosion potential pH and
5 various anion species and that will also be simulated in full
6 scale because we are now developing sensors for the actual
7 ESF operation, hopefully which will lead us into actual
8 monitoring for the eventual repository.

9 DR. CANTLON: Before you get away, is this now with the
10 base plan container or with the new thinking of the larger
11 in-drift placing?

12 MR. CLARKE: It's going to be both and it will cover a
13 suite of materials which will involve all the range from cold
14 to a hot repository.

15 DR. CANTLON: Thank you.

16 DR. CORDING: You've been trying to take that off for
17 several minutes, Ned.

18 MR. ELKINS: Sorry about that.

19 DR. CORDING: Thank you very much.

20 Our next presentation is by Michael Chornack with
21 the USGS. It's the characterization of the Yucca Mountain
22 unsaturated zone in the ESF.

23 MR. CHORNACK: Thank you, Ed.

24 Between Ed's introduction and Ned's talk, I think
25 I'll just do a summary here because they've pretty much

1 covered a lot of ESF tests. But, what I'm going to try to do
2 today is give a little more detailed presentation of what
3 we've got planned for some of our tests that will be
4 connected with the study plan characterization of Yucca
5 Mountain unsaturated zone studies facility.

6 There was some discussion yesterday as far as how
7 current these study plans are. This is one study plan that's
8 been quite extensively reviewed. When we first wrote the
9 study plan, we were looking at one shaft and one shaft
10 facility. With the change in the design from shaft to two
11 ramps, we've had to modify the study plan quite extensively.
12 So, this actually is Revision One of the study plan. And,
13 because the study plan consists of eight A tests, some of
14 these tests are construction phase tests and some of these
15 tests are at the main test level. There are actually--
16 sections of this study plan that are actually being written
17 right now.

18 This is a brief outline of how I'd like to
19 structure my presentation with the purpose and objective and
20 rationale for the study and then, more important, I'd like to
21 get into the description of the test activities as outlined
22 in the study plan. And, I'll talk a little about the--use
23 the studies in the starter tunnel of the first alcove,
24 although Ned has pretty much given you everything there is, a
25 good update on that already, and I'll conclude with some

1 summaries.

2 We've seen quite a few versions of this diagram of
3 the ESF. Basically, starter tunnel and the first testing
4 will also be conducted in the north ramp. We've got an
5 extensive testing program in the south ramp which pretty much
6 mirrors the north ramp testing and we've also got some tests
7 that will be conducted in the main test level in the TSw₂,
8 the Topopah Spring welded.

9 The schematic of the lithologic units that comprise
10 Yucca Mountain, we've broken them into stratigraphic units
11 and also geohydrologic units and you can see that in places
12 the stratigraphic units and the geohydrologic units do not
13 coincide. The geohydrologic units are based primarily on
14 hydrologic properties units trying to group the welded
15 fractured tuffs together and the non-welded and non-fractured
16 tuffs together.

17 I'll have to apologize. This diagram is not in the
18 handout, but I've had copies made and distributed. This is a
19 fairly recent diagram and it shows the north ramp and it also
20 highlights some of the test locations for some of the
21 unsaturated zone tests that we'll be conducting in the north
22 ramp. As Ned pointed out, this is the first alcove and in
23 that alcove we will conduct our radial borehole test and also
24 our ESF hydrochemistry test. And, as Ned also pointed out,
25 we have already conducted the first ESF hydrochemistry

1 sampling in this alcove. And, the various other test
2 locations going down along the projection of the north ramp
3 testing both intact blocks of rock, contacts, and also some
4 of the structural features that will be intersected by the
5 north ramp.

6 Basically, our study for the characterizing of the
7 unsaturated zone in the ESF, I've broken into two types of
8 tests; construction phase tests and what I call post-
9 construction phase tests. What I'm going to concentrate on
10 today in my talk are the construction phase tests which
11 consists of these five tests; the radial borehole tests,
12 excavation effects, perched water tests, hydrochemistry
13 tests, and the major fault tests. Now, these are not listed
14 in any order in which the tests will occur. This is
15 basically the order in which they are in the study plan. And
16 then, at the main test level, we will conduct also these
17 other three tests, but because of the length of time it would
18 take to describe all those tests, I'm going to concentrate on
19 the construction phase tests. But, they are the intact-
20 fracture tests, percolation tests, and bulk permeability
21 tests.

22 Also, listed beside these tests are the principal
23 investigators who will actually be conducting these tests.
24 I'm fortunate today that I do have the three principal
25 investigators for the construction phase tests. They are

1 present in the audience today. So, at the end of my talk,
2 they will be able to answer any detailed technical questions
3 because one person can't know all the technical details of
4 all these tests. They're quite involved.

5 Here's a block diagram that just shows how the
6 various tests feed into the characterization of the
7 unsaturated zone and connects to our site unsaturated zone
8 hydrology study. And, all these studies--the regional
9 hydrology site saturated zone study feed into the
10 geohydrology program.

11 Okay. The purpose of the study, three main
12 purposes. The first is provide hydrologic parameter input
13 for the resolution of design and performance issues, a very
14 important purpose of this study. Secondly is to provide an
15 understanding of the impacts of ramp and drift construction
16 on the in situ hydrologic characteristics. Thirdly, the
17 studies will contribute an understanding of the in situ
18 hydrologic characteristics of the unsaturated zone.

19 I also wanted to make a very important point here
20 that this study is not a stand-alone study. In fact, none of
21 the studies at Yucca Mountain are stand-alone. But, the
22 hydrologic evaluation of the unsaturated zone will be
23 conducted as an integrated set of surface-based and ESF
24 activities with a common objective to provide an
25 understanding of the past, present, and future fluid flow

1 characteristics in the unsaturated zone at Yucca Mountain.

2 There was a lot of discussion yesterday as far as
3 characterizing the unsaturated zone in the vertical sense
4 with boreholes in a horizontal sense in the ESF ramps and
5 drifts. And, what we will do in the final analysis of all
6 this data, we'll combine all this data and hopefully have a
7 very good understanding of the fluid flow characteristics in
8 the unsaturated zone at Yucca Mountain.

9 Okay, the objectives of the study. I've sort of
10 broken these down into technical and what I call regulatory
11 objectives. The technical objectives are to characterize the
12 in situ unsaturated zone hydrologic conditions. We will do
13 this by analyzing core and fluid samples obtained from the
14 boreholes that are drilled in the ESF in connection with this
15 study. From borehole logs, both the geophysical logs,
16 lithologic logs, and tv camera logs to look at primarily the
17 fractured characteristics encountered in the boreholes, the
18 in situ fractured characteristics. And, also, we will
19 conduct in situ borehole testing and monitoring. The in situ
20 borehole testing monitoring is the major emphasis of the ESF
21 studies. We're also trying to characterize the spatial
22 distribution of present day fluid flow within the unsaturated
23 zone and characterize gas and vapor flow in the unsaturated
24 zone.

25 Here's another block diagram that sort of

1 illustrates this flow of data gathering to answer the final
2 questions of the hydrologic program primarily through the
3 input to the various geohydrologic models; in this case, the
4 unsaturated zone hydrologic model.

5 And, regulatory objectives. The regulatory
6 objectives are primarily designed to answer design and
7 performance issues. One is to provide hydrologic data for
8 calculations of unsaturated zone groundwater travel time.
9 Secondly, provide hydrologic data for the predictions of
10 radionuclide releases to the accessible environment. This is
11 primarily through some of the gaseous or water vapor studies.
12 And, also, to provide hydrologic properties data to design
13 analyses of the underground facility, repository seals, and
14 waste packages.

15 And, this is just basically another block diagram
16 that shows how the unsaturated zone studies feed into the
17 various issues and some of the breakdown of the performance
18 issues/design issues in characterization programs.

19 Okay. The rationale for the study, why do we want
20 to conduct these studies? First, hydrologic testing in the
21 exploratory studies facility or ESF will supplement or
22 compliment surface-based testing. I think this is a very
23 important fact again stating that the surface-based testing
24 gives us a lot of--because the boreholes penetrate the
25 unsaturated zone in vertically, we get a lot of site-specific

1 vertical information from the vertical boreholes because the
2 ramps give us an opportunity to intersect these units and
3 structural features in more of a horizontal sense. We get
4 more opportunity to investigate contacts and different
5 structural features in situ in the exploratory studies
6 facility.

7 The ESF provides an opportunity to evaluate
8 hydrologic parameters for a wide range of scales and this
9 will be pointed out when I get into more of the test
10 descriptions. The ESF provides a testing environment that is
11 suitable for three-dimensional characterization of the
12 hydrologic properties of the rock mass. The effects of
13 excavation on the host rock can be studied directly in the
14 ESF. And, ESF tests will provide data for multiscale
15 numerical modeling of the unsaturated zone.

16 All right. Now, the meat of the program,
17 description of test activities. As I go through the test
18 activities, I'm going to try to follow as closely as I can
19 the schedule and basically point out the activity objective
20 for the individual tests, the five construction phase tests;
21 the rationale for the activity selection; and then, lastly,
22 go into a very brief description of the test activity itself.
23 What I'd like to do, I'd like to leave as much time as I can
24 at the end of my talk, since I do have all the three PIs who
25 are associated with these tests in the audience. Like I say,

1 then they can fill in any information or answer the questions
2 that come up as far as the technical description of the test
3 activities.

4 The first test I'd like to talk about is the radial
5 boreholes test and this is one of the tests that will be
6 conducted in the first alcove in the starter tunnel along
7 with the ESF hydrochemistry testing. The activities of the
8 objective are to quantify gas permeability and anisotropy of
9 the hydrogeologic units within the unsaturated zone.
10 Estimate the tortuosity and effective porosity of drained
11 flow paths within the unsaturated zone hydrogeologic units.
12 Quantify the boundary effects at the hydrogeologic unit
13 contacts. And, last, compare pneumatic and hydraulic test
14 results, especially at the hydrogeologic unit contacts.

15 All right. The rationale for conducting the radial
16 borehole tests. It's hypothesized that most fractures in the
17 unsaturated zone are devoid of significant liquid water. The
18 upward movement of water vapor may indicate the potential for
19 upward movement of gaseous radionuclides. The downward
20 movement of water may indicate the potential for
21 radionuclide-solute transport and also downward flowing water
22 may be diverted laterally at unit contacts.

23 All right. The test description. There are four
24 test programs for testing in two ramps in the ESF. These
25 four test programs are we will conduct air permeability-

1 anisotropy testing within hydrogeologic units; primarily
2 looking at the air permeability of fractures in these units
3 contained within individual hydrogeologic units. Air-
4 injection testing across unit contacts and see what effect
5 the actual unit contacts going from a non-welded to a more
6 welded tuff, what effect this has on air-injection and later
7 relating that possibly to the percolation of water. What
8 happens to water when it reaches these contacts. We'll
9 conduct long-term monitoring of selected boreholes that were
10 drilled for these other two tests. And then, as a final
11 phase of the activity, after long-term monitoring, we will
12 conduct water-injection testing at contact sites in selected
13 boreholes at these contact sites.

14 All right. We were going to conduct gas-injection
15 and -withdrawal testing in these boreholes. For this, we
16 will utilize single-hole, constant-flow-rate, transient
17 tests; single-hole, steady state, gas-injection and -
18 withdrawal tests. After we do the single-hole testing, we
19 will conduct at selected sites cross-hole, constant-flow-
20 rate, transient tests and also cross-hole, steady-state, gas-
21 injection and -withdrawal tests.

22 All right. The first test we will conduct will be
23 the air-permeability anisotropy test. And, this is a
24 schematic, a cartoon, of what we visualize the configuration
25 of these tests to look like. These tests will be conducted

1 from three boreholes drilled from an alcove. This will be
2 the first type of testing that is conducted, the first type
3 of radial boreholes test that will be conducted in the first
4 alcove in the starter tunnel. As you see here, three
5 boreholes drilled from an alcove. The boreholes will be
6 configured in an expanding equilateral triangle. At the face
7 where we spread the boreholes into the drift wall, the
8 boreholes will be approximately two meters apart and
9 configured in an equilateral triangle. The boreholes will be
10 approximately 30 feet long and they will expand out from the
11 initial equilateral triangle at approximately an 8 degree
12 angle to where, when we terminate the boreholes that are
13 approximately 30 feet, the distance between the boreholes
14 should be about 9.3 meters. This will allow us to look at
15 fracture permeability in both close to the boreholes and then
16 look as we get out in the equilateral triangle and see if we
17 can actually see air-flow when we do our air cross-flow
18 testing at various distances across the boreholes.

19 DR. NORTH: A point of clarification.

20 MR. CHORNACK: Yes?

21 DR. NORTH: Your slide says 30 meters and you've been
22 saying 30 feet.

23 MR. CHORNACK: I'm sorry, it is 30 meters. Thank you.
24 Yes, 30 meters long boreholes, excuse me. Primarily, the
25 length of the boreholes are determined to extend beyond the

1 excavation disturbed zone.

2 As in all our boreholes we've drilled for ESF
3 tests, to the extent possible, core samples will be collected
4 for unsaturated zone hydrochemistry and matrix property
5 studies. And, these boreholes will be dry-cored. They will
6 be HQ3 size boreholes and, like I say, they will be
7 continually cored to provide samples for hydrochemistry
8 testing and also for matrix property testing.

9 The second type of test we'll conduct in connection
10 with the radial boreholes test is the air-permeability--
11 excuse me. I'm sorry, this is a further description of the
12 air-permeability anisotropy testing. With the air-
13 permeability anisotropy testing, we're trying to quantify the
14 permeability, anisotropy, effective porosity, and tortuosity
15 of fractures in the unsaturated zone. To do this, packers
16 will be installed in the boreholes for air-injection
17 monitoring and testing. We will conduct single- and cross-
18 hole pneumatic testing. Nine preliminary sites have been
19 selected, but the final sites will be determined as the ESF
20 and the ramps are excavated. Also, a long-term monitoring of
21 up to five years will be conducted on these boreholes
22 following testing.

23 The stratigraphic column is the one I showed
24 previously. This shows our preliminary test locations for
25 conducting the anisotropy testing. You see, we have two

1 tests in the Tiva Canyon welded unit, the first which will be
2 conducted in the starter tunnel alcove; one test in the
3 Paintbrush nonwelded; and then, two tests in the Topopah
4 Spring welded unit, one in the TSw₁ and one in the TSw₂. The
5 other numbers indicate that we also will repeat this testing
6 in the south ramp also.

7 All right. Now, the second type of testing that
8 will be conducted in the radial boreholes is the air-
9 injection testing. The air-injection testing will be
10 conducted in four boreholes drilled from an alcove again.
11 The boreholes will be configured in a rectangular pattern.
12 The boreholes will be 30 meters long, again to extend along
13 beyond the excavation disturbed zone. And, in the other
14 boreholes, corehole samples will be collected for
15 hydrochemistry and matrix hydrologic properties testing.

16 This test, the air-injection testing, will be the
17 test that we conduct at the contacts. And, the schematic
18 here shows again that the boreholes will be drilled in an
19 alcove, two of the boreholes above the contact, two below the
20 contact, and the boreholes will be drilled up to 30 meters
21 out perpendicular to the face of the alcove to extend beyond
22 the disturbed zone caused by excavation.

23 All right. Further description of the air-
24 injection testing. By conducting the air-injection testing,
25 we want to quantify the hydrogeologic contact effects on air

1 and water flow in the unsaturated zone. Again, packers will
2 be installed in the boreholes for air-injection and
3 monitoring. We will conduct single-hole and cross-hole
4 pneumatic testing. Four preliminary sites have been selected
5 for these activities in the north and south ramps. And,
6 again, long-term monitoring of up to five years will follow
7 the initial injection single- and cross-hole testing.

8 The two contacts we would like to test both in the
9 north and south ramp is the contact between the Tiva Canyon
10 welded and the Paintbrush nonwelded unit and then again
11 between the Paintbrush nonwelded and the Topopah Springs
12 welded unit, the TSw₁. And, again, we will conduct this
13 testing in both the north and the south ramp.

14 As I stated before, after we conduct the air-
15 injection testing, we'll conduct long-term monitoring. We'll
16 instrument and monitor intervals in selected boreholes for up
17 to five years. The boreholes will be instrumented using an
18 inflatable packer and also pressure transducers, thermistors
19 of thermocouples, and most likely, most of the boreholes,
20 also thermocouple psychrometers. The boreholes will be
21 monitored to detect barometric influences, water movement,
22 and/or construction effects in these boreholes. Also, in
23 these boreholes, we will have access where we can do gas
24 sampling. Gas samples will be periodically collected during
25 monitoring and these samples will be collected for the UZ

1 hydrochemistry test.

2 Following the long-term monitoring period, we're
3 going to conduct water-injection testing. The water-
4 injection testing will be conducted at completion of long-
5 term monitoring. We will use injection and monitoring
6 boreholes. The reason we're going to do this is to determine
7 the usefulness of effective air permeability in calculating
8 hydraulic conductivity.

9 All right. The next test, excavation effects test.
10 The activity objectives are to estimate the magnitude and
11 extent of modification of the hydrologic properties in the
12 Topopah Springs welded unit caused by excavation of the ESF.

13 The rationale for the activity selection is
14 excavation in fractured rocks can significantly alter the
15 physical properties of the rocks near an underground mined
16 opening. The permeability, before and after excavation, is a
17 parameter required by other ESF tests to estimate errors in
18 hydrologic properties caused by construction. Also,
19 evaluation is needed to determine the significance of
20 excavation effects and to develop methods to correct for
21 changes in hydrologic properties caused by excavation. So,
22 we basically will use the results obtained from the
23 excavation effects test to make any corrections in the
24 hydrologic properties determined from the other testing.

25 All right. The test description: the evaluation

1 parameters needed. To conduct the excavation effects test,
2 we need pre-mining fracture permeability, rock stress, and
3 water saturation. We also need to measure the stress
4 changes, fracture deformation, and permeability changes
5 resulting from the excavation. These will be the actual
6 parameters we monitor during the excavation effect. And,
7 also, for the excavation effects test to be considered
8 significant, first, the change in fracture permeability needs
9 to be measurable. Secondly, final permeability values need
10 to be statistically different from the initial values
11 encountered.

12 Okay. The general approach for the excavation
13 effects test. One, the test will be conducted from alcoves
14 on both sides of the planned excavation. A quick schematic
15 of what that will look like. Boreholes will be drilled
16 parallel to the proposed ESF opening. Air-permeability
17 testing before and after the excavation will be conducted.
18 This will give us our pre-mining permeabilities and our post-
19 excavation permeabilities. In situ stress and mechanical
20 property measurements need to be conducted before, during,
21 and after excavation.

22 There are basically two approaches we're going to
23 use for the excavation effects test. The first is the
24 physical approach. This is a schematic of the borehole
25 layout, alcove and borehole layout, for the physical

1 approach. Yours are in order; mine were out of order. Okay.
2 The physical approach is a deterministic approach where all
3 parameters are measured. And, you can see from the borehole
4 layout, we've got stress boreholes, permeability boreholes,
5 and also deformation boreholes. So, we're monitoring all
6 these three different parameters in connection with the
7 physical approach. The measured parameters are used to
8 support the geomechanical model and the coupled hydrologic-
9 mechanical model is used to analyze results and to predict
10 excavation effects where in situ conditions are different.

11 So, you see basically in the physical approach
12 around the mined opening, we have a series of boreholes;
13 stress boreholes, permeability, and deformation boreholes at
14 varying distances and distances away from the mined opening.
15 In these boreholes, we will construct the alcove, drill the
16 boreholes, emplace the instruments, and then as the ESF is
17 excavated past the boreholes, we will monitor for changes in
18 these various parameters in the boreholes.

19 We also apply the statistical approach during the
20 excavation effects test. The initial statistical test is
21 required to verify that changes in permeability are
22 measurable and that final permeabilities are statistically
23 different from initial permeabilities. In the sequence of
24 testing, the statistical tests would be conducted first
25 because, if we don't find that we meet these conditions, we

1 know that there's no reason to go and continue with the
2 physical approach in the testing. We also need to know that
3 the statistical test measurements are repeated at several
4 locations to minimize prediction uncertainty. And, lastly,
5 predictive permeabilities are only valid in areas where the
6 in situ physical properties, stress, and excavation methods
7 are the same. So, the statistical approach cannot be--it has
8 to be, as stated there, the results can only interpolate to
9 areas where these three properties or these three conditions
10 are the same. Whereas in the physical approach because we
11 measure so many different parameters, the results of the
12 physical approach can be interpolated to other hydrogeologic
13 units and other excavation methods in ESF, also.

14 DR. CORDING: Mike, you have a lot of different tests to
15 describe here and perhaps we--would this be a good--I thought
16 we might break it into some sections where we could ask
17 questions on some of them because you have a long
18 presentation also.

19 MR. CHORNACK: Yes, sir.

20 DR. CORDING: Would now be a good time to talk about the
21 previous tests?

22 MR. CHORNACK: Yes, sir. That would be fine, Ed.

23 DR. CORDING: Okay. Are there questions regarding the
24 testing and the information that he's provided to us at this
25 point? Don Langmuir?

1 DR. LANGMUIR: Mike, just something for clarification
2 for me. When you're running a test and you're trying to find
3 out the properties of fracture zones by injecting in these
4 radial boreholes, is the only way you establish what the
5 properties are the recovery in an adjacent hole in that same
6 alcove or do you look in other alcoves at some later date?
7 Is there any cross-referencing away from individual alcoves?

8 MR. CHORNACK: At the moment, the way the plan is done
9 --and luckily we have Gary LeCain, the principal
10 investigator--but we will look for the perms in two ways. We
11 will do single-hole injection and just look for a pressure
12 decay response, but also we will do cross-hole testing. But,
13 the cross-hole testing will be contained within the boreholes
14 within one alcove. We don't think that we'll be able to
15 monitor from one alcove to another because, first of all, the
16 space in the alcoves is quite distant between the two
17 alcoves. And, we don't think that--because of the fractured
18 nature of the welded tuffs and the way the fractures are
19 connected, we don't think, it would be highly unlikely, we
20 could inject into one fracture and monitor any great distance
21 away. I don't think we'd want to put that kind of pressure
22 in the ground.

23 Gary?

24 MR. LeCAIN: No, that's exactly right. All the testing
25 probably--

1 DR. CORDING: Could you use the microphone there?

2 Thanks. And, identify yourself?

3 MR. LeCAIN: Gary LeCain, I'm the PI for the radial
4 boreholes testing. And, Mike has described it exactly. The
5 testing will be between boreholes in a single alcove. The
6 distances would be too great between alcoves.

7 DR. LANGMUIR: Okay. There are no alcove setups planned
8 in the ESF where you would actually hit the same fracture
9 elsewhere at a different position, I take it?

10 MR. CHORNACK: Probably not, Don. The only thing we--
11 where we could know is the same fracture would be in major
12 fault zones in the north and south ramp and there's no way
13 physically possible, I don't think, that we could test across
14 that great a distance with cross-hole testing.

15 DR. LANGMUIR: You're using a chemical tracer in the
16 gas, are you not?

17 MR. CHORNACK: Yes, we are.

18 DR. LANGMUIR: Is this--

19 MR. CHORNACK: The tracer choice, whatever that is.

20 DR. LANGMUIR: Carbon hexafluoride, I think is what the
21 compound is, one of the--

22 MR. CHORNACK: We have used sulphur hexafluoride.

23 DR. LANGMUIR: Sulphur hexafluoride.

24 MR. CHORNACK: And, we're also looking at using Suva and
25 I know the DOE has an ongoing program. They're looking at

1 various other tracers that are environmentally acceptable
2 that we could use, Don, also. But, right now, yes, the major
3 tracer is sulphur hexafluoride for the air-injection testing.
4 Is that correct, Gary?

5 MR. LeCAIN: Correct.

6 DR. DOMENICO: Probably to Gary. I know you have
7 mathematical models to interpret cross-hole tests in
8 saturated material developed by people in Arizona. Do you
9 have similar mathematical models to interpret quantitatively
10 the cross-hole tests when you're dealing with air?

11 MR. LeCAIN: It's being worked on right now, Pat.

12 DR. DOMENICO: You mean, you don't have them?

13 MR. LeCAIN: Not at this time. We have modeling that we
14 can do to try and match the results that we might get, but
15 you're exactly right. The methods need to be modified to
16 work with air.

17 DR. DOMENICO: Yeah, they had the methods with the
18 saturated zone that have been tried successfully, I think, in
19 some of these cases and that's a current matching procedure,
20 too. But, I didn't think you had the mathematical models
21 developed yet for the pneumatic--

22 MR. LeCAIN: Well, what we hope to do is adapt the
23 saturated zone models for the unsaturated zone.

24 DR. LANGMUIR: Just one more thought on this. I'm
25 expecting and you're probably expecting, as well, that when

1 you inject a gas with a tracer in one hole, you may only get
2 5% back.

3 MR. CHORNACK: Yes, exactly.

4 DR. LANGMUIR: So, you'll be able to interpret these
5 kinds of results quantitatively in terms of fracture
6 properties?

7 MR. CHORNACK: Yes. Yes. We don't assume that all the
8 gas we put in one fracture--to the best of our ability, we
9 will try to isolate single fractures that occur in both
10 boreholes. Now, whether we can do this is all going to
11 depend on the fracture systems we encounter in the borehole.

12 DR. LANGMUIR: What about fracture zones where there's a
13 whole series of closely spaced fractures?

14 MR. CHORNACK: If we have closely spaced fracture zones
15 or swarms of fractures, we will try to isolate these both in
16 the monitoring--excuse me, the injection hole and also the
17 monitoring hole. Yeah, and we will try to inject across
18 either fracture zones or single fractures. But, no, even if
19 we are fortunate enough to isolate a single fracture, we
20 still don't think we will recover--we will get all the
21 tracers that we inject in one borehole because of the
22 dispersive nature of the interjection testing.

23 DR. LANGMUIR: When you alrove into a fracture zone, do
24 you get any more than characteristics in the immediate area?
25 In other words, can you have any way of knowing how far into

1 a fracture system can you go from an alcove to get a sense of
2 another dimension?

3 MR. CHORNACK: With borehole drilling, Don?

4 DR. LANGMUIR: Yeah?

5 MR. CHORNACK: We've stated right now we're going to try
6 to limit the boreholes to 30 meters or approximately 100
7 feet. Gary might be able to elaborate on it a little more.

8 MR. LeCAIN: Yes, we're limited to 30 meters, Don, for
9 interference factors. But, I think what addresses your point
10 is the reason we use an expanding equilateral triangle. That
11 is to try and get different scale.

12 DR. CANTLON: Are the investigators doing the surface-
13 based hydrology and gas studies the same as the underground
14 group?

15 MR. CHORNACK: Yeah. Fortunately for Gary's position,
16 he is the principal investigator for the surface-based air-
17 injection testing and also the underground air-injection
18 testing, also. Yes.

19 DR. CANTLON: The second question, has there been any
20 instance in which the study plans have been modified through
21 feedback from the initial performance assessment run?

22 MR. CHORNACK: I'm not familiar with any right now. Gary?

23 MR. LeCAIN: The only feedback we've had is from the
24 review of the study plan. I imagine things will change once
25 we start getting the initial data in from the testing.

1 DR. CANTLON: Have the people getting ready to make the
2 second performance assessment run been in consultation with
3 the PIs collecting the data?

4 MR. LeCAIN: Not that I'm aware of.

5 DR. CANTLON: Thank you.

6 DR. DOMENICO: I know we can do air-permeability tests
7 in the laboratory. Has anybody ever done any field air-
8 permeability tests either in a single borehole or any other
9 way? Pneumatics is not exactly my field, but we do have
10 hydraulic tests that I'm quite familiar with and I don't know
11 if you have similar kinds of models to quantitatively look at
12 the response and obtain from that high permeability which is
13 a number and which is something you want. Is that--

14 MR. CHORNACK: Right, we're fortunate this is one of the
15 tests where we have conducted prototype testing. In fact,
16 Gary conducted quite an extensive program testing down at the
17 NRC Apache Leap site and he can elaborate on this more.

18 MR. LeCAIN: Yeah, Pat, we've done prototype air-
19 permeability testing in the field in five inch boreholes in
20 tuff and, fortunately, the University of Arizona under
21 Professor Evans has also conducted air -withdrawal and
22 -injection testing in the same holes. We were able to match
23 our results with theirs. They came out very close and the
24 methods that we have adapted for doing the air permeability
25 testing really required very minor modifications to the

1 hydraulic test methods.

2 DR. DOMENICO: Thank you, Gary.

3 MR. CHORNACK: Gary, could you elaborate a little more
4 on how we plan to use the water injection test results,
5 possibly to--

6 MR. LeCAIN: One of the big questions is what good are
7 the air-permeability estimates in extrapolating those values
8 out to possible hydraulic conductivities which is exactly
9 what we hope to show is possible or not possible by following
10 air-permeability testing with the water-injection testing.

11 DR. CORDING: One question on these air-permeability
12 tests. You tend to pack off a fracture that you locate
13 within a given hole. I think that was what you described.
14 And then, would you be able to monitor then the multiple
15 packers in the other holes so you could pick up--you can
16 identify other fractures and then identify which fracture is
17 flowing through, is that the intent?

18 MR. CHORNACK: Yeah, exactly. Our practice is we're
19 going to use--as you stated, we're going to use a multiple
20 zone packer system where we will, having identified various
21 fracture zones in the boreholes, we will pack off these zones
22 in the boreholes and, in those boreholes, we will have both
23 --probably, in the case of the injection, the cross-hole and
24 single-hole injection testing, we'll have pressure
25 transducers and also some sort of either a thermocouple or

1 thermistor to look for pressure changes and also any kind of
2 temperate changes. We will also have the ability to sample
3 for our tracer gas in case, if we're just getting very, very
4 small flow through the boreholes, hopefully, by some of the
5 tracer gas sampling, we can detect the presence of the
6 injected air in the monitoring boreholes, also.

7 DR. CORDING: I guess going back to yesterday, our
8 discussion yesterday, on the surface-based holes, would
9 somewhat the same sort of process be used in the surface-
10 based holes with multiple factors where you're injecting and
11 observing?

12 MR. CHORNACK: Yes, exactly. Right now, when we get our
13 multiple borehole complexes up, Gary will also inject--will
14 conduct surface-based air-permeability testing in those
15 boreholes, also, using similar methods to what we use
16 underground.

17 DR. CORDING: Single-holes and, I think, in some cases,
18 cross-holes, is that right?

19 MR. CHORNACK: Exactly, yeah. It will first be a
20 single-hole test and, in fact, we're getting ready to start
21 the single-hole surface-based air-permeability testing in
22 Borehole UE-25, UZ-16, hopefully, within the next week or so
23 to start that testing. And then, eventually, we will conduct
24 cross-hole testing when more boreholes are drilled in that
25 complex.

1 DR. CORDING: Then, once that's done, then is it where
2 you're going to do a passive shut-in testing, is that
3 correct?

4 MR. CHORNACK: We've already done our shut-in test at
5 UZ-16 in connection with the gaseous phase circulation
6 studies. And, I think, after we do the air-injection
7 testing, we'll go back and repeat the UZ hydrochemistry
8 sampling from that borehole and again conduct possibly some
9 more pressure shut-in tests. Hopefully, over the winter, we
10 get some more--

11 DR. CORDING: So, you continue to monitor over some--so
12 you can get some of those seasonable storm effects, is that
13 correct?

14 MR. CHORNACK: Yes, exactly. Yeah. Unfortunately--and
15 then, UZ-16 is our VSP hole. So, eventually, there will be
16 an instrument string put in that hole for--a geophone string
17 for vertical seismic profiling. But, in the other surface-
18 based boreholes, we will again put a long-term monitoring
19 system similar to what we'll use in the ESF boreholes in
20 those holes that collect water potential from thermocouple
21 psychrometers, pressure from--obviously, pressure
22 transducers. We'll have thermistors to look at temperature
23 changes in the boreholes and also a fairly elaborate gas
24 sampling system in those boreholes.

25 DR. LANGMUIR: Just a minor clarification, maybe.

1 You've been talking about excavation effects test plan work
2 and it wasn't clear to me whether this started where the TBM
3 is going to begin or whether it looks at the drill and blast
4 portion of the tunnel, as well as the TBM portion.

5 MR. CHORNACK: Right now, the location for the
6 excavation effects test is scheduled to be where we start the
7 turn for the first--the first turn at the bottom of the north
8 ramp. Is that correct, Falah?

9 MR. THAMIR: That's correct.

10 MR. CHORNACK: And, are we going to look at in the main
11 test level at drill and blast effects?

12 MR. THAMIR: We're still looking into that because we
13 know that the TBM machine needs a starter tunnel and so we
14 would not be able to drill the site rooms and then start the
15 TBM. However, where Michael mentioned where we might do the
16 test at the turn, we may have some extra room to drill the
17 holes ahead of the tunnel. And, we may or may not repeat the
18 test where drilling and blasting is used because we're
19 looking at differences where the waste will be isolated and,
20 if it's going to be isolated in rooms that will be drilled
21 with a TBM machine, then we will not repeat it in places that
22 will be excavated with drilling and blasting.

23 DR. CORDING: Would you identify yourself?

24 MR. THAMIR: Falah Thamir with the USGS.

25 DR. CORDING: Thank you.

1 Just one question in regard to this excavation
2 effects test. It's something perhaps we can discuss more
3 this afternoon, but to do that and to drill ahead and--of
4 course, you have to wait and--any advance of the TBM has to
5 await that work to be completed. So, you're talking about
6 delay there of, I would assume, it's certainly in excess of a
7 month. And so, I guess, one of the points is that maybe what
8 you're trying to do is to see if you can't find a target of
9 opportunity where you're doing something else where the TBM
10 would have to otherwise be stopped. Is that correct?

11 MR. CHORNACK: Yeah, that's correct. Another option we
12 have, and if we do go to the Calico Hills, would be to do the
13 test where the Calico Hills ramp comes off the main test ramp
14 because that would leave us--give us plenty of time to go and
15 set up and do the test and not delay the excavation with the
16 TBM, at all.

17 DR. CORDING: So, you might be able to do that, in other
18 words, after the main loop is done and then come in and drill
19 across before the Calico Hills excavation were done?

20 MR. CHORNACK: Exactly, yes. Yeah, that would be
21 another--that would be a good window of opportunity to come
22 back to those tests, yes.

23 DR. CORDING: Sure. I think one other possibility is in
24 the core test area for the thermal testing. One of the
25 things we've been suggesting is using a TBM to do some of the

1 excavation there for those tests which, I think, it's needed
2 in order to have the right type of surface to evaluate
3 something that will be used in the future repository. And
4 so, there might be some opportunities there also.

5 MR. CHORNACK: Yeah. As Falah said, we're trying to
6 pick a location to where we're not going to delay the
7 progress of the TBM significantly.

8 DR. CORDING: Okay. Thank you.

9 Pat Domenico?

10 DR. DOMENICO: Probably to Gary, it was mentioned that
11 permeability of air is not the same as permeability of water.
12 So that's why you're going to run the hydraulic tests
13 afterwards to check the values. But, they must have had that
14 same concern at Apache Leap and did they do such a study and
15 what did they learn from that?

16 MR. LeCAIN: The only comparison they did between air-
17 and water-injection was laboratory work. And, they were
18 generally within one order of magnitude and they did
19 differ.

20 DR. DOMENICO: But, it was not based on the field
21 comparison laboratory--

22 MR. LeCAIN: Not that I'm aware of.

23 DR. DOMENICO: Well, lab work is easy to do.

24 MR. LeCAIN: We hope for the best, Pat.

25 DR. CORDING: Okay. Staff had a question. Russ

1 McFarland?

2 MR. McFARLAND: Yeah. On your size of your disturbed
3 zone, looking at earlier illustrations, your drilling out 30
4 meters from the face of your alcove. Your alcove looks to be
5 about, oh, 10 meters. Are you reaching beyond the
6 disturbance caused by the excavation of the ramp or the
7 disturbance caused by the excavation of the alcove?

8 MR. LeCAIN: That being just a schematic, the distance
9 we actually go out with the alcove will probably vary. The
10 first alcove is actually planned on being from 70 to 80
11 meters away from the ramp and it will be outside the zone.

12 MR. McFARLAND: Why are you out 70 to 80 meters from the
13 ramp?

14 MR. LeCAIN: In this particular case, there was a shear
15 zone. The shear zone being that there was unstable rock,
16 basically, that we had to get through. We didn't really want
17 to conduct our testing on that unstable rock because it
18 wouldn't be representative of the rock of the mountain, most
19 of the rock.

20 MR. McFARLAND: The reason I ask, is the alcove
21 necessary to allow you to reach farther out or is the alcove
22 a means of providing a drill platform? You could just as
23 easily, if possible, drill from the face of the ramp, for
24 example, in some cases in lieu of having an excavated alcove.

25 MR. LeCAIN: Both, exactly. It's to provide a point to

1 drill from without being in the way of the TBM operating and
2 it's also to get us away at least two diameters from the ramp
3 to make sure we are testing relatively undisturbed rock.

4 MR. McFARLAND: One additional question. Perhaps, it
5 could be addressed by Ned, but a viewgraph was shown on the
6 second page of the presentation showing the layout of the
7 ramp that I don't think has ever been presented to the Board
8 before. It shows two runouts. It shows a runout on the
9 north ramp and it shows a runout on the south ramp which was
10 not presented at the last--

11 MR. CHORNACK: Excuse me, what illustration is that in?

12 MR. McFARLAND: Pardon me? Your presentation, second
13 chart. I wonder if we could have that explained some time
14 this afternoon or this morning, whenever appropriate?

15 MR. CHORNACK: This one here?

16 MR. McFARLAND: That one, yes.

17 MR. McKENZIE: Those ramp extensions are in the new--you
18 know, the enhanced ESF layout. I have a better picture on
19 the one I showed yesterday, the color one. It does show
20 those ramp extensions on it.

21 MR. McFARLAND: It might be appropriate to explain those
22 changes that have occurred since our last meeting to the
23 north ramp.

24 MR. McKENZIE: Okay. Those are on--this is the same
25 layout. The only thing that I noticed is it looks like there

1 are three Ghost Dance drifts when, I think, we only planned
2 on having two originally. But, this is the same layout that
3 we showed to you in July in Denver.

4 MR. McFARLAND: With the runouts on the end?

5 MR. McKENZIE: Right. Those are in lieu of the two
6 cross-drifts that ran across the block before.

7 MR. McFARLAND: And, those were presented? I stand
8 corrected.

9 MR. LeCAIN: I'd like to clear something up here. I was
10 just informed I said the alcove was going to be 80 meters out
11 from the--I meant 80 feet, excuse me.

12 DR. CORDING: Just a clarification. That's the alcove
13 that's being excavated right now?

14 MR. LeCAIN: Yes, sir.

15 DR. CORDING: All right.

16 Perhaps, we could go ahead with your--you've
17 anticipated me with the perched water tests. Why don't we
18 continue with that?

19 MR. CHORNACK: Thank you, Ed.

20 All right. The perched water test. As Ned in his
21 presentation pointed out, this is a contingency test. It's a
22 test we hope we don't have to use. But, with some of the
23 developments at UZ-14, we always like to be prepared for
24 everything.

25 So, the activity objective is to detect the

1 occurrence of any perched water that might be encountered in
2 the ESF. If it is encountered, estimate the hydraulic
3 properties of the perched water zones, determine the
4 implications of the existence of perched water zones on water
5 flux, flow paths, and travel time.

6 Okay. The rationale for the activity selection.
7 Perched water may imply a particular flow path for water in
8 the unsaturated zone. Perched water ages can be used to
9 estimate groundwater travel times. The conceptual
10 unsaturated zone model indicates perched water may occur
11 within or immediately above the PTn, Paintbrush nonwelded, or
12 bedded tuffs between the Tiva and the Topopah, or at the top
13 of the Calico Hills nonwelded hydrogeologic units. And, in
14 fact, this is approximately the location where we did
15 encounter water in both UZ-1 and UZ-14. The presence of or
16 potential for perching of water in the host rock could
17 interfere with construction, operation, and performance of a
18 potential repository. And, also, perched water could cause
19 modification of geochemical interactions, transport
20 processes, flow paths, and travel times.

21 Okay. A brief test description. Again, tests will
22 be conducted if perched water is encountered. If perched
23 water is detected, hydraulic tests and chemical sampling will
24 be initiated as soon as the area in the ESF is accessible.
25 Flow-rate measurements will be conducted if large inflows of

1 perched water are encountered. Boreholes will be drilled
2 into perched water zone for sampling, testing, and monitoring
3 of those zones.

4 Here's a diagram of possibly what one of our
5 perched water boreholes could look like. Basically, drive a
6 borehole into perched water zone. We will have again a
7 multi-zone monitoring system instrument with pressure
8 transducers and probably some sort of temperature monitoring
9 device, either a thermocouple or thermistor, and also it will
10 be plumb so we can do a sampling of the perched water zone
11 while at the same time monitoring for pressure changes during
12 sampling.

13 Okay. If we just encounter a very small perched
14 water zone where we have just seepage into the mined
15 openings, we will conduct seepage measurements. The seepage
16 estimates will be estimated prior to borehole drilling.
17 Then, we will drill boreholes into the zones where the water
18 is seeping from to sample and also to instrument the
19 boreholes to collect pressure measurements in the perched
20 water zone and also for flow-rate determinations. And, also,
21 from all the perched water boreholes, we'll, of course,
22 sample perched water for hydrochemical analyses.

23 Okay. The instrumentation in the perched water
24 boreholes. Packers and/or liners will be installed in the
25 boreholes. There will be sampling ports connected to access

1 tubing for each borehole for both pressure monitoring and
2 also sampling. We'll have pressure transducers. We could
3 have tensiometers and/or thermistors in the boreholes to
4 monitor these pressure water potential and temperature.

5 Okay. The hydrochemistry test. Again, this is one
6 of the tests we've--we've already done some preliminary
7 hydrochemical gas sampling as they're mining the first alcove
8 in the starter tunnel. The plan there is we're after--before
9 they do any excavation, we'll take some gas samples and, as
10 the excavation proceeds, we're taking gas samples from
11 shallow boreholes drilled in the face of the alcove.

12 Okay. The activity objective is to collect and
13 preserve core samples for extraction of unaltered water and
14 gas. Collect in situ water, water vapor, and gas samples
15 from boreholes in the exploratory studies facility. Obtain
16 hydrochemical and isotopic data for interpretation of
17 transport mechanisms, flow direction, and travel time of
18 water and gas in the unsaturated zone. And, also, to
19 determine the geochemical evolution of unsaturated zone water
20 using hydrochemical and isotopic techniques.

21 We're also, through the hydrochemistry test, trying
22 to evaluate flow and storage of gas and water within the
23 repository block. Look at the unsaturated zone chemistry and
24 gas distribution to help evaluate chemical transport and flow
25 processes within the repository. Looking at pore-water

1 chemistry and mineralogical data to provide input to the
2 geochemical models to provide information on rock-water
3 interactions in the unsaturated zone. And, also, to provide
4 information on solubility and reactivity of the natural
5 geochemical environment in the unsaturated zone and of the
6 artificial environment created by the engineered-barrier
7 system.

8 Okay. To conduct the hydrochemistry test, we will
9 do gas sampling in boreholes drilled specifically for this
10 test and we will also conduct gas sampling from other
11 boreholes drilled for other ESF testing. So, hydrochemistry
12 gas samples will be collected from boreholes drilled for
13 other ESF testing. We will do--before we do any gas-
14 injection testing, say, in the radial boreholes test, we will
15 do gas sampling for hydrochemical analysis from those
16 boreholes. As I stated before, we're also drilling short,
17 one to two meter, small diameter boreholes prior to any
18 excavation of alcoves and during alcove construction and also
19 we intend to drill these boreholes as soon as we get access
20 behind the TBM mined openings to provide gas samples that are
21 representative, or as close to representative as possible, of
22 pre-mining conditions. We will also drill long boreholes.
23 If we can get them out to 45 meters, that's fine; but
24 probably some between 30 and 45 meters will be drilled from
25 alcoves at selected locations for the collection of core and

1 gas samples.

2 And, here, this is an old diagram. So,
3 unfortunately, you can see the ramp is more than a 2% grade.
4 So, if you do it like that, everybody will feel a lot more
5 comfortable with it. These are some preliminary--but,
6 unfortunately, it shadows the faults out quite a bit and
7 makes the units dip a lot steeper. But, these are some of
8 the locations where we're going to do our hydrochemistry gas
9 sampling. As you see, this is the first alcove at the Bow
10 Ridge Fault and various locations down along the projection
11 of the north ramp. As you see, most of these locations are
12 boreholes that are drilled for other activities and not
13 specifically for the UZ hydrochemistry test. Again, the same
14 for the south ramp. We're looking at basically boreholes or
15 windows of--boreholes of opportunity that are going to be
16 drilled for other studies we will sample for the ESF
17 hydrochemistry testing.

18 Okay. The instrumentation for the hydrochemistry
19 test. Gas and water sampling from the boreholes will utilize
20 access tubing in the packer-instrument systems. Again, we
21 will have a multiple zone packer system constructed where we
22 can put in the borehole and pack up various intervals along
23 the boreholes so we can sample from these various intervals
24 at one time; similar to what we do at the surface-based UZ
25 hydrochemistry testing.

1 Peristaltic pumps will be used to collect gas and
2 water samples from the boreholes. The samples will be
3 collected for isotopic composition, $^{13}\text{C}/^{12}\text{C}$ ratio, and also
4 ^{14}C , and also ^3H . A lot of these samples have to be sent out
5 to outside laboratories for analyses; some of the analyses we
6 can do within the U.S. Geological Survey.

7 We might possibly use, if we encounter moist zones
8 in the boreholes, inflatable liners with an absorbent
9 material to collect water samples from moist zones if we
10 encounter any moist zones in boreholes drilled in the ESF.
11 Also, the perched water samples would be analyzed as part of
12 the UZ hydrochemistry test.

13 All right. The last tests I'm going to describe,
14 construction phase tests, is the hydrologic properties
15 testing of major faults. The activity objective is to
16 measure pneumatic and hydraulic permeability, porosity, and
17 anisotropy of major faults and associated fault zones. Also,
18 to conduct long-term monitoring for the vertical flow of gas,
19 water vapor, and water in the major faults. And, also,
20 conduct tracer tests to estimate the tortuosity and effective
21 porosity of major faults.

22 Okay. Rationale for the activity. Yucca Mountain
23 contains and is bounded by west-dipping, high-angle, normal
24 faults that may serve as pathways for or barriers to flow
25 dependent on the ambient moisture conditions at the time.

1 Under wet conditions, the major faults could act as barriers
2 to fluid--excuse me, conduits for fluid flow; under drier
3 climatic conditions, they could actually act as barriers to
4 fluid flow. Laterally, under wetter conditions, they could
5 act as conduits for fluid flow down the fault plane; under
6 drier conditions, they could act as barriers to fluid flow
7 both laterally down-dip and also because of air being in the
8 faults themselves they could act as barriers to fluid flow
9 down the fault plane itself.

10 It's also expected that hydraulic conductivity
11 varies along faults and fault zones. It's generally believed
12 that major faults effect flow in the unsaturated zone. And,
13 an additional understanding of the factors controlling fluid
14 flow in major faults must be obtained to meet site
15 characterization requirements.

16 Okay. A test description of the major fault test.
17 To quantify the fault and fault-disturbed zone permeability
18 and porosity, it is necessary to quantify the undisturbed
19 tuff. Equipment and test configuration for this test were
20 designed to maximize the testing range and also to allow for
21 test modification depending on the types of fault zone and
22 the types of fault-disturbed zone that we encounter as we
23 excavate the ESF. And, also, single-hole and cross-hole
24 testing will be conducted. Gary LeCain was chosen as the
25 principal investigator for this test because a lot of the

1 testing techniques we use for the major faults are very
2 similar to the radial boreholes test.

3 Okay. The alcoves and boreholes. As I believe
4 Dennis said yesterday, he started giving my talk for me, too,
5 but he was describing some of the fault testing that we're
6 going to do and here's a schematic diagram of what we intend
7 to do. But, the question came up yesterday how are we going
8 to test some of these features? Well, basically, they'll be
9 conducted from alcoves and boreholes will be drilled from the
10 alcoves and there will be one fault-parallel and one fault-
11 straddling alcove at each test facility location. Fault-
12 parallel and fault-straddling. Here's the fault indicated by
13 the hatches and the stippled zone indicates the fault-
14 disturbed zone. As you can see, we've got one alcove that
15 straddles the fault and one that is basically parallel to the
16 fault.

17 Okay. Boreholes will be drilled from the alcove to
18 test undisturbed rock, fault-disturbed zone, and the fault.
19 And, again, we're looking at a 30 meter maximum length of the
20 boreholes.

21 Here, we have--basically, you see the borehole
22 patterns for Alcove 1 again is a triangle, but the boreholes
23 are approximately five meters apart on the side and the
24 boreholes, as opposed to how they are in the radial boreholes
25 tests, the boreholes are pretty much parallel to each other.

1 But, the three borehole configuration allows us to do both
2 single- and also cross-hole testing in undisturbed rock, the
3 fault zone, and the fault itself.

4 Now, in case the fault-disturbed zone is too large
5 to where we can't penetrate into the borehole with a 30 meter
6 borehole, we will drill a fourth hole out away from the fault
7 itself to try to test undisturbed rock with some single-hole
8 air-injection testing. And, again, for the fault-straddling
9 alcove, a maximum of three boreholes configured at one on
10 either side of the fault in the fault-disturbed zone and one,
11 if there is a definite enough fault plane, will be drilled
12 into the fault plane itself.

13 And, again, we will test the major faults by using,
14 at first, pneumatic testing. Single- and cross-hole
15 pneumatic testing will be conducted in the boreholes in both
16 alcoves. Results from the initial single-hole testing will
17 be used to design the borehole layout. So, basically, we'll
18 drill one borehole, test it, and then based on the results
19 from the single-hole air-injection testing, we will see what
20 kind of spacing we need in the other two boreholes to conduct
21 cross-hole testing. This will provide preliminary estimates
22 of permeability and data for scoping calculations for the
23 layout of the other boreholes.

24 Okay. Then, we'll conduct cross-hole testing.
25 Configurations will be determined from the single borehole.

1 I've said that. But, then, the cross-hole pneumatic testing
2 characterized the permeability and anisotropy within the
3 fault-disturbed zone and the fault zone.

4 And, this is just a schematic of the type of
5 instrumentation we were intending to use. Disregard SEAMIST
6 and substitute borehole packer liner system for that. We're
7 not sure--we probably will not use a SEAMIST system; we'll
8 probably use more of a conventional packer system with
9 instrumented zones in the borehole. But, basically,
10 instrumentation will be the same. We have an injection
11 borehole and then monitoring boreholes where we have pressure
12 transducers and also gas sampling lines to try to detect the
13 movement of any pressure changes or the actual tracer--detect
14 the tracer that was injected in the one borehole into the
15 monitoring boreholes.

16 Okay. Cross-hole testing will be used to estimate
17 tortuosity in fractures, fracture zones, and possibly within
18 intervals in the fault zone within the fault itself. Cross-
19 hole hydraulic testing will provide the opportunity to
20 compare pneumatic and hydraulic test results. So, hopefully,
21 after we've done our initial interjection tests, we'll come
22 back eventually at a later time and possibly, as in the
23 radial borehole test, do some cross-hole hydraulic injection
24 testing. And, eventually, the boreholes will be instrumented
25 for long-term monitoring to try to detect any water movement,

1 water vapor movement, or pressure changes in the faults that
2 is transmitted down on the fault zone
3 themselves.

4 Okay. I'd like to talk a little bit about UZ
5 studies in the starter tunnel, although Ned did a better job
6 than I can of that since he's privy to more recent
7 information than I am. But, basically, we started to mine
8 the first alcove in the starter tunnel. Since we started
9 construction of the alcove, we have conducted one episode of
10 gas sampling for UZ hydrochemistry from one of these fairly
11 shallow, one to two meter, small diameter boreholes. And, we
12 will conduct hydrochemistry gaseous-phase circulation and
13 radial boreholes testing in the boreholes drilled in the
14 alcove. What we will do is after the borehole is
15 constructed, the first borehole, we will go in and do our gas
16 sampling studies. Then, we will conduct a pressure shut-in
17 test for a certain period of time in that borehole to see if
18 we can detect any barometric changes, surface barometric
19 changes, in the borehole. And then, lastly, we'll go in and
20 conduct the single-hole air-permeability testing and then,
21 eventually, after we drill the other two boreholes, do our
22 full blown radial boreholes test.

23 And, the summary. Okay. The results of the ESF
24 unsaturated zone testing, the results will be used in the
25 resolution of Yucca Mountain Project performance and design

1 issues concerned with fluid flow in the unsaturated zone.
2 Principal applications will be in the assessment of
3 groundwater and gas travel times, design analysis related to
4 the underground repository facilities. And, also, issues
5 concerned with the waste package containment and engineered-
6 barrier systems will use information resulting from this
7 test.

8 DR. CORDING: Thank you, Mike.

9 We have time for questions now on the--
10 particularly, focusing on the perched water tests, the
11 hydrologic properties of major faults, and the hydrochemistry
12 tests.

13 DR. LANGMUIR: I guess, it would be better if I would
14 look at the details, but I'm curious. Obviously, it's
15 critical that you don't cause any contamination in the
16 process of doing the sampling and it's very easy in any kind
17 of sampling I'm aware of to contaminate a sample with
18 material around it. Maybe you don't have any overheads that
19 show this, the design of the gas and water sampling devices.
20 Perhaps, they can be discussed very briefly. This may be a
21 little more than this audience needs to hear on how one
22 prevents contamination effects in sampling gases and fluids
23 from the ESF.

24 MR. CHORNACK: Sure. Let me take a stab at it real
25 quick, but, Charlie, you probably want to join in.

1 Basically, by contamination, do you mean as the
2 sample is being taken, Don, collected? Basically, what we'll
3 have, we'll have access tubing down to the zones of interest
4 and we'll just use a peristaltic pump and the tubing will be
5 isolated from the atmosphere. And, basically, for the
6 isotopic and gas composition samples, we use a syringe and we
7 purge the syringe so there's no contamination there in that.
8 Am I on the right track?

9 DR. LANGMUIR: Yeah, that's--

10 MR. CHORNACK: Charlie might want to elaborate a little
11 more as far as some of the other--the CO₂ and ¹³C sampling.

12 DR. LANGMUIR: Yeah, the tritium and the ¹⁴C sampling is
13 another critical--

14 MR. PETERS: Yeah, I guess I need to be specific to what
15 constituents you're thinking about. We'll collect tritium
16 and stable isotopes from the water vapor that we pump out of
17 the hole. And, I don't--I guess I'm not sure where we could
18 cause contamination there. We use teflon tubes. God, I just
19 don't see where--

20 DR. LANGMUIR: Well, your sampling into evacuated
21 containers, for example, so there's nothing there to give you
22 problems?

23 MR. PETERS: Right. We'll collect it into a cold trap,
24 a glass cold trap, and we'll dedicate that cold trap to the
25 specific zones. Yeah, as far as the sampling of cores out of

1 the holes, we've looked fairly carefully to date at what
2 we've been doing to the cores as we're collecting them.
3 We're very careful about how we remove the SF-6 that's
4 injected as part of the drilling air. We're still doing
5 studies at surface-based holes. We've done studies at Apache
6 Leap, at UZ-16, and we'll do them at 14. And, basically, the
7 chronology of the holes underground will be we'll drill them
8 with a trace gas. We'll try to remove that trace gas. We'll
9 test the gas to be sure that we have removed it to a level
10 where it's not going to bother us as far as the carbon
11 isotopes and other major gases. Then, we'll collect a
12 complete set of ^{14}C and other gas chemistries. Then, Gary
13 LeCain will come in and do his work. He'll inject some more
14 gas probably using a different tracer. We'll do the removal
15 work again to make sure we clear the hole. Then, we'll
16 collect another set of ^{14}C and we'll monitor over the next
17 four or five years.

18 DR. DOMENICO: How do you run a tracer test in
19 unsaturated material? That's a new one on me.

20 MR. LeCAIN: Theory has it that the flow is in the
21 fracture systems and that the fractures are dry. We will
22 inject the tracer into an injection interval under very low
23 pressures, probably other selected intervals, and measure the
24 travel time that it takes between the two injections and the
25 point where it shows up.

1 DR. DOMENICO: What's driving that tracer?

2 MR. LeCAIN: A pressure gradient.

3 DR. DOMENICO: --pressure gradient, probably?

4 MR. LeCAIN: Yes.

5 DR. DOMENICO: My understanding of tracer test is you
6 get a combined parameter. You get a ratio of tortuosity to
7 porosity. You never can isolate one or the other.

8 MR. LeCAIN: Very true and we've thrown in another
9 unknown in this and that's are all the fractures actually dry
10 at any particular time? So, interpretation is not an exact
11 science in this case.

12 DR. LANGMUIR: Given all of that ambiguity, how does one
13 validate a measurement?

14 MR. LeCAIN: I think the best way to answer that is that
15 it bounds the measurements. It bounds the values that might
16 be used in models in estimating flow through the unsaturated
17 zone. I would hesitate to say that we can actually give you
18 an exact value, but I would also make that statement about
19 most any hydraulic or pneumatic test conducted in an oil
20 well, a gas well, or in any aquifer.

21 DR. CORDING: I had one question regarding the test
22 across the faults. It's a sort of sampling that I think
23 should be very useful because, first of all, we'll know where
24 those faults and features are and it's well-mapped in the
25 tunnels. How many of those are you planning to do or what

1 range--how are you going to make the selection of the fault
2 testing?

3 MR. CHORNACK: The faults that we actually test?

4 DR. CORDING: Yes?

5 MR. CHORNACK: In the plans right now, we intend to test
6 every major fault that is intersected in ESF. That would be
7 the--the first one we get to would be the Bow Ridge Fault.
8 That will be the--you know, there's about seven or eight
9 major faults. I could name them off if you want me to, Ed,
10 but any major fault and these are basically--by major faults,
11 they're pretty much faults that are mappable features at the
12 surface. All of these major faults, we will test and any--if
13 we see any significant or major faults that up until now they
14 haven't been mapped because they don't have any kind of
15 surface expression, we'll also test those, also. Is that
16 correct, Gary?

17 MR. LeCAIN: Yes. Yes, we've left it very open as to
18 our selection of what we constitute to be a fault that we'd
19 like to test.

20 MR. CHORNACK: But, we will test--we'll test the Bow
21 Ridge, the Ghost Dance, the Abandoned Wash Fault, the
22 Solitario Canyon Fault, a lot of these major features will be
23 tested.

24 DR. CORDING: And, the Calico Hills, as well, is at the
25 --

1 MR. CHORNACK: Yeah, that's one thing I guess I should
2 clarify. At one time, we had a Calico Hills test and we also
3 had a multi-purpose borehole activity in this study. These
4 have been dropped. What we plan to do in the Calico Hills is
5 we don't have a separate test activity. What we intend to do
6 and we stated this in the study plan that if, indeed, we do
7 go to the Calico Hills, any of the test activities that we
8 conduct in the units above the Calico Hills, we will also
9 conduct in the Calico Hills with the exception of probably
10 the excavation effects test; we won't conduct in the Calico
11 Hills. But, all the other data collection activities, we
12 will conduct those in the Calico Hills also.

13 DR. CORDING: Do you consider that most of these fault
14 tests would be--you'd be able to conduct after completion of
15 the loop?

16 MR. CHORNACK: Yes.

17 DR. CORDING: So that you can do the alcoves after the
18 loop is done so that you won't have to do those every time
19 right behind the machine?

20 MR. CHORNACK: I believe that's true. Isn't it, do you
21 think, Gary, on that? The timing of the tests and the--

22 MR. LeCAIN: The impacts on the major faults would
23 probably be minimal if we did finish the loop, although I'll
24 always argue that we need to do these right away.

25 DR, CORDING: Okay. In regard to data collection and

1 data system, I know there's discussion of some sort of a
2 system that would collect data and bring it to the surface
3 and evaluate it, process it, a major data logging system.
4 And, I was wondering just what your--on these tests which are
5 going to be spread throughout the facility, what your
6 approach would be on the collection of the data itself?
7 Would there be basically the data collection effort--are you
8 thinking it could be done right there in the alcove? What do
9 you have to have in terms of that type of support?

10 MR. CHORNACK: As far as the data acquisition system?

11 DR. CORDING: Data acquisition?

12 MR. CHORNACK: Yeah, what we intend for most of the
13 tests, we intend to have stand-alone data acquisition
14 systems, some sort of portable data log that would be right
15 there at the testing location. This data could be
16 transferred into the larger IDS or DAS system that is going
17 to be installed in the ESF. Falah, do you want to comment on
18 that, at all? I know you attend a lot of those meetings.

19 MR. THAMIR: Some tests that require mobile data
20 acquisition systems, like Gary LeCain, that's what he'll use
21 and then we'll use programs that convert the data collected
22 by those mobile systems to a standardized format that will be
23 stored on a centralized system.

24 DR. CORDING: Is it something that has to be transmitted
25 to the surface or is it a matter of being able to collect the

1 data there and then transfer it by disk? I mean, are you
2 going to have to have lines and a system running to the
3 surface to do that?

4 MR. THAMIR: We're currently working on that with the
5 DAS people and it depends on how fast they will be able to
6 install their network underground. If they are able to
7 install their network before we start testing, then it will
8 all be done underground. Otherwise, we'll have to work
9 around this.

10 MR. CHORNACK: We could go either way, Ed. You know, if
11 there is some sort of transmittal system installed in the
12 ESF, we can go ahead and tap into that. But, we're not
13 dependent on it. We can stand alone. We can actually
14 physically just transfer the data from our collection
15 activities to the surface.

16 DR. CORDING: I would assume that your activities would
17 be one of the major reasons for having an IDS system,
18 wouldn't it?

19 MR. CHORNACK: I don't think so. No, I think some of
20 the other--although, I'm not really familiar with this aspect
21 of the program. I think there would be other--some of the
22 other testing activities, like the thermal experiments and
23 things like that, are a little more dependent on the
24 installed--the hard line to carry the data to the surface.
25 Falah, is that your understanding?

1 MR. THAMIR: That's correct.

2 DR. CORDING: Thank you. It's time for--well, we have a
3 question from our staff. Any staff questions? Leon?

4 DR. REITER: Several times in the past, we have visited
5 the Äspö Hardrock Laboratory in Sweden. They're digging an
6 underground facility there. The last time there, we asked
7 the geologists what are some of the surprises they've had.
8 One thing that came out was they said that it was very--
9 although it was easy to see the fractures in the faults, it
10 was very hard for them to predict which of them water would
11 be flowing out of. And, the reason being the interconnection
12 was there; they couldn't understand that. Now, they have the
13 advantage, they have a wet system. They can see where the
14 water is flowing out. You're doing a lot of studies in
15 individual faults. We know that fault zones exist. We know
16 the Ghost Dance is, God knows, how many hundreds of feet
17 wide, the Imbricate Fault system. How are you going to take
18 these studies of these individual faults and translate that
19 to how the fault systems are behaving, particularly at a time
20 when you have--in the future, we may have a lot more water
21 than you have now.

22 MR. CHORNACK: That sounds like a modeling question.
23 Ed, where's our modelers? I have some modeling support here.
24 Where did he go? Ed, is that a modeling question?

25 DR. REITER: Excuse me, and part of the concern was, I

1 think, Ed's paper--Ed's presentation to the Board in April
2 where he did a theoretical study showing that depending on
3 how much rainfall, different size fractures were activated.

4 MR. KWICKLIS: I think we do have a problem in that we
5 are sampling the faults at relatively few locations and I
6 guess it's a question of do we want a little information or
7 no information, at all. We're constrained somewhat by where
8 the ramps intersect these faults. And, while we'd like to
9 have measurements at many more locations, the current layout
10 of ESF dictates that we're going to cross these faults only
11 at certain locations and we have to live with these
12 constraints. And, we acknowledge that the transmissivity of
13 these fault zones is, in part, saturation dependent and there
14 will need to be a lot of interpretive modeling to go with the
15 physical measurements which are measurements only at one
16 saturation. And so, we'll need to depend on laboratory tests
17 on smaller scale features in combination with these field
18 tests and modeling to really understand how these fault zones
19 are going to behave under different saturation conditions.

20 DR. REITER: Just one last question. How are you going
21 to overcome the problem of interconnection of these systems?
22 You can model--you would have to test every single fault in
23 the system, but how are you going to overcome the
24 interconnection aspects of it?

25 MR. KWICKLIS: I'd have to say that, you know, you're

1 going to really rely on a complete picture formed by
2 geochemistry, pneumatic testing, modeling, and that this
3 information is going to be complimentary. And, we'll look at
4 things like isotopes, ^{14}C , gas, and liquid isotopes to help
5 us understand just how interconnected and flowing these
6 features have been in the past because we can't test every
7 interval, but we can look at travel times within those fault
8 zones to help us understand how liquid has moved there in the
9 past then. And, in combination with the physical property
10 determinations from air- and water-injection testing and
11 interpretive modeling, our hope is that we can have a
12 somewhat coherent picture of how these faults behave.

13 MR. CHORNACK: Do you care to elaborate on that, Gary,
14 at all? Do you have any thoughts on this?

15 MR. LeCAIN: Not a chance.

16 DR. CORDING: All right. Well, thanks very much.

17 We have a break until 10:45.

18 MR. CHORNACK: Thank you.

19 (Whereupon, a brief recess was taken.)

20 DR. CORDING: We're ready to reconvene.

21 Our next speaker is Dale Wilder, Lawrence Livermore
22 National Lab, talking about thermal--the precise title is
23 thermal testing update.

24 MR. WILDER: Thank you, Ed.

25 I struggled a little bit, I'll have to admit, with

1 what I was going to say since we had discussed this topic
2 very recently within the last three months. And, I decided
3 what I was going to do is to perhaps review just briefly some
4 of the things that we had talked about the last time and then
5 bring you up to date on what has transpired on the large
6 block test because that's where most of the current work is
7 occurring. And so, I will call your attention to the
8 presentation which was made in July. I guess, if I stand
9 there, you're not going to be able to see, are you? I'll
10 stand over here.

11 At that time, we did talk about the waste package
12 environment thermal testing. I don't plan to plow that same
13 ground too much today except I would call to your attention
14 that in your package are some of the viewgraphs--for
15 instance, the testing strategy and so forth--that came out of
16 that presentation. I've put that in there for your review.
17 I'm not planning to really discuss too much on this unless
18 there are questions. But, I would remind you that we did
19 talk about the fundamental hypothesis that we were going to
20 be testing, the criteria for the ESF test themselves, and
21 then we talked a little bit about schedule. There were a
22 number of different schedule alternatives, two of them to be
23 exact, which we did discuss. What I'm going to do today is
24 to restrict myself pretty much to talking about the strategy
25 where we're looking at the large block test and how it fits

1 into the ESF testing.

2 I think that I pointed out last time that the
3 results of these large block tests would be used to help us
4 to revise our study plans and activity plans for the ESF
5 test, but that the test at the large block would not be
6 completed in time to precede the study plan. Therefore, what
7 we would do would be to review those ESF plans in light of
8 the early large block test data. Our anticipation was that
9 we could begin heating some time in the middle of 1994 and
10 that, based on what we were seeing, we would make any changes
11 to the test plans and certainly would modify any equipment
12 orders and calibrations that may be progressing.

13 I also talked about in terms of ESF testing a
14 concept of using abbreviated testing to provide the data for
15 the license application and a series of tests, a cool-down
16 test and a constant heating test, to back that up at the time
17 when we went to license. I know that some of this material
18 was picked up in your report that I had a chance to review
19 last night and certainly one of the issues that I brought up
20 was that for some of the heterogeneity reasons, we may have
21 to do very long-term monitoring and performance confirmation
22 testing.

23 Also, during our conversations in July, I talked
24 about the need to begin testing prior to the ESF test and
25 gave the rationalization for that large block test. And so,

1 at that time, we did--I hope you can see this--we did give
2 you a little bit of a status on the large block test. At
3 that time, we had cleaned off the outcrop, we had mapped--I
4 think I showed you some of the fracture mapping--and we had
5 selected a general block location, all this work being done
6 at Fran Ridge. So, now, I would like to then discuss what
7 has happened since July.

8 As I say I'm going to be stressing the large block
9 test because we haven't really changed much in our thinking
10 in terms of the ESF testing, although we continue to have
11 meetings with the project office and with other participants.
12 There's really not been a lot that's been changed in our ESF
13 test planning. There has, however, been quite a bit of
14 activity on the large block test.

15 One of the things which did occur was planning
16 offsite. We spent three days discussing the large block
17 test. And, out of that, came several important conclusions
18 and directions. Let me just try to summarize a few of those.
19 One is the recognition for a increasing need for material
20 testing. Our original test plan was to include some metal
21 coupons perhaps on the heaters that were going to be emplaced
22 in the large block and to observe the corrosion, if we could.
23 We recognized, however, that there wasn't going to be much
24 moisture in the area of the heaters. So, we had been
25 thinking about moving the location of those metal coupons

1 down below the heater plane where we would expect to have
2 condensate dripping. I think we may have discussed this at
3 our last Board meeting.

4 At the offsite, it became quite apparent to us that
5 we not only needed to put the boreholes below the plane of
6 the heaters in order to do metal tests, but we also talked
7 about the number of other needs and one of them was to go
8 ahead and put the metals in the heater boreholes in addition
9 to the ones below because of issues over thermal degradation,
10 thermal issues on the materials themselves. We don't expect
11 to see any corrosion because, as I say, there will be a very
12 minimal amount of water. We also are going to incorporate
13 some rather exciting work that's being done with
14 microelectronics, looking at corrosion potentials and so
15 forth. Those will be incorporated both in the heaters and in
16 the boreholes below the heater plane.

17 We also recognize the critical need to better
18 constrain our tests for geochemical purposes and we would be
19 able to--in an in situ test and I think probably one of the
20 bottom lines that came out of this offsite was the
21 recognition that even if we were allowed to do as we had
22 originally hoped, in situ testing somewhere, prototype
23 testing, that we would still need something like a block test
24 where we could control the boundary conditions and we could
25 look at some of the issues such as refluxing which have come

1 to the forefront a lot more over the last few months. Part
2 of this is in addressing things like the crushed tuff column
3 experiments at Princeton and so forth and also part of it is
4 a recognition in the difficulty in trying to characterize
5 geochemistry. The advantage that we have with the block is
6 when we are completed, we can take the block apart. We can
7 look at the fracture systems. We can try to understand, at
8 least, the changes in the mineralogy and relate those to the
9 hydrology and geochemistry monitoring that have been done
10 during the test.

11 We discussed a lot of new instrumentation during
12 this offsite, much of which will include things like fiber-
13 optics. The SEAMIST is going to be very critical for our
14 program in the large block test. We are also looking at, as
15 I mentioned, microelectronics and fiber-optics to look at
16 some of the geochemical parameters.

17 We also decided that one of the things we needed to
18 do in order to give us some confidence in our hydrology
19 models was to control the boundary conditions. And so, out
20 of this, came a lot of details which are going to be
21 reflected in the activity plan in terms of guard heaters
22 along the edges, the boundaries, as well as just monitoring
23 the temperatures where we can keep controlled temperatures
24 along the boundaries, seal the boundaries so that we do not
25 have any moisture going out of the boundaries, and we will

1 then be able to look at refluxing conditions above the
2 heaters. And, part of this was discussed at our last Board
3 meeting.

4 A couple of other things that did come out of the
5 offsite planning. The scientific investigation plan had
6 already been prepared, but the offsite planning provided the
7 basis for a very detailed activity plan which is currently in
8 our technical information department for editing and should
9 be out beginning its review process at the end of this month.
10 And so, we anticipate that we will be able to get the
11 planning documents completed as a result of this planning
12 offsite.

13 A couple of other things that have happened. We
14 did complete the topography maps and started planning how to
15 do the excavation. As a matter of fact, some of the
16 excavation work has started and I'm going to talk about that,
17 as well. A lot of discussion at the offsite. It was how
18 would we excavate the block without damaging the block itself
19 or excavate the material outside of the block.

20 The other thing that I should mention is that the
21 test frame contract has been awarded. There was a lot of
22 discussion over this one because in the offsite, it became
23 quite apparent that although the test frame complicates our
24 test, we didn't feel that we could go without some sort of
25 loading on the block. One of the problems that we had is

1 that, in essence, with those five boreholes, five heater
2 boreholes, we have created a presplit condition if we're not
3 careful and, if we heat the block, we were concerned that we
4 were going to get a horizontal fracture across the line of
5 the heaters and also at the bottom of the block where we are
6 expecting horizontal stresses that might fracture the block.
7 And, I know that this has been a problem in the past with
8 some of the tests. For instance, the heated block test that
9 Sandia had, they felt they had a disconnect at the bottom.
10 In many respects, we would like to have done that, but we
11 can't control it and so we didn't want a fracture being
12 created. So, we really felt that we needed a vertical
13 loading. And, of course, for reasons of asperity contacts,
14 in terms of pressure dissolution and so forth for the
15 geochemistry, we felt that we did need to maintain horizontal
16 stresses.

17 Originally, we had planned on a stress ratio
18 similar to what we would expect underground at Yucca
19 Mountain. It became quite apparent, as the bids came back to
20 us, that it was going to be entirely too costly for us to be
21 able to build a test frame capable of 100 bars vertical and
22 50 bars horizontal. Through a series of renegotiations, we
23 backed off to a 50 bars vertical and horizontal. That does
24 not necessarily mean that they will be the same, horizontal
25 and vertical stress, but we certainly will not be able to go

1 up to 100 bars in the vertical. Our expectation is that the
2 frame will be available in about six months. And so, that
3 fabrication is progressing as we speak.

4 Let me then share with you--and, I apologize it
5 was--I know you're not supposed to apologize for a slide, but
6 nevertheless, this one, I recognize it's somewhat busy. It's
7 the only one that I had available. But, let me try to walk
8 through this schedule. As you'll notice, there's a
9 preliminary sawing that was scheduled and I will talk about
10 that. We did a test with the belt saw. It's not the full
11 length saw that will cut the block, but it is a similar
12 design and I'll talk about some of the results of that
13 because we're quite encouraged by the results. We also had
14 scheduled leveling off the block and I'll talk about this in
15 some detail with fracture mapping. In essence, we are on
16 schedule with this and expect that we will be able to do the
17 fracture mapping perhaps not the first of November, but
18 certainly very close thereto. With sawing of the block
19 itself scheduled for mid-November and I believe that's still
20 on schedule and then excavation starting of the block. The
21 block support is in active design right now and, of course,
22 it will have to be available at the time we start doing the
23 actual excavation. The characterization work continues in
24 terms of the mapping. We will be doing more mapping after
25 the leveling is completed. I'm going to talk a little bit

1 about some of the drilling, both the vertical and the
2 horizontal drilling. So, I guess, in terms of status, we
3 feel that we are very much on schedule.

4 I mentioned that we did a prototyping of the saw
5 cut. This is the belt saw that was used. You can't really
6 see it because it's so bleached out, but this is a sump that
7 was provided for the recirculation of the water used in the
8 sawing operation; basically, just a black plastic around here
9 to catch the water. We made two parallel cuts. This is a
10 view looking at the frame of the saw. The other view is one
11 that you already saw, a little bit expanded view with the
12 belt on the pulley system. And so, we did cut two slots
13 approximately four foot deep and I think they were about five
14 or six feet long. We were very encouraged by the results. I
15 do have a video. Unfortunately, I don't have the tv here. I
16 understand it may be available during the break if people are
17 interested.

18 But, we looked down the cut that was left with a
19 fiber-optic camera and two or three things that we saw that
20 encourage us that we'll be able to excavate this block. One
21 was we did see areas where the rock had obviously had started
22 falling out on us. And, one of our concerns and the reason
23 for doing the prototype testing was to make sure that we
24 weren't going to get the blade of the saw wedged in by chunks
25 of rock coming out. Apparently, what happened is, is these

1 started to fall out. They were just chewed up by the saw and
2 they were not a problem, at all, to us. So, you can see in
3 this little video that there's some areas where the rock has
4 fallen out and those chips were not a problem to us.

5 We were also very gratified at how straight and
6 even the saw curve was. It was very straight and smooth-
7 walled. We also saw one section which again is visible on
8 the video where you could see the water that had been used in
9 the drilling had run into the fracture and was weeping back
10 out. It looked--well, it wasn't weeping, but it was moist
11 along the fracture surface.

12 What you're looking at here is after the two saw
13 cuts had been made and these are the two parallel saw cuts.
14 For whatever reason, we decided not to make four of them and
15 I think with a little hindsight wished that we had have made
16 the four. We would have had a block exposed. But, at any
17 rate, after the saw cuts, REECo went in with just a jackleg
18 and excavated out material that was outside of the saw cut.

19 I should move that up. Now, I think I've got a
20 closer view. Let me move to the closer view so I can--you
21 can't get a good sense for how straight this cut is because
22 of the change in elevation and so forth and also the color.
23 But, you can see some of the blocks that were taken out. So,
24 they were able to actually pop out some fairly good size
25 blocks off the side with no damage to the remaining block.

1 This block is approximately two feet--or the saw cuts were
2 approximately two feet apart and, as I say, they were as much
3 as four feet deep.

4 DR. LANGMUIR: Dale, what's the formation we're cutting
5 out of here and making the block?

6 MR. WILDER: Okay. This is, essentially, the Topopah
7 Springs tuff. We are a little bit south of where the block
8 is and we're right on the contact with the lithophysae. And,
9 as you'll see right at the top here, this is not the zone of
10 interest. It's the deeper zone which will be represented in
11 the block. But, it is the same tuff that we would expect in
12 our in situ tests in the ESF.

13 DR. LANGMUIR: Is that altered material in the top of
14 the block that you're going to--

15 MR. WILDER: That's altered and it's also--well, let me
16 go ahead and just put on the other. What you're looking at
17 and the reason it says top and it's kind of upside down is
18 this is the block that was excavated and laid off to the side
19 that I showed in the previous picture. And so, it's kind of
20 like a little wedge and this is the soft surface that matches
21 the other surface over here. As you can see, we do have
22 these lithophysaes present. Part of what you're seeing is
23 the surface alteration and part of it is also the fact that
24 we are right in that lithophysae zone. As you get deeper, as
25 you can see, it does get to be more of the typical Topopah

1 Springs.

2 DR. LANGMUIR: Are you going to avoid looking at the
3 thermal effects on the altered portion and try and exclude
4 that from your block test?

5 MR. WILDER: Yes, a good lead-in for the next viewgraph
6 here. Our intention is to excavate the first couple feet,
7 perhaps as much as three feet, above the block area. We'll
8 level that, so that we can then go in and make our saw cuts
9 for the block itself. After all of that has been done, we
10 will trim off the first--the top foot so that we can remove
11 any damage that occurred during the excavation. One of the
12 things that we're also in the process of doing is we're going
13 to have to build a sump to catch the water from the sawing
14 operation and also to allow us access from this direction to
15 do our horizontal drilling. This work has pretty much
16 progressed on schedule.

17 What you're looking at is a plan view of this
18 excavation area. It's the excavation plan with the topo
19 shown on top. I would point out that this first portion of
20 this benching operation was performed as a prototype. That
21 is they drilled a series of presplit holes and then went in
22 with these vertical holes and excavated with explosive the
23 way that they were planning to do the excavation. We
24 identified fractures in which we had painted lines across
25 where we could investigate whether or not there was any

1 movement of those fractures as a result of the excavation and
2 then they did their first excavation here. And, that is on
3 the videotape, as well as a closeup of the little grid that
4 was put on the fractures.

5 DR. CANTLON: Dale, what's the scale there? What's the
6 red dot with--

7 MR. WILDER: Let's see, our scale--well, let me show you
8 another figure. I don't remember the exact scale. I think
9 this may help us. Six and a half foot? Thanks, Jim. The
10 vertical scale, we're looking at approximately 20 feet of
11 vertical elevation from the point of the excavation here on
12 the east up to where we will eventually be excavating this
13 top leveling bench. The total distance scale, as you can
14 see, is somewhere about, well, 120 feet approximately from
15 this edge up to this edge. The block itself, of course, we
16 talked about it being approximately 10 foot square, though it
17 doesn't show up here, but it's located essentially in the
18 center here.

19 After the first prototype excavation, if you will,
20 the vertical holes in this part of the benching were drilled.
21 The excavation was not completed because we needed access up
22 to this area in order to do these vertical boreholes. So, a
23 ramp was constructed and the drill rig is in the process of
24 drilling these holes. Now, we did have an accident which,
25 fortunately, was not a serious one. We were very lucky that

1 no one got hurt. But, they did tip the drill rig over. And
2 so, now, they're completing the last--I think it's about a
3 dozen holes, 10 to a dozen holes, by hand with a jackleg and
4 that work is progressing also, as I understand, and should be
5 completed by the end of this week.

6 After that work is completed, then the plan is to
7 go back to the lower area and excavate out all this material,
8 so that there is then an ability to have access for these
9 horizontal holes which will be drilled so that we can break
10 the rock without doing too much damage to the underlying
11 block area itself. Then, they will detonate the explosive in
12 the overburden and we'll remove it. At that point, we should
13 have access to begin the mapping. As I say, the mapping is
14 scheduled early November and, at that time, not only will we
15 map and select a location for the block, in general, we will
16 put in vertical boreholes because we need to drill those
17 first and we will do air-permeability testing in the first
18 borehole. Based on the results of that testing, we will
19 either decide we're going to have to move the block somewhat
20 to get in rock that's more appropriate for our test or we
21 will then finalize the location of that block, put on a
22 template in which we can then drill all of our
23 instrumentation boreholes, vertical boreholes, and then we
24 can move to make the saw cuts.

25 DR. LANGMUIR: I'm wondering what your preliminary

1 assessment is of the amount of fracturing that you're likely
2 to find and whether there's still continuity in terms of
3 physical strength across the fractures and what they
4 represent in terms of what you'd expect in the mountain?

5 MR. WILDER: Okay. We certainly feel that there's going
6 to be a number of major, as well as minor, fractures present.
7 I think I showed the map the last time and I didn't bring a
8 copy of that with me. But, we have certainly fractures on
9 approximately at one every foot kind of spacing. Most of
10 them are vertical, although we are seeing a lot more
11 horizontal fractures especially if we went down the pit
12 that's nearby and looked. There are a number of horizontal
13 fractures, but the predominant fracture is going to be
14 vertical fracturing, approximately one every foot, some of
15 which are very continuous, others terminate on other
16 fractures. So, our expectation is that we'll see the
17 complete range of fracture characteristics that would be
18 necessary for us to really get an understanding on this, both
19 interconnectivity of the fractures, as well as the
20 statistical distribution of our hydrologic responses in
21 either short fractures, tight fractures, so forth. We also
22 have seen apertures that have varied anywhere from maybe as
23 much as half an inch, three-eighths of an inch, on down to
24 essentially completely tight and all you see is just an
25 alteration almost like a pencil line to define the fracture.

1 Our big concern, as we had expressed last time and
2 I think is still a concern for us, is that the fractures are
3 healed with perhaps--not 100%, but many of the fractures are
4 healed with silica, carbonates, and so forth. We feel that
5 this will not invalidate our geochemistry tests. What's it's
6 going to do is test a different part of the geochemical
7 understanding models than perhaps we will eventually need to
8 validate for the ESF. We don't expect that kind of--
9 certainly underground. We're not sure how much of that is
10 going to die off with depth and we're hoping that we can get
11 out of the major portion of field fracture zones.

12 I think that that pretty much concludes what I was
13 intending to talk about. I should have mentioned when I was
14 talking about the offsite that this was not just a Livermore
15 offsite. We did invite a number of participants. We had the
16 representatives there from Los Alamos, both the project
17 management office here, as well as the geochemists, Sandia,
18 the M&O, DOE, and we feel that we've got a pretty good
19 relationship developed in terms of making sure our test is
20 going to be useful to everyone. We do plan to use some of
21 the testing that Sandia is developing for hydrology and we
22 are going to be using some of their--specifically, their x-
23 ray tomography and we're going to be trying to incorporate
24 some of the Los Alamos geochemical approaches, as well. So,
25 I think that we are moving. The one slide that I didn't show

1 which was in your packet and somehow I've lost it was the
2 slide showing the test excavation. I guess, I would without
3 trying to dwell on it too much say that, yes, we are moving
4 forward. As the slide says, we're moving dirt. We've
5 excavated and it looks like we're moving on schedule.

6 DR. CORDING: Thank you, Dale.

7 Questions, Board?

8 DR. LANGMUIR: Dale, you mentioned that you had silica
9 sealing of fractures that you observed in the shallow parts
10 of the formation that you're looking at. I'd be curious from
11 the GS whether they've observed the same kind of shallow
12 sealing of fracture zones in their vertical boreholes as
13 you're seeing here and what happens to them as they proceed
14 down. It's a question for someone else perhaps, but maybe
15 you've talked to them about this.

16 MR. WILDER: Let me first share with you what I know and
17 I'm sure someone from USGS can amplify on this. There is a
18 horizontal borehole very near to where the large block test
19 is located. In that borehole, they did see fractures healing
20 at the very near collar position. When they got to, as I
21 understand it, approximately the equivalent of 30 feet of
22 overburden, that fracture healing started to pretty much die
23 out.

24 DR. FLINT: In the 24 or so holes that we've drilled on
25 Yucca Mountain in the last two years, what we've typically

1 found is about the first 20 feet to 25 feet, the fractures
2 are for the most part filled with calcium carbonates. As we
3 get below that from 30 to maybe 50 feet, we find a lot of
4 fracture coatings, and then below maybe 50 to 75 feet, we
5 start to find more open fractures. But, about the first 20
6 to 30 feet are almost always filled with carbonates.

7 DR. LANGMUIR: Is this a general phenomena that includes
8 what you see in Trench 14? Do you think it's the same sort
9 of surface--

10 DR. FLINT: It's the same--

11 DR. LANGMUIR: Weathering and then percolation down?

12 DR. FLINT: It's the same type of phenomena where we
13 have the calcium carbonates deposited on the surface mostly
14 as dust and then that's dissolved in the water. Then, water
15 moves into the fractures. We don't see very deep flow of the
16 water. So, when the water evaporates, it leaves the
17 carbonates there. In the soils in the area, we see it out
18 two to three meters. We see these big carbonate layers.
19 But, where we have very thin soils or exposed--we get water
20 down right into the fractures and we do see that plugging to
21 about 25 feet or so.

22 DR. LANGMUIR: This is getting away from Dale's talk,
23 but I'm curious now. How tight does that make the top of the
24 mountain if you're looking at healing at below and moving
25 fluids up through it? Have you got a cap because of these

1 ceilings?

2 DR. FLINT: To a large extent, I think we do. I think
3 we have a well-healed surface for a large extent.

4 DR. CORDING: Thanks, Alan.

5 Other questions?

6 DR. LANGMUIR: Last week, I was at a workshop, Dale,
7 where Rich Van Konynenburg talked about corrosion of metals
8 and concluded that it was likely to occur when water ponded
9 on the metals around the repository, perhaps, and radiolysis
10 created nitric acid which was then the basis for the
11 corrosion effect. I'm just wondering, have you thought about
12 this or were you aware of his conclusions and how does this
13 tie into your proposed test of metals in your block?

14 MR. WILDER: Certainly, we have observed that. We
15 observed it at the spent fuel test where we had dripping
16 water and saw tremendous corrosion of the carbon and steel
17 borehole liners. We've done some analysis. Rich Van
18 Konynenburg basically is the one responsible for that in
19 terms of radiolysis and its impact. And, of course, as we've
20 said many times, it depends on what the final design is. If
21 we go with some sort of a self-shielded container, it's going
22 to be much less of an issue. What we've seen in terms of the
23 environment itself, however, is if we went with the SCP kind
24 of a reference design, thin-walled container, in a borehole
25 that the radiolysis is of concern only in the borehole

1 itself, within a couple of centimeters. You no longer have
2 issues of radiolysis within the rock matrix. It's strictly
3 within the borehole. And so, it's going to be dependent upon
4 what moisture conditions are. As Rich says, if you've got
5 water ponded there next to a non-shielded container, that
6 certainly can change the water chemistry. I think it's also
7 going to depend upon what your container material selection
8 are as to how sensitive that is to the changes. But,
9 certainly, the production of nitric acid or ammonium, if
10 you're going to a copper base, would be of some concern. I
11 know that Bill Clarke and his folks have looked at that
12 rather extensively.

13 In terms of our block test, we are not planning to
14 try to evaluate radiolysis in any fashion. And, we're also
15 assuming that the ultimate design will probably be an in-
16 drift emplacement. There are a number of things you can do
17 in in-drift emplacement to try to moderate any ponding and so
18 forth, although you may get some water film. So, our tests
19 are strictly to look at dripping water on top of the metal
20 coupons, down those holes in the condensate zone, and to look
21 at what happens at the heaters themselves where you do go
22 through the drying out and possibly depositing some
23 precipitants.

24 DR. CORDING: We're running out of time here. But, I
25 just had one question. When do you see the start now?

1 What's the latest on the start of the underground testing
2 within the ESF? When do you think you can actually start
3 heating underground? What's your current prognosis?

4 MR. WILDER: My understanding is that we still expect to
5 have access in like the June of '96 time frame to begin our
6 test installation. We would start heating six months after
7 we have access. So, we're looking, essentially, at the end
8 of '96 to begin our heater tests is my understanding. I
9 think Ned may be able to give you further insight. Is that
10 correct, Ned? Are we still on track for '96? I think Ned
11 said we might even beat that.

12 MR. ELKINS: We'll talk about it.

13 MR. WILDER: Okay. Ned will talk about that later.

14 DR. CORDING: Okay. You know, one of the things that
15 we've--you discussed in your previous presentation was the
16 desirability of having some sort of offsite tunnel type
17 tests. You know, the timing of going underground and the
18 timing of that sort of thing is obviously important. If it
19 takes you as long to develop one at the surface as it does to
20 get underground, then it's no point in doing one off the
21 site. But, if there's--if we're going to look at this three
22 years down the line and not have started anything
23 underground, then people will be saying, well, why didn't we
24 do something earlier prior to this? I'm sure there will be
25 reasons why, but the question is, you know, how long--how

1 long will it take for us to really get started underground
2 and there's a lot of other considerations in terms of how the
3 underground work goes. But, is it going to slip to the point
4 that the possibility of a separate facility is one that still
5 ought to be considered? I guess that's the question I have.

6 MR. WILDER: Of course, our view has always been that we
7 would prefer to have a Busted Butte or other location to do
8 testing before ESF, but the very practical issue is would it
9 even make any sense if we stay on the schedule? And, as far
10 as I know, we are currently on schedule to get underground in
11 '96.

12 DR. CORDING: Anything else?

13 (No response.)

14 DR. CORDING: Thank you very much.

15 The next presentation will be Ned Elkins talking
16 about ESF testing and test locations.

17 MR. ELKINS: What I would like to try and provide for
18 you now is a little more information on the scope of the
19 underground test program and our future test program plans
20 recognizing that we are in the middle of a lot of the actual
21 planning for not only our construction program, but certainly
22 our test program underground, as well. We'll share with you
23 what our current ideas are, our plans are, and some of the
24 main areas that we're actively working, main areas of concern
25 in that ongoing development.

1 Let me start this by showing you this and also
2 using it as an example of the environment in which we're
3 finding ourselves right now in ESF. It's fast-moving and
4 there's changes. As we begin to settle on configuration, as
5 procurement of TBM and arrival and setup and the beginning of
6 construction begins, this that I've put together a couple of
7 months ago is already somewhat dated. That's why I say use
8 as an example of that environment that we're in.

9 The construction of Alcove #1 is ongoing. We
10 talked about that a little bit this morning. We won't spend
11 any more time specifically with it now unless there's
12 questions.

13 Initial hydrologic testing begins and has begun now
14 with hydrochemistry testing in that alcove and will run
15 through June of '94. This date will almost certainly now
16 extend beyond June of '94 as our initial core drilling in
17 this alcove will probably not commence until late December/
18 early January and we believe we need about three months to
19 drill and set up. I'm talking about three months for initial
20 testing. So, we may be a little too optimistic in thinking
21 we'll close down our initial phase in that first alcove in
22 June.

23 Start of TBM excavation, I believe is still
24 current. This date still holds at about August 1994.

25 Entry into the block at TSw₂ horizon, this is

1 information that the test coordination group developed on
2 some preliminary information, March of '95. We don't know if
3 that still holds. That may be a little premature. I don't
4 know if Dan or someone is here that wants to correct that or
5 give us an update on it, but this is the date that we're kind
6 of using as a planning basis.

7 Our daylight on the south ramp, I'm showing here
8 May '96. I believe I've seen June, maybe a little slight
9 update on that date.

10 Initial construction of core test area, based on
11 what I am currently hearing from construction design is that
12 it will not be concurrent. Is that right, Dan? Therefore,
13 the beginning of that construction in the core test area
14 coincides essentially with the end of loop construction.

15 MR. MCKENZIE: That's correct, Ned. We're talking about
16 running the loop first and then basically immediately
17 thereafter starting excavation of the main test area.

18 MR. ELKINS: Okay. Now, given the inability to co-
19 develop a core test area in the main test level of the ESF
20 with loop construction, the dates that we have currently on
21 the books for initiation of our thermal test program which is
22 the large test program in the ESF is obviously going to see
23 change if that doesn't in some way get modified. And, the
24 ways to modify that are two-fold. Either find and we're
25 working on ways to get an underground thermal program going

1 without dependency on the large scale test in the core test
2 area of the MTF. The second is to find a way to concurrently
3 develop that core test area and begin to set up for thermal
4 testing without major impact while TBM loop is developed.
5 Both of those are still being evaluated and being looked at,
6 but the conservative schedule that's being reflected here
7 assumes that for safety and operational reasons, no major
8 development lateral to that loop can be concurrent with TBM
9 operation.

10 DR. CORDING: Briefly there, Ned, that would put--to
11 develop the core test area for the testing would be, at
12 least, another year or year and a half and so it would be
13 almost two years from that point which you'd really be able
14 to turn on heaters.

15 MR. ELKINS: Yes, sir. I believe Dan's walking up
16 again, but I believe you're--the time frames you just
17 mentioned are almost exactly right. Dan?

18 MR. MCKENZIE: Pretty close. I think based on that kind
19 of a start in the main test area, we would project a November
20 '97 to flip on the switch for the heater test. So, we're
21 looking at, what, 18 months or something after daylight.

22 MR. ELKINS: Very briefly, I wanted you to have a
23 feeling for what we put into planning. This is the detailed
24 planning prior to taking an activity in the field. Really
25 getting serious about planning and doing the detailed work on

1 any activity is going to follow this implementation sequence,
2 the prioritization/implementation sequence I named earlier.
3 It will also be driven to some degree by the complexity of
4 the test. A very simplistic test, we don't need to plan on
5 very long ahead of implementation, but something such as a
6 waste package environment test, we're going to need to be in
7 a formal planning and development and design development
8 process probably a year to a year and a half before that test
9 activity would hope to go to the field. So, design and
10 construction complexity, as well as long-lead procurements,
11 might get us into a formal planning activity earlier, but all
12 tests will eventually go into and develop a very controlled
13 planning process.

14 The elements of that detailed planning are the
15 design requirements both for the facility itself and the
16 design of the test. The test layout, as well as the ESF
17 facility support design must be there for the test. That
18 input must be provided formally through ongoing ESF design
19 and so our scheduling and our test planning must coincide
20 with the concurrent packages being developed on the ESF side.

21 Test performance criteria are a part of that
22 detailed planning, certainly. We must do detailed
23 interference and site performance impact analyses that are
24 performed to look at the impact of the activity on other
25 activities, also on potential impact of the activity on

1 overall site performance and waste isolation capability.
2 Procurement planning, as I mentioned, is a part of this
3 process making sure that procedures that will be used in the
4 actual implementation of the test are in place, formally
5 there, brought by the PI organization. And then, lastly,
6 taking that planning activity and infusing that into the
7 overall scheduling and integrated network development, and
8 costing through the job package process which is a formal
9 documentation procedural process that all of our tests must
10 go through so that we can track progress, both cost and time,
11 as this test activity gets put in the field.

12 Our emphasis on planning is always in trying to
13 maintain flexibility, not to over-specify a test in a control
14 document process where we're spending all of our time going
15 through formal changes to formal documents when we get into
16 the field because the field will always provide an
17 environment of surprise to some degree and we must be able to
18 modify our test program, capture those changes in our
19 administrative process, capture those changes in our
20 scientific notebooks and our field activities, and not get
21 them tied up too often in control documents.

22 Real briefly, to follow on, Ed this morning had
23 given you one way to break down these 42 activities in the
24 ESF. I want to take a little different spin in it real
25 quickly and just take a look at the activities planned

1 underground based on where they're going to be fielded.

2 Starting with the tests that would be in the ESF
3 ramps and drifts--and this is the initial loop and this is
4 the main drift program in the ESF--are geologic and
5 geohydrologic tests that will be in the ramps and drifts and
6 I'm not going to spend too much time with any of them, but
7 would entertain questions. Some of them, you've heard in
8 detail, especially the percolation type tests. Chornack
9 spent a lot of time on them. Mike did a good job of
10 summarizing those. Some of these others, we won't hear
11 anything about today. I'll, at least, answer questions if
12 you have any in general on these.

13 But, these are the primary tests that will be
14 performed in our ramps. Mapping, which is ongoing; sampling,
15 ongoing. Intact-fracture testing, percolation, radial
16 boreholes, hydrochemistry, properties in major faults, all of
17 those out of a single USGS study plan that you've heard about
18 this morning. Diffusion testing, tomography/vertical seismic
19 profiling, perched water, which is again USGS percolation
20 test plan. I put asterisks by these that either do
21 definitely or could require the development of a side
22 excavation, a small alcove or niche to perform these test
23 activities.

24 Also, in the ramps and drifts, non-geohydrologic or
25 more of the geomechanical or engineering tests that we have

1 currently planned. Consolidated sampling again is a part of
2 that effort. Excavation effects testing, which you heard
3 some about this morning. Maybe a quick point of
4 clarification there, I may not have been in the room at the
5 time that we were discussing this. I want to make sure you
6 understand that that test would not be performed in the main.
7 It would not be in the loop. This test is designed right
8 now currently on book to be performed in two areas of
9 opportunity; one is a take-off of the north ramp extension to
10 the Calico Hills, and second, the west extension or the
11 east/west drift in the MTL. In both of those instances, we
12 would have opportunity ahead of time to set up for this test
13 at a place where we're going to come back to a lateral
14 excavation, either a TBM take-off through the Calico in one
15 instance or a mobile miner or smaller TBM drive on the core
16 in the main test level to the west, and this would not
17 directly interfere. That instrumentation package that Falah
18 clarified and that Mike talked about is not designed to be
19 run in the main or in the loop.

20 So, anyway, excavation effects, a demonstration
21 breakout room that we still have planned for the upper
22 Topopah, TSw₁, high lithophysal zone. We still intend to run
23 a heater test program in that demonstration breakout room.
24 Plate loading tests, excavation investigation activities
25 including convergence monitoring, stability, and ventilation.

1 Overcore stress testing and in situ seal component testing
2 which is planned for down the line. None of that will be in
3 construction. Most of this is after we've completed our
4 construction activity or seals program. We'll extend right
5 into a confirmatory program.

6 And, on the mains and drifts, we get to the core
7 test area itself. Our primary program on the book for the
8 core test areas, consolidated sampling; a set of thermal
9 activities, canister-scale heater, heated block, thermal
10 stress, heated room, repository horizon near-field hydrologic
11 environment, and geomechanical attributes of the waste
12 package environment. These activities, the last two,
13 encompass Lawrence Livermore's primary program; second,
14 third, fourth, and fifth of those primarily are Sandia's
15 thermal program. I will talk a little more in a minute about
16 our concepts and where we're headed with consolidation of
17 those programs. But, in terms of specific SCP activities,
18 those are the thermal related activities in the core test
19 area.

20 Geologic/geohydrologic tests in the core test area
21 include mapping, consolidated sampling, percolation, radial
22 boreholes, diffusion, hydrochemistry, and tomography/VSP
23 work. The geomechanical and engineering tests in the core
24 test area are sampling, plate loading, rock mass strength,
25 sequential drift mining, excavation investigations--we've

1 talked about a little bit earlier--and overcore stress.

2 I want to shift from actual location of these
3 activities to a little bit about deferrability now and how
4 these tests would be sequenced in construction of the ESF.
5 And, I want to focus on tests that we believe, at least, to
6 some degree are non-deferrable, tests we must be involved
7 with during construction of the ESF and, specifically, here
8 at the loop, the TBM loop that we've spent so much time on
9 this morning already.

10 The first of those is just the pad area and with
11 the testing that was primary there was just a geologic look
12 and mapping of surface exposures which has been done. In the
13 north ramp starter tunnel, we spent time talking about these.
14 Mapping, which is there in the drill and blast environment
15 and that is ongoing still in our alcove. Limited
16 consolidated sampling and mineralogy/petrology,
17 chloride/chlorine-36 or water movement type sampling
18 activities, and matrix hydrologic property sampling, perched
19 water there as a contingency, and construction monitoring or
20 design verification, a set of activities that are actually
21 looking at construction and doing design verification as that
22 component of the excavation is underway.

23 As we then go into the TBM excavation following the
24 starter tunnel, geologic mapping will continue to be a non-
25 deferrable activity, consolidated sampling to the extent

1 possible. We'll take all the samples we can during the
2 actual excavation and get those out into the laboratory
3 analyses programs. Our perched water program always will be
4 there and be ready to step in if saturation is encountered.
5 Construction monitoring and design verification will continue
6 in that construction environment as it must. Radial
7 boreholes, in which I put both anisotropy and contact
8 testing. Hydrochemistry testing and hydrologic properties
9 and major faults. Especially, and I wanted to emphasize,
10 initial geothermal phase of that program and I don't know if
11 Mike spent any time on geothermal element of that test this
12 morning or not. These are three hydrology tests that I--as I
13 mentioned this morning, we're not certain right now about the
14 deferrability of this entire program. However, I am
15 gratified at the number of witnesses in this room to hear the
16 USGS this morning tell us that these were deferrable in terms
17 of alcove construction. So, I'm going to tend to remember
18 some of that because I don't think we're quite there at that
19 point yet to make that statement. But, we felt it was very
20 important to get an initial alcove in right now to learn some
21 of these types of tests; the hydrochemistry and the radial
22 borehole test primarily to give us some idea about what kind
23 of risk we're running with deferring these tests long-term
24 after that excavation is complete.

25 Certainly, as I mentioned this morning, we want to

1 get the alcove in on the Bow Ridge Fault and do that testing
2 along that fault just as quickly as we can. The ability
3 after that to defer until post-loop construction or later in
4 the program additional alcoves for radial borehole type
5 testing or fault property testing, if at all possible, these
6 will be deferred if they can be, certainly, outside of the
7 construction impact arena and maybe even until after the loop
8 is there, but I think it's premature to say that we have
9 confidence that those in all cases could or should be delayed
10 until after excavation is complete.

11 DR. LANGMUIR: If you defer them, do you defer cutting
12 the alcoves?

13 MR. ELKINS: Well, yes, that's the primary--once the
14 alcove is cut, there is no question in our mind about
15 deferrability. Once an alcove is in place, the tests must be
16 fielded immediately. For instance, in our first alcove that
17 we're constructing now, we have a design depth on that alcove
18 where we believe proper conditions are going to be met to
19 initiate drilling of the triangular pattern of holes that
20 Mike described this morning. However, we are also in the
21 process of getting together our drilling system, dust
22 suppression system, tracer injection system, that whole
23 procurement is coming together now. A requirement we have on
24 construction of that alcove, given the permeability nature
25 and some of the potential drying effects that may be in that

1 alcove, we cannot finish that alcove. We cannot collar up or
2 be at a point of collaring up until within a week or two of
3 the start of that actual drilling program. If we're not
4 ready to drill, we're going to stop short of final completion
5 of that alcove and then finish the last couple of rounds when
6 we know for a fact we're ready to drill. That's how
7 important that is.

8 The test program consolidation, I've talked about
9 it on and off just a little bit and I'd like to give you a
10 little more detail on some of our ideas there. We are
11 underway with investigating consolidation, wherever possible,
12 in our test program. Highlighted areas of potential
13 consolidation for our test program, I've identified five of
14 them here. One of them is already complete.

15 Nine of our activities, as I mentioned this
16 morning, are sampling activities. We have combined those
17 nine sampling activities which cross the organizational
18 boundaries of the GS, Livermore, Sandia, and Los Alamos into
19 a single consolidated sampling program, a single field
20 activity primarily supported by our USGS, USBR geologists
21 underground to provide our samples for all of our laboratory
22 analyses and to minimize the traffic and the number of people
23 that at any point in time will be underground looking at that
24 collection of just bulk samples from the ESF.

25 We have six thermal waste package environment

1 activities that we're looking at consolidating, wherever
2 possible, into at least a single environment where we use co-
3 utilized heater and drift environments to let these
4 activities go forward. And, these are primarily Sandia and
5 Lawrence Livermore. Lawrence Livermore's program is
6 perceived to be the driver or the bigger of those programs
7 and, to every extent we can, we would like to have the Sandia
8 program dovetail or consolidate into that and use
9 opportunities provided by the drift and heater emplacements
10 of the Livermore program.

11 The third is excavation effects, which you heard
12 some about this morning, and sequential drift mining tests;
13 sequential drift mining being Sandia's program. Excavation
14 effects of the USGS program, we're going to look, at least,
15 at the possibility of having PIs utilize the same opportunity
16 to collect this information. And, we're just very early in
17 discussions on this potential consolidation.

18 Bulk permeability testing and radial borehole
19 testing, two of the activities out of the USGS percolation
20 program. Pretty much--and I don't know if the GS--Falah or
21 maybe somebody here would like to speak to this a little bit
22 more. For the most part, I think that the USGS is pretty far
23 along that consolidation already. We intend to primarily
24 consolidate those two test activities into a single activity
25 we're calling radial borehole. So, we won't be running bulk

1 permeability tests, per se. That configuration will be
2 combined. And, I don't know, Charlie or Gary, I don't know
3 --Gary LeCain, Mike, do you all want to expand on that a
4 little?

5 MR. LeCAIN: Yeah, the radial boreholes and the bulk
6 permeability use a lot of the similar methodologies and, as
7 far as planning packages, they probably could be
8 consolidated. The main differences are the locations. The
9 bulk permeability tests are located at the main test level;
10 while the radial boreholes are in the ramp coming in. And,
11 the scale, the bulk permeability test is a much larger scale
12 test than the radial boreholes. But, as far as test planning
13 or design, paperwork, they are quite similar.

14 I'd like to make a comment, though, to Ned. When
15 Mike Chornack was referring to the deferment possibilities
16 with the major faults, I'm sure he was referring to the
17 pneumatic testing of the major faults which is what he
18 presented to you. There is another component of the major
19 faults that requires a borehole to reach the fault zone
20 previous to the TBM reaching the fault zone. That cannot be
21 deferred or we lose the data from that test.

22 MR. ELKINS: Yeah, the initial--the overhead that I
23 showed indicated parenthetically an initial geothermal
24 borehole. Let me just make sure that you understand. That's
25 what Gary was stressing. There's a two component activity at

1 a fault. One of them is a borehole prior to major
2 disturbance and, certainly, before we begin to get
3 ventilation exchange along that fault zone, we feel it's
4 important to get that borehole out there.

5 The second and the potentially deferrable or the
6 one that we want to look at deferrability on is the alcove
7 development pneumatic testing. But, I believe the GS would
8 back me on saying that until we get more data, we certainly
9 don't want to be comfortable with just saying that all of
10 those alcoves are deferrable until post-loop. At least, I've
11 never been comfortable with that from the GS perspective to
12 this time.

13 Let's see, have I gone through these? Lastly,
14 excavation monitoring test activities into a single program
15 integrated with construction. Essentially, that has already
16 taken place, as well, in terms of field implementation.
17 Sandia, who has these five activities, pretty much run a
18 single construction monitoring activity. We encapsulate that
19 into a single planning activity, a single package of
20 activities that go into the field looking at things such as
21 drift stability, ground support monitoring. These activities
22 are done singularly as opposed to individual in the field.

23 A couple of overheads. This, I believe, is an
24 overhead that was in the morning package. I'm not even sure
25 I threw it up this morning. But, it was shown--I think,

1 Mike showed a variation of this and it came from the Test
2 Coordination Office. I'll throw it up again. I think, it's
3 the one where Russ questioned some possible--these extensions
4 which are shown here. The Test Coordination Office put some
5 dates on that are not coordinated with or don't reflect the
6 current, I think, design or construction planning, but it's
7 where we started from a test planning saying if we had no
8 programmatic impacts of a construction program, whatsoever,
9 and giving a consistent rate of excavation events, what would
10 primarily be our loop excavation rate and then coming back
11 and getting into these ramp extensions. Test planning needs
12 a basis on which to begin to look at its opportunities,
13 deferrability/non-deferrability of tests and scheduling, its
14 planning. We've used this as a basis and this drawing
15 represents a test coordination representation, not design or
16 construction.

17 However, one of the things that I'll mention very
18 briefly in terms of opportunities that we haven't begun to
19 spend a lot of time with, but we will certainly, is the
20 current area where the core test area would be developed as
21 opposed to the opportunities that may be presented in the
22 extension of these ramps. It's very exciting to the test
23 community. And, may offer great opportunity to find an
24 earlier opportunity with less development required to get
25 some of our thermal test programs and in situ testing off

1 into these ramp extensions without having to develop several
2 thousand feet of development in the core test area. The
3 opportunities are there; not only better access, but in some
4 cases a better vertical look at the unit in question, TSw₂,
5 where those ramp extensions will see high, middle, and low
6 elements in that profile, not just at one location. So,
7 we're currently beginning to heat up to begin to look at
8 taking full advantage of those opportunities.

9 DR. CORDING: Ned, those extensions would be after the
10 main loop is excavated or not?

11 MR. ELKINS: Yes, that's my understanding. I don't know
12 the last--I see Dan's nodding his head in the back. Yes, the
13 last that I have certainly been involved in any planning, we
14 would complete the loop and then using either that TBM or
15 different TBM--I haven't heard what we would actually use to
16 excavate--Dan, I don't know if that's been decided--but come
17 back in and then begin these extensions.

18 DR. CORDING: I believe that's the drawing that we were
19 referring to earlier which we hadn't--I think it's true that
20 we had not been briefed on that. So, it's good to see that.

21 MR. ELKINS: Okay.

22 DR. CORDING: And, we may have some more discussion of
23 that perhaps after lunch.

24 MR. ELKINS: Sure. The other thing that I wanted--
25 because I heard some comment about the lack of ability to

1 look at our faults in multiple locations. This configuration
2 and one that in testing we haven't yet been able to fully
3 embrace, but has always, since we first saw this
4 configuration, had one very exciting opportunity with the
5 Ghost Dance Fault is that this ramp--or this drift system
6 that comes in and parallels the Ghost Dance allows us--and,
7 we've shown two, but I could just as easily say we might want
8 five. These are very short stub drifts. If we can get them
9 in and they can come in post-excavation of the ramp, come in
10 and look at multiple locations across the Ghost Dance, I
11 think we're going to get a much stronger look at, at least,
12 one good fault system that is going to be very important to
13 us.

14 The other opportunity I think we have here is this
15 boring, the possibility of a geothermal program which doesn't
16 even require driving a drift out there, but just an alcove
17 off of the main where--to run a series of these geothermal
18 type holes, I think are going to be things the test program
19 are going to very much want to look at, as well. So, we're
20 excited about some of these opportunities that this
21 configuration allows.

22 DR. CORDING: And, that configuration, you are able to
23 do all this alcove work in the vicinity of the fault from
24 those extensions and that means that you're not going to be
25 putting that into the delay on the main drift driving with a

1 large machine?

2 MR. ELKINS: Absolutely. Absolutely.

3 DR. CORDING I mean, I think one thing that in looking
4 at all the things that you're wanting to do here and, when
5 someone says we're going to be drilling ahead to locate--you
6 know, to get information on the fault before the tunneling is
7 in the vicinity of it and recognizing what the width of some
8 of these faults can be, that you can get into an awful lot of
9 drilling out ahead. There's a tremendous opportunity for
10 interference here and to tie together the--to me, it's just
11 essential and I know you're working on this, but to tie
12 together what is really needed from a testing standpoint
13 because this is an exploration testing program, that's what
14 it's for, but to tie it together with the construction in
15 such a way that you can make the best progress possible so
16 that you can get to other things that you've got to be doing
17 like the core test area and to put all this together, it's a
18 tremendous challenge.

19 MR. ELKINS: Absolutely.

20 DR. CORDING: And, I believe that trying to go in and
21 --for example, I think the fact that you have a large tunnel
22 to work with means that you're going to have some extra room,
23 particularly if you use certain types of haulage like--use
24 rail haulage, you're going to have some extra space in that
25 that might allow you to do some of the drilling out ahead to

1 work off of platforms that won't interfere with the transport
2 of muck and material, men, people, to the heading, so that
3 you can keep going with the tunneling. And, I think that if
4 you put together all the things that you're wanting to do
5 here, then a two year progress through this facility is
6 probably where you're at, but the actual tunneling required
7 here is more like one year for the TBM. So, the more you can
8 gain on that, the more you get earlier to your other--get the
9 whole area opened up for all the other work you're trying to
10 do. I think that's a challenge that it's just going to take
11 some very close coordination working with your contractor,
12 with your design people, as well as your scientific groups.

13 MR. ELKINS: I agree completely. Absolutely. And, we
14 are certainly not there now. But, it begins with very close
15 coordination and communication with design construction and
16 the testing community and we are there now. And, if that
17 communication is daily and is a continuous interchange, that
18 always has as its focus the ability to continue providing for
19 our data collection needs while not, at least, shutting down
20 and completely putting idle our construction activities.
21 And, we seek that opportunity. We've come a long way from
22 the times of the old vertical shafts, drill and blast
23 construction, where we had better than 1,000 days of
24 construction down time to facilitate testing into a program
25 where we already have down to even anticipating programmatic

1 delays, we're only talking weeks of likely down time in this
2 activity. We're very pleased with that and we continue to
3 seek those opportunities wherever we can to better streamline
4 and organize this program. A lot of challenges, we agree.

5 DR. CORDING: Thank you.

6 Don?

7 DR. LANGMUIR: We heard from Mike Chornack this morning
8 about the GS plans to use radial boreholes to get at the gas
9 characteristics of fracture systems and you've just pointed
10 out and reminded us of the Ghost Dance Fault proximity to
11 that drift. I would have assumed--I would have like to have
12 seen GS proposing that, yeah, we have these things in the
13 plans currently, the alcoves, but here's a terrific
14 opportunity to look at flow within fractures between two
15 points.

16 MR. ELKINS: Yes, absolutely.

17 DR. LANGMUIR: And, let's defer some alcove work and go
18 out and start proposing some tests on that Ghost Dance Fault
19 zone.

20 MR. ELKINS: Believe you me, the GS is anxiously ready
21 to begin. This right now is still not a projects decision.
22 This has been proposed and we're looking at it and testing
23 has embraced it as something that we can fully run our
24 program at and, in fact, we see--and, you just picked up a
25 good example--some real advantages of this program. Once the

1 project has formally accepted this as their technical
2 baseline, then we will begin, I think, very aggressively to
3 see some of our test planning to begin to embrace some of
4 that.

5 MR. MCKENZIE: The whole idea of this enhancement to the
6 ESF is pretty new to the program. Some guys from Morrison-
7 Knudsen, myself, and a couple of others who really had more
8 to do with it than I did, sort of just said, hey, guys, we've
9 got a better idea and, you know, we showed it to them six
10 months ago. So, there's a lot of--they're just starting to
11 try to get used to this plan and, as Ned says, it's not even
12 the baseline yet, but it's getting close. So, if it looks
13 like, gee, there's a lot of opportunities we're missing here,
14 it's not that we're missing them; it's just that everybody
15 has got to get used to the idea that there's a lot of--for
16 example, the drift that's very close to the Ghost Dance all
17 along for 10,000 feet, there's a lot of opportunity there.

18 MR. ELKINS: I agree. And, we'll take full advantage of
19 that.

20 DR. CORDING: Don?

21 DR. LANGMUIR: Just one other. Perhaps, this is not for
22 you. Maybe Gary LeCain can answer the question. But, you
23 mentioned and I'm aware that we're going to have ventilation
24 effects within the tunnel system as we proceed and we're
25 going to have pressure effects. And, I wonder how that's

1 going to be dealt with when we're gas sampling in fracture
2 zones? Because if you're going at low pressures when you
3 inject into the radial boreholes, these pressures won't be
4 very much greater, perhaps, than the pressures in the tunnel
5 itself. How do we prevent contamination effects because of
6 the pressures in the tunnel?

7 MR. ELKINS: Gary, I see you walking up.

8 MR. LeCAIN: You've hit the nail on the head, Don. How
9 do you discriminate between the barometric influences that
10 you're seeing--potentially seeing and those that you hope to
11 cause by your gas-injection? But, what we basically do is
12 keep a barometer, air pressure transducer, that tells us any
13 barometric or any fluctuations in the tunnel or the ramp and
14 then try and take them out in the analysis. Now, usually, we
15 hope that the measurements that we make are significantly
16 larger than the smaller barometric fluctuations we might see.

17 MR. ELKINS: Thanks, Gary.

18 DR. CORDING: Okay. I think we need to close our
19 session and meet at 1:00 o'clock. We're delaying this a
20 little bit for after lunch. So, we'll have a one hour lunch.

21 I would like to emphasize to you all that we're
22 going to be having a round-table discussion after one or two
23 presentations. I'd like to make sure that the participants
24 of this morning, as well as those of yesterday, are available
25 to participate in that discussion and we're going to be set

1 up in a way in which you should be moving towards the front
2 of the room to be ready for that discussion which will be
3 held around 2:00 o'clock.

4 So, thank you very much. We'll see you at 1:00.

5 (Whereupon, a luncheon recess was taken.)

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AFTERNOON SESSION

3 DR. CORDING: We're ready to begin our afternoon
4 session. If you'd all be seated. We're ready to begin this
5 afternoon's session.

6 This afternoon we're going to have presentations by
7 Tom Statton and then Russ Dyer will provide closing remarks
8 for DOE. At that time then we're going to have a short
9 break, then we're going to reassemble for the round-table
10 discussion which would be held sometime around two o'clock,
11 and I will be a little bit involved in the presentations and
12 I tend to be sitting in the front row of the chairs that we
13 have set up for the round-table discussion. I believe the
14 round-table discussion will have no table.

15 So we're ready to start this afternoon and I know
16 Ned Elkins was disappointed that we didn't have more
17 questions for him at the end as everybody wanted to go to
18 lunch, so we also will have during that round-table
19 discussion--I'm sure Ned will receive his wishes on that.

20 So the Testing Program Coordination and Integration
21 by Tom Statton, who's manager of site characterization,
22 strategic planning and technical integration with the M&O.

23 Tom?

24 MR. STATTON: And I made a deal with Ned over lunch, and
25 he can have my questions. I didn't want him to feel left out

1 either.

2 What I want to get at is sort of a couple things in
3 the purpose of this talk, and I hope that the view graphs
4 that were sort of envisioned a couple weeks ago turn out to
5 be a good vehicle for us to talk about some of these things.
6 The first of which was a comment in the most recent Board
7 report that addressed itself to strategic planning and an
8 expanded strategic plan for the program, specifically the
9 testing program and with inference to testing versus
10 construction and surface based testing versus underground
11 testing and the like. The project office has concluded also
12 sort of simultaneously--probably at the time the Board was
13 preparing its report--that maybe we needed to address
14 ourselves in a more succinct way to what that strategic
15 planning is about. And I think we have organized ourselves
16 in concert with the Department of Energy as the M&O to try
17 and produce that strategic plan, to try to articulate some of
18 the things that I think throughout the morning we've heard.

19 We've clearly this morning heard that an individual
20 activity has planned, focused on providing specific
21 information. We've heard through some of the presentations
22 that groups of activities have organized themselves to
23 provide some rolled-up understanding of the site.

24 We started off at the beginning talking about sort
25 of a master plan for the program, whether it's the test and

1 evaluation plan, here's the test planning, here's the
2 implementation and here's the evaluation of that. We
3 certainly began with the SCP and maybe we'll start with sort
4 of a little motherhood bit that says, yeah, we did start with
5 an SCP that articulated a strategy to get from where we were,
6 where we needed to know something, to the end of a process
7 where in fact if this turns out to be the right place to be,
8 we can develop a license application.

9 Clearly, that strategy forms the basis of our
10 program.

11 You want it higher? That's pretty good. Nobody's
12 ever asked me to talk louder or more often.

13 But clearly, this negotiated strategy of the SCP
14 with our regulator in fact forms the basis of our program.
15 We've had a lot of discussion as to whether or not that
16 strategy as identified in the SCP is one that's acceptable in
17 today's environment. We've talked about a deep borehole
18 program and we spent some good time yesterday talking about
19 whether or not we needed to core, all the core that was going
20 to be collected, or indeed whether we needed to drill all
21 those boreholes that have been identified. And I think we
22 need to remember that the strategy of the program is a fairly
23 conservative strategy. It was envisioned at the time it was
24 written to be a low-risk strategy of getting from point A at
25 the beginning to point B, which was the ability to license a

1 site.

2 I question whether or not, you know, forty deep
3 borehole program at the conclusion of one and a half of those
4 boreholes, it's time to begin to pare that program. Is it
5 time to pare the program down in terms of the number of holes
6 or the amount of core or the number of tests being done, or
7 are we in fact evidencing our frustration with the fact that
8 the funding profiles haven't provided the execution path we
9 wanted, time is too long, dollars are too scarce? And so,
10 we're struggling at this point in time with how to fix that
11 problem when in fact we're at a fairly immature or beginning
12 state of the program that we're talking about. So I think
13 those are some of the things we want to think about as we
14 talk about this planning process, and we'll get into at least
15 what my vision of what the strategy or strategic plan needs
16 to be, what it's role in governing our program needs to be,
17 and then how we translate that global rather low-risk
18 conservative strategy into executable bites in an environment
19 we don't like transpires. How does the program get guided in
20 that condition.

21 Certainly we start off with the identification of
22 data. We had a bunch of talk about that this morning. We
23 talked in fact very specifically about how some tests address
24 themselves to regulatory issues. We've talked about how some
25 groups of tests relate themselves to some intellectual state

1 of knowledge that in fact does something for us. So we do
2 start with the concept of identifying our data needs and that
3 translates all the way down into defining the facilities that
4 are required for us to go make the group of observations that
5 we make. We have within the program some fairly
6 sophisticated testing. I'm more of a low-key
7 observationalist and so I look at it as an opportunity to
8 make a suite of observations about an experiment that Mother
9 Nature's been running for several million years for us, and
10 what we're trying to do is provide ourselves the opportunity
11 to go read the dial gages; some in a perturbed state in
12 running an active test, some in a very observational state.
13 And it's that observational state that I think has a lot of
14 our interest focused here on the ESF. But nonetheless, as we
15 go through all of that, we need to remember that the specific
16 observations, the specific tests after we've now identified
17 the parameters and the facilities required for those, do in
18 fact need to relate back to the regulatory issues that we're
19 supposed to be addressing ourselves to.

20 It's this planning exercise that I think relates
21 our thinking, our program, to the opportunity to make the
22 observations, the opportunities to collect the bits of data.
23 We certainly had some discussion as to whether all the right
24 bits of data have been envisioned as we progress down this
25 road of learning about Yucca Mountain, and in fact, those are

1 very useful discussions to us and I think it is through this
2 organization of trying to articulate that master plan that we
3 can gather those bits of information and incorporate it into
4 the baseline for the program.

5 What I'd like to do is sort of talk through the
6 planning process in sort of three phases. The framework
7 development phase, which to me is kind of the intellectual
8 backdrop. It is the strategy that's articulated in the SCP
9 that is our long-range plan. Now, whether or not each of the
10 pieces along that route ultimately have to be undertaken,
11 whether all of the tasks have to be run, whether all the
12 evaluations have to be made, I think in today's environment
13 it's probably not a relevant consideration anymore than my
14 view do I need 40 boreholes or 39 boreholes out of the plan.
15 The question is, do I have a plan against which I can
16 measure what I've learned and observed to help me shape
17 tomorrow's plan. And I think that's what this backdrop is
18 about. It's the articulation of the strategy in terms of
19 words and specifics that we've laid out in the SCP.

20 Well, we have some other constraints put on us.
21 The Department of Energy has sort of the one to three or
22 three to five year plan that's a mandated exercise as part of
23 the way they do business. Those are dictated to us both in
24 the budget profiles that we will be planning for, as well as
25 the time term that we'll be looking at. And those come from

1 the Internal Review Board, they come from the Office of
2 Management and Budget, they come from a variety of sources
3 and they say here are the planning assumptions against which
4 you will set your construct. I know that there have been a
5 number of comments made that said the program always plans
6 for a budget that it's never going to get, and those have
7 been fairly blunt words and it isn't that we don't understand
8 that. It's that the constraints internally require us to
9 establish those baselines. So it's the process of filtering
10 this plan into this context that drives us into the planning
11 cycles and the planning assumptions that we make. That's not
12 to say that given the establishment of an intellectual
13 backdrop there aren't alternate strategies that could be
14 developed. But I think based on both the Board report and
15 our internal observation, we've concluded that we need a
16 little better articulation or I think in your words, it was
17 an expansion of the study program into a comprehensive
18 strategy. I think from the vantage point of the project,
19 it's not that the strategy doesn't exist; it exists at
20 various levels of detail. And the question is, is how do you
21 knit that together so that I can see a coherent whole against
22 which I can measure change, or against which I can measure an
23 alternative strategy.

24 So I think this near-term planning exercise that we
25 go through, while it becomes the frustration of a lot that

1 watch it, that's not optional. I mean, clearly, the
2 department has to respond to that kind of demand.

3 And then the last, of course, is the annual
4 planning process. Now, at the last meeting I think we talked
5 a bit about the annual planning process. We talked about the
6 concept of getting program guidance translated into specific
7 priorities that allow us to distinguish and select among the
8 various activities that are in fact included in the master
9 plan. We heard a lot about that here today. We heard a lot
10 about it from Ned, for example. And Ned identified three
11 specific priorities, and we'll go back and talk about some of
12 those as we go through.

13 One of the points of interest as was related to us
14 is how do we go through that, who's involved and what is it
15 that gets done. So if we go back to the long-range plan,
16 this framework development, this intellectual backdrop
17 against which we're going to measure both progress and change
18 in state of knowledge and change in program, the who are all
19 the people that you've heard from today and others. The who
20 that's involved in the development of the long-range plan is
21 in fact the department as putting together the master
22 construct, but capitalizing on the wisdom of all of the
23 various PIs that have come and sort of presented the bits of
24 their program. What we want to accomplish in the long-range
25 plan is to capture the bits of wisdom that we heard in the

1 relation of a specific activity to a specific parameter, a
2 specific group of parameters to a specific understanding.
3 Those are the things that need to get captured and the only
4 way that can get done is by having all of the participants on
5 the program work to help with the construct of the long-range
6 plan.

7 The plan wants to--we say here well articulated
8 with measurable intermediate milestones. I'm not sure that
9 that's exactly what was behind the comment in the Board
10 report, but I think it may have had something to do with it.
11 It's how long do I remain agnostic in this process before I
12 believe I'm making progress with the program. And I think
13 establishing some of these intermediate milestones, and we'll
14 talk a little bit about what that is, in our thinking at
15 present anyway--helps understand the progress of the program.
16 It not only gaggles together the groups of programs, the
17 groups of subelements, the groups of activities to that end,
18 but I think it provides the network with which they are in
19 fact knitted together so that we can look at the end product.

20 The other thing is we deal with prerequisites,
21 prerequisites for the observations that need to be made at
22 the program level, and they break themselves down into a
23 surface-based test program and an in situ test program. I
24 like to--even though it may not be exactly the vernacular of
25 the Board--I like to look at an in situ test program as

1 opposed to an ESF. An ESF to me is a tool. It's nothing
2 more than a very large horizontal borehole that provides
3 access for specific observations and specific tests. And I
4 think that's the integration that the program has, but we
5 tend to talk about it in the construct of a construction
6 centric plan or a test centric plan. And when we do that, it
7 doesn't appear that they're held together when in fact they
8 are. The sole purpose of the ESF is in fact--in my not very
9 highly technical vernacular--to be able to walk with my
10 candle in a cup through the mountain for purposes of
11 observing whether or not my master construct of the site
12 looks like what I'm seeing and gives me the ability to
13 collect a few samples to validate my operative hypothesis of
14 what that mountain looks like.

15 So, I think that's what we want to do. Our
16 surface-based test program, as I think Dennis presented, sort
17 of talked about--and I believe Chris Rautman as well-- sort
18 of the spatial distribution that allows us an understanding
19 of what the construct is for this volume of ground we call a
20 potential repository host.

21 The in situ testing program is our immediate
22 ability to wander through and validate the model or the
23 vision we've created from disparate observation into what it
24 is we're actually going to be living in. It also provides us
25 the opportunity to take direct samples at the repository

1 horizon clearly to run a couple process thermal tests both of
2 which are important programmatic elements but both of which
3 have perhaps less immediate relevance to the determination of
4 the suitability of the site.

5 Beginning with the framework that was laid out in
6 the SCP, the data needs, the facilities required to get those
7 data needs, we find a great deal of interrelationship among
8 the various activities of the program, and those aren't
9 necessarily just the interrelationship between a bulk
10 permeability approximation being made from a borehole to a
11 bulk permeability approximation being made in the
12 underground. Or, the relationship between this large
13 underground borehole as measured by changes observed in an
14 adjacent small diameter borehole. That's back to the
15 pneumatic testing exercise that we talked a bit about,
16 getting our boreholes in from pneumatic monitoring prior to
17 the passing of the tunnel so that we could look at the
18 response of the mountain as a whole to these changes in
19 barometric pressures that are being introduced.

20 What I want to get back to--and I know you've seen
21 this before, and you're probably not happy that you're seeing
22 it again--but the way I think about the program comes through
23 my fish hook diagram, and that fish hook is important to me
24 for a number of reasons. One, it's the opportunity on a
25 single piece of paper to identify lots of parts of a program.

1 For those of you who didn't get this, there's an extra
2 figure in the back that was reproduced, and I think the Board
3 has a copy of this. And if you don't, you've probably seen
4 it and you don't care. But, what this wants to do is kind of
5 relay the structure with which the program thinking is sort
6 of postured. Clearly, our in-goals are simply a
7 recommendation of this site as either being a suitable place
8 to develop a repository or not and as long as that is our
9 only milestone it's not only remaining fairly agnostic until
10 we get to the end of the process. So clearly, the
11 development of some meaning interim milestones such as what
12 we've done here with these interim site evaluation reports is
13 part of that process. It's a process where we can structure
14 the thinking and the findings through time to identify what
15 the advancement is to the ultimate goal.

16 Now, given that there's a possibility anyway at
17 this point that this site may indeed be a licensable site,
18 there's some other considerations to be made, and those
19 relate to interim license evaluations. The license ability
20 of a site and the suitability of a site are not necessarily
21 one and the same. There are bits of differences between
22 those two where a suitable site in fact may not be licensable
23 for wholly other reasons.

24 So what we want to do is structure that process
25 through the long-range plan so there are places in time

1 whereby a state of knowledge is, number one, intended to be
2 achieved, and number two, is articulated as identifying the
3 progress made with respect to specific issues. This was
4 started, of course, with the early site suitability
5 evaluation. It went through the Department of Energy's order
6 that structures how one determines suitability. Clearly,
7 until that's taken away it wants to be included in the
8 structure and format of how one addresses our progressing
9 state of knowledge with respect to site suitability.

10 Well, the other thing other than identifying some
11 interim milestones in deriving our final goals that wants to
12 be in the long-range plan is recognition that there's a
13 program that's the underpinning to that, and that program as
14 it's laid out here wants to at least notionally accept the
15 interrelationships among the various program elements.
16 Whether those program elements are the design or repository
17 and waste package activities, both of which are important as
18 we progress in our state of knowledge, both of which may put
19 specific demands on a site investigation program. This is
20 the diagram that Dennis showed you earlier that we sort of
21 talked about as the sausage diagram. The sausage diagram is
22 intended to depict the various subelements of a model
23 understanding that get rolled up into a more comprehensive
24 statement of our state of knowledge at points in time
25 throughout the program. Well, it's those design demands, as

1 design begins to mature of either the repository or the waste
2 package, that puts specific demands for information
3 parameters understanding on the site investigation program.
4 We focused a lot here on the site investigation program, the
5 specific hydrologic, geochemical, whatever parameters that
6 are required in fact for our end products, but it's the
7 relationship between those and a maturing design that also
8 has to be in the system.

9 The other thing that's on here is performance
10 assessment. There were some questions--fortunately I was out
11 of the room--with respect to the feedback loop between
12 performance assessment and in fact the site characterization
13 activity. They do exist. They have not been formalized in
14 the sense that the department would like to see them
15 formalized. And consequently, part of this new organization,
16 part of the articulation of this plan is to formalize that
17 feedback in a much more succinct sense such that it
18 specifically pushes influence on to both the long-range
19 planning exercise which needs to get revised as we go through
20 time with new findings and understandings, as well as the
21 specifics of the annual planning exercise that says from
22 performance assessment I found these parameters to be
23 parameters that outcome is sensitive to; these that outcome
24 is not sensitive to. I think it's through the formalization
25 process here and these feedback loops that one drives into

1 the program the specifics of the response to performance
2 assessment.

3 The other part of that is clearly to get a road map
4 for performance assessment. Here's the way I, as the
5 performance assessment leader, believe I'm going to make my
6 progress through time. That allows us in a preplanning sense
7 to organize activity such that they're complete in time for
8 those analyses, in time for the development of the process
9 models and the roll-up into the total system performance
10 model.

11 The other thing that's on here is the ESF
12 construction and testing. What you find here I think is that
13 the testing is not as readily apparent as it probably ought
14 to be on here. We are in a site characterization program
15 that's dominated by testing and analysis. But it's trying to
16 take a look through time in finding both these interim states
17 of knowledge that we want to articulate in terms of the
18 interim site suitability assessments that we make as to the
19 outcomes that we're going to find through facilities that are
20 available.

21 Well, one of the facilities is the ESF. Clearly,
22 one doesn't want to make some new proclamation about the
23 suitability of this site before we've now had the opportunity
24 to take the construct that we've got in mind and walk through
25 and validate it in an observational sense walking through the

1 ESF.

2 The next viewgraph that you've got in your package
3 was trying to do the same thing but I decided that was
4 probably too simple, and what we really wanted to do was go
5 back to something that's clear to me and probably not clear
6 to anyone else. But it gives me the opportunity to talk to
7 it. This is simply trying to say the same thing. It's
8 trying to identify the relationships among program parts with
9 the investigative program driving us to a conclusion. What
10 it doesn't show on here are these interim reports that we're
11 talking about.

12 Near-term planning I think is driven mostly by,
13 one, our need to forecast in a tactical sense the next
14 several years. And one of the reasons we need to do that as
15 an executioner of a program is that we need some stability
16 year to year in that the activities and the state of
17 understanding we're driving at don't come in annual bites.
18 So we need to have some kind of continuity that goes beyond
19 the fiscal year which seems to drive our lives. It also
20 conveniently ties with what the regulations are that are
21 coming to us from the various organizations, like IRB and OMB
22 for our planning exercise. Again, the players in that are
23 the same. All of the participants play as we begin to
24 forecast with a little more detail the next several years out
25 of this long-range plan.

1 We go to a little greater detail in the
2 articulation of our schedules in the one to three to five
3 year bite that we do in the long-range plan. It probably
4 doesn't do us much good to lay out a very detailed plan with
5 the execution that Dennis showed us about when I'm going to
6 build a pad, when I'm going to clear a road, when I'm going
7 to have pipe on order and when I'm going to have a drill rig
8 show up for a hole that we're going to do in 1999. That's
9 not very useful to us today. And, in fact, I think it's more
10 the recognition that that might not be the right hole and it
11 might not be in the right place because we haven't learned
12 much yet. Again, we're into this program to the tune of one
13 and a half of forty deep boreholes. We're into this program
14 to the tune of 200 feet out of a five mile tunnel. So
15 detailing of some of those activities down to the level we're
16 talking about for the hole that we're going to begin this
17 week probably isn't very useful to us.

18 It becomes slightly more useful in the one to three
19 year sense because there's still time for procurement,
20 there's still time for intellectually deciding that we're
21 heading down the right path that needs to get articulated.
22 And I think that's part of the value of this interim tactical
23 plan to us, saying have I got all the right things for the
24 next five to six boreholes that we're going to proceed with.

25 Also, it gives us the opportunity to take a program

1 that says I want to understand the groundwater flow or
2 transport time in the unsaturated zone down to something with
3 a little more detail. This is the point where work-scope
4 consolidation efforts that you heard about at our last
5 meeting begin to take some preliminary form. What am I going
6 to do in these particular tests? How am I going to pare it
7 down from an understanding of gas flow in the mountain to
8 something a little more specific that might in fact find its
9 home in the next performance assessment evaluation or in the
10 next analysis for some submodel or element?

11 This is sort of the point where we begin--and
12 again, this is just the icon of that little sausage diagram
13 at the top--to break these things down into program elements.
14 Sort of the submodels that make up some of those things in
15 our little sausage. Those get broken down into some
16 descriptive models and then again down into the components of
17 those models. What now specifically are we beginning to use
18 as the construct for stating what the content of this model's
19 going to be when it's produced. And this model may be off in
20 the future by two or three years, but what are the components
21 of that and then drive down into the subelements of what's
22 the construct for that.

23 Once I've described the state of knowledge I want
24 here, I have now described in fact the activities that have
25 to be done. And in a world we live in where we're handed a

1 budget and we're handed a schedule, this becomes fairly
2 important to us. It's the content perhaps that we haven't
3 relayed as well to the outside work as we need to have, and
4 that's part of what this new planning function and exercise
5 is about.

6 So this, then, takes the part of this grandiose
7 understanding and begins to break it down into program
8 subelements where we can describe the state of knowledge we
9 need to have.

10 Sort of the next level of detail gets us down into
11 the annual planning, and in fact I sort of view that as my
12 annual executable. My job is to understand where it is I'm
13 going, have some tactical plan that allows me to make some
14 achievements over the next several years, but I still have
15 this demand that says I've got an executable bite that I've
16 got to perform in a given year, and how do I go about doing
17 that.

18 Well, again, the who of what that is all about,
19 it's the same who. It's the same who that helped us develop
20 the overall network down to the intermediate network down to
21 the annual plan bite. The difference here is we now have
22 some fairly specific priorities that are laid out. Ned
23 talked about some of those priorities. Irretrievable data
24 was one of those priorities. Specific site suitability
25 issues, one of those priorities. The long-length or long-

1 duration tests that require an early start are part of those
2 priorities. Those of you who sort have been through the
3 draft annual plan either gained an appreciation of the
4 process or were confused by the process, but we did as we
5 took the whole suite of activities that was planned for
6 nominally this chunk of the program, leave them out and broke
7 them out into the very discreet priorities. The one Ned
8 didn't talk about, because Ned was talking nominally or
9 addressing himself to the in situ testing program within the
10 ESF, is the demands being put on the investigative program to
11 support the design issues for the ESF. Our number one
12 priority for this year in structure in the site investigation
13 program was to produce, albeit the minimum requirement, but
14 to produce those activities that ended up as design bases for
15 the development of the ESF. Now, along with that came this
16 pneumatic testing program that we spent some time talking
17 about, but to make sure that they were in the schedule early
18 enough--and I know there's been some discussion about what
19 early enough is--in the program such that those data weren't
20 lost given the advent of the construction of ESF.

21 So, those were our priorities; taking the testing
22 program as a whole and biting them up into those things that
23 are design related, fulfilling design requirements for the
24 ESF. We added one other subelement that I think Mike
25 Chornack sort of alluded to, which are during construction

1 tests and deferrable tests. Well, our second priority, were
2 those tests that were required to all ESF to continue. Now,
3 in some sense they probably fall into the next category also,
4 which is the irretrievable data category. As we gain
5 guidance for each year's plan, as we gain advice from you and
6 others as to what each year's plan is, we need to remember
7 that there are ongoing data sets being collected, that we
8 can't just turn the switch off for. We're clearly not going
9 to take a seismic network and conclude that that's not my hot
10 button for the year, so I'll turn that off and I'll come back
11 when it's that turn. So we've encumbered ourselves with a
12 program that has a lot of ongoing monitor. The holes in
13 those data sets are not things that we can afford to lose,
14 and that's why irretrievable data came so high on our
15 priority list.

16 I guess the last thing I wanted to talk about here
17 is one of things that the annual planning process does very
18 specifically is it tries to capture the state of
19 understanding gained in prior years, the findings gained in
20 prior years, albeit findings from things within the program
21 as well as some things outside the program, such as
22 performance assessment, but incorporate that into the current
23 year planning. And one of the things I think you'll find in
24 the site investigation testing plan will be recognition of
25 where we were in completing last year's work, what state of

1 knowledge we have gained in last year's work, and how that
2 applies and helps formulate what we're going to do in this
3 year's work.

4 I don't know that I need a viewgraph to tell you
5 how we go about that, but I can tell you that the annual
6 planning process for fiscal year '94 began about last
7 February, and it started first with an evaluation and
8 articulation of where we wanted the program to go, how the
9 things we wanted to do related to the guidance that we
10 received, the advice that we received from your board, the
11 advice we received from others, and that progressed through
12 time. And subsequently--maybe this is a better way to do
13 that--we started off with a draft annual plan. That draft
14 annual plan tried to take from this long-range plan what
15 appeared to be the annual bite and began to sift through it.
16 Recognizing as we do this, we develop annual priorities
17 because they may change with time slightly.

18 I guess the big part of that is when one gets a
19 budget overlay. When we first took a look at the plan as it
20 was laid out, the plan wanted to encompass about twice as
21 many activities as we can afford to execute in fiscal year
22 '94. That's where the prioritization comes into play.
23 That's where you begin to distinguish among activities,
24 picking activity A and dropping activity B simply based on
25 that prioritization. Not that there were any of the things

1 that were on the plate that were either not worth doing or
2 things that we don't believe would be worthwhile to do this
3 year. Just that that wasn't on our menu.

4 Then the annual plan comes back. It will
5 articulate and it's final form--it's being finalized at
6 present. It will describe the whys or various tests being
7 selected; it will identify what the cost of those tests are;
8 it will identify where in the schedule they belong; why they
9 belong there in the schedule and how they're linked to other
10 activities, what the demands are. And a lot of the things
11 we're doing this year are in fact linked to the development
12 of the ESF. Those linkages will be existing within the
13 annual plan of the testing program formally.

14 What I can say is I'm bent a little bit more with
15 some of these, because these aren't new viewgraphs, toward
16 the testing program. The exercise that we're undertaking
17 right now is not focused solely on the testing program. It's
18 focused on the whole of the program. So we'll be developing
19 annual plans for each one of the elements of the program. Be
20 it design, be it performance assessment, be it the ESF
21 construction activities, what we're trying to do is to
22 develop a suite of plans and then marry them together in a
23 project plan, in a long-range plan where we can better
24 transmit to you the fact that there is planning and
25 underpinning to the program as it's going, even though that

1 may not be so clear as we sort of present you a suit of
2 little dots. You need to step back from a Serat to be able
3 to see what the painting is about. And we recognize we tend
4 to punctuate that in some of our meetings with you. But
5 again, in this process is where we very distinctly try to
6 cull out the learnings that we've--the findings, the things
7 we've learned versus how that influences where the program
8 goes from there.

9 Now, that process is followed--once there's a
10 selection of the activities for a given year, the job isn't
11 over. The next part of that job is to derive some test
12 specific design criteria. The purpose of that step is to,
13 one, as Dennis talked about, and I think as others have
14 talked about, we've gaggled together lots of different
15 activities into single opportunities. Once we concluded that
16 we required a borehole in the block for the development of
17 ESF design, we concluded that that in fact married very well
18 with what we were intending to achieve with the first of our
19 systematic drill holes, SD-12. As we began to look at SD-12,
20 we said, you know, that's a real opportunity for us to get
21 into the pneumatic testing and monitoring program. So those
22 happen and they happen through this step, the description of
23 the test specific criteria.

24 This also provides the opportunity to know that the
25 test very specifically being designed in fact fulfills the

1 goal that was laid out in the long-range plan and the annual
2 plan. So that's our first loop-back to make sure that what
3 we're executing is in fact precisely what it is we thought we
4 needed to know.

5 Then we go through the suite of analyses. Ned
6 talked a bit about preparing some of the test planning
7 packages and you talked about the global test planning
8 package, the refinement of that into a specific test planning
9 package, and then the empowerment documents through the job
10 packages. Well, those are all done also for the surface-
11 based test program.

12 There are some other things that sort of happen as
13 overlays on that. We have an evaluation as to the
14 interference of one test with another test, the interference
15 of construction with the test. We talked a bit this morning
16 about--I think it was you, Don, that talked sort of about how
17 do I know whether I'm getting a contaminated sample. While
18 intellectually at a high level we want to think about that,
19 at the execution level we want to think very specifically
20 about that. We don't want to put salt in a drilling pad for
21 a grounding agent that's required if what we're interested in
22 is chlorine 36 in the groundwater. There are a number of
23 these little things that can get out of sync unless we're
24 careful. Of course, the other requirement is to make sure
25 that the tests that we run don't influence the long-term

1 behavior of the mountain. And then, as this goes through, we
2 go through the implementation of that test and then the
3 reporting and the feedback of that test.

4 Dennis, I think, showed you this slide, and this is
5 the final control that we have in deriving at whether or not
6 we're getting our achievements.

7 We've laid out what it is we expected for the year.
8 We've laid out a suite of components of that roll-up, and
9 we've translated that down to not only the activity that
10 takes money, but in fact the product from that activity that
11 feeds to our outcome. And so, the way we've been keeping
12 account of where we are or begun to keep account of where we
13 are is through this kind of detailing. So we've got a
14 network that starts with I'm interested in, in this case, the
15 unsaturated zone hydrologic model down through the
16 deliverable that says I need the gas and vapor flow data, and
17 I'm tracking my progress down to the lowest level.

18 I think for this board, the interest is probably
19 more in the tracking of higher level goals. What I think we
20 want to transmit is these are important to us. That
21 structure is important to us, but in our annual executable
22 we've got to get down to the individual contributors to
23 anyone of those.

24 I'm not sure exactly what the questions were or
25 whether I've addressed some of that. One of the things I

1 think we wanted to leave you with is that while we've
2 punctuated these discussions with our plan and purpose and
3 objective and the fact that we've got some idea of what we're
4 doing, that there is indeed a master plan. We recognize that
5 we may have not in the past found the right vehicle to give
6 that to you. That is an exercise that's being undertaken
7 this year such that a master plan can come with text, with a
8 very complete description of the whys behind some of the
9 decisions made, the interrelationships between some of the
10 activities undertaken, and I guess one of the other things we
11 wanted to put across is that the ESF and surface-based
12 testing program to us are simply an in situ testing program
13 and a non-in situ testing program. And in fact, some of the
14 tests planned utilize the ESF as a borehole while others of
15 the test plan simply use that as access to some observations.

16 Maybe that's all I'll do.

17 DR. CORDING: Thank you, Tom.

18 Do each of those little tick marks up there
19 represent a year? I was trying to count when you were going
20 to have a license application.

21 MR. STATTON: You'll notice they were all empty. Maybe
22 for purposes of today's meeting I should say none of these
23 are short than a year.

24 DR. CORDING: I had it down to the month. That last one
25 was not quite a year, that last tick.

1 Questions for Tom?

2 John Cantlon.

3 DR. CANTLON: I was the one that raised the question of
4 the interaction of the investigators with the total
5 performance assessment activity, and as you're well aware,
6 the Board has been uneasy about really the level of
7 integration for really our whole existence. And you've
8 touched on the issue as though it were primarily a problem of
9 communicating your integration activity to the Board and
10 outside reviewers. But I would suggest that in our
11 interaction now over almost five years, we've interacted with
12 essentially very, very broad segments of your internal
13 contractors, researchers and so on, and I think you have as
14 big a job communicating it to the people generating your data
15 as you have to communicate it externally.

16 MR. STATTON: I don't disagree.

17 DR. CANTLON: And with that in mind, I go back to my
18 question this morning, and that is, what is the nature of the
19 process by which you bring your investigators into an
20 integrating feedback with the performance assessment process,
21 which is one of your integrating elements.

22 MR. STATTON: If I look at the very broad integration
23 issue of this program, I'm, I think, as confused as everyone
24 else is. This construct utilizing the plan for the program
25 in its global sense down to its executable sense I think is

1 the centerpiece for that interaction to happen. And I think
2 internally perhaps we haven't been as crisp on some of those
3 boundaries as we need to have been. I can say that I believe
4 internally we have been better at it than it appears we've
5 been at it. And especially based on some of the comments it
6 appears that we don't have any at all, and I understand that.
7 This to me is the tool to do that, and the tool says that my
8 next iteration of total system performance wants to have in
9 place these process models with this degree of fidelity to
10 them. Well, once we've laid that out, to me, those process
11 models drive the data demands back into the various
12 activities. So now we've at least got the communicating
13 vehicle between the performance assessment at a high level
14 and the individual trying to gather the parameter for its
15 use. So, my belief is this is going to be a powerful tool if
16 we could get it fleshed out and put on the table. I
17 certainly didn't try to imply that life inside is wonderful,
18 but I didn't want to say that.

19 DR. CORDING: Warner North.

20 DR. NORTH: I like this diagram. It makes it possible
21 now to say that the need is to tighten the links between the
22 fish hooks and the sausages. That's a nice shorthand.

23 I'm not sure this conceptualization is entirely
24 new, but, on the other hand, I like it. It's concise. I
25 would hope that it's something that people both inside and

1 outside the program can readily understand. I've heard you
2 refer to it as a new tool and talk about it in the future
3 tense as opposed to the past or present tense. I'd like to
4 put on record for myself very strong encouragement. It
5 certainly addresses concerns I was raising yesterday about
6 the need for this kind of interaction.

7 I'd like you to comment, if you would, on the three
8 time frames you talked about, the long-range, the one to
9 three years and the annual, in terms of where this diagram
10 most needs implementation and your view of the match between
11 the feeds and needs to pick off your term--I used supply and
12 demand yesterday--as to how big is the job in each of these
13 time frames that needs to be done to implement this new
14 planning tool?

15 MR. STATTON: The short answer is, I think it's a big
16 job. I think it's a huge job. I think it's an achievable
17 job. I think it provides the flag around which all of us
18 with interest in the program can rally. Consequently, the
19 job gets a lot easier once you become a believer in laying
20 out the milestones.

21 One of the most important things to me is to get a
22 written strategy that's not 8,000 pages long that says here's
23 how I'm going to get from beginning to end. I see that
24 taking several forms. I see that taking the form of a
25 written strategy for an individual element, recognizing the

1 interfaces, as well as an articulated strategy for the whole
2 as it moves across. So I see, for example, a project plan
3 of--I don't know what--25 pages that tries to say here's my
4 global strategy and if you want to see the details of the
5 strategy that play into that, look in appendix A and you'll
6 find a more detailed discussion of that strategy and its
7 interfaces with appendix B which is this strategy.

8 The reason this is so important to me is I believe
9 you have to have an intellectual backdrop against which you
10 can measure change. If I looked at the single most important
11 function of those three plans, to me, this is it. This is
12 the one that says here is my strategy against which findings
13 can change my future.

14 The annual executable, to me, is a detailing simply
15 of a one year--I better not show that exactly slice through
16 here saying here are now the elements that I need to pay
17 attention to. I need to pay attention to the next total
18 systems performance and here, when I look at its annual plan,
19 is what it needs.

20 So the value of that to us at the project level I
21 think is as a management tool. It allows us to do the
22 bookkeeping that says I laid these things out and I'm
23 chugging along and I'm making the progress I expected. At
24 the end of the year, I'm able then to say I'm going to
25 contribute to this, or, what I found doesn't allow me to

1 contribute to that; consequently, I changed the program for
2 the next executable year.

3 The interim planning I think is important in the
4 sense of providing some continuity of thought and direction,
5 providing a precursor to some things that I'm not prepared to
6 do today. So neither of those two bites to me is
7 unimportant. We started with the annual plan and that was
8 certainly not the way you begin to do this, but you're a
9 little behind the power curve and I need a management tool.

10 I think the intermediate plan has been started and
11 Dennis showed you some of that, and that's simply because I
12 got resource allocation problems and I've got to be able to
13 anticipate what happens.

14 What I really feel the most important tool is the
15 intellectual backdrop; do I understand what it is I'm going
16 to say I intend to know at that point in--

17 DR. NORTH: That's your long-range plan.

18 MR. STATTON: Yep. Did that skirt the issue so I didn't
19 answer the question?

20 DR. NORTH: Well, I'm going to summarize your answer as
21 the biggest gap between the need and the feed is the long-
22 range plan, and your incentives are to start with the annual
23 and the intermediate because that's where you get a lot of
24 pressure. You got to have something to deal with the
25 planning function at that level. So, if you get too busy,

1 what slips is the long-range plan.

2 MR. STATTON: No. That won't happen. One of the things
3 we've organized this year is a very specific function and a
4 specific group of individuals that in fact are not only
5 knowledgeable but talented in each one of the subelements,
6 and their sole goal in life, if any of us ever have a sole
7 goal in this program, is the production of that long-range
8 plan. Now, I can say--and every time you talk to a group
9 like this I worry a bit--my expectations of this thing being
10 the panacea in its first construct aren't great. But I think
11 the first thing we got to do is hold it up and then we'll
12 patch up the holes in the curtain.

13 DR. CORDING: The subelement, Tom, you're referring to
14 is what? What are the subelements proficient in the
15 subelements you just commented on?

16 MR. STATTON: Oh, I'm sorry. In that context what I'm
17 talking about is somebody who's proficient, for example, in
18 performance assessment and code modeling. Somebody who's
19 proficient in either the construction or the design or the
20 site investigation; whether it's the hydrology or the
21 tectonics program.

22 DR. CORDING: Within the M&O basically, working in that
23 area.

24 MR. STATTON: Yeah. At present that core team sits
25 within the M&O. I'll tell you, I don't know whose cover will

1 be on this product when we're finished, and I trust it will
2 be a DOE cover. But it will in fact represent the sweat and
3 blood from everybody you've heard from and a whole lot you
4 haven't heard from.

5 DR. CORDING: It seems to me that your interaction with
6 the PIs is not just ask them to revise their program plan.

7 MR. STATTON: No.

8 DR. CORDING: It's continually, you know, make changes
9 or adjustments in that, or occasionally make adjustments in
10 that, but some other interactions that you have. And perhaps
11 these people that are proficient in the subelements are the
12 ones that are getting down there and doing that work. Is
13 that correct?

14 MR. STATTON: Yeah.

15 DR. CORDING: Talking or meeting. How do you see them
16 interacting?

17 MR. STATTON: When we facilitated the meeting for the
18 first construct, I guess, for example, the U.S. Geological
19 Survey brought the hydrology program into a room and we began
20 to think about the various activities that were ongoing and
21 where they were headed; what's the tie, how do I get back to
22 relating myself to some very specific understanding for site
23 suitability. We looked at where they are, how you got there,
24 which is what you had learned, and where you thought you were
25 going. And it was that network that through our workshop

1 there began to take form, and it took form of some of these
2 subcomponents that we talked about. I should have brought a
3 hydrology one seeing as we have most of our hydrology folks
4 here today. But it was this kind of construct. Breaking
5 down what it is we wanted to know into some subcomponent and
6 then the activities that address themselves to those
7 subcomponents. So what it was in fact doing is defining the
8 state of knowledge I'm going to have progressing through
9 time, because this may be--one of the conventions we used is,
10 say I want to produce that geology submodel in 1996. What is
11 it I'm going to know in 1996, what is it that I think I ought
12 to be able to know, and what are the elements that feed that.
13 So, now I'm back to where I can drive a program based on a
14 state of knowledge. If my selection of a topic says I want
15 to be able to address myself to groundwater travel time in
16 the saturated zone, I want some hard data that say here's my
17 current understanding and I think I've got a problem or no
18 problem. That quite clearly rolls up in to a saturated zone
19 hydrology model, but it breaks down through a suite of
20 components and in fact goes right back to the first thing you
21 need to do guys is go run us a test at the C-well complex.
22 Well, that's in fact part of the process that drove us to our
23 C-well testing that's on the boards for this year.

24 I don't know if that--

25 DR. CORDING: That helps.

1 Other questions? Staff?

2 Leon Reiter.

3 DR. REITER: Tom, let me go back to a very basic
4 question. You said that the basis of everything is laid out
5 in the SCP. I guess the question I want to ask you is what
6 is DOE's long-term waste isolation strategy, and the reason
7 I'm asking that is at various times we have read and we've
8 heard things like the geologic barrier is the primary barrier
9 and then among all the barriers the Calico Hills is the most
10 important element. We've seen statements by people and
11 papers challenging that assumption, promoting strategies
12 that, for instance, the Calico Hills is not that necessary.
13 We've seen studies that depending on where you stop the study
14 you can either conclude that Calico Hills was important or
15 was not important.

16 Is there a present strategy and where is it
17 articulated?

18 MR. STATTON: Go ahead, Susan.

19 MS. JONES: I wouldn't touch that one with a ten foot
20 pole. Is that right?

21 MR. STATTON: No, no.

22 MS. JONES: It seems to me that the strategy has always
23 been a system of multiple barriers. That you cannot rely
24 totally on a natural system; you cannot rely totally on an
25 engineered system. You have to combine the two, take

1 advantage of both, maximize both. That is the principal
2 we've been operating under for years.

3 DR. REITER: I'm sorry. I really should have prefaced
4 my question. Aside from general statements about multiple
5 barriers, where is the waste isolation strategy laid out?
6 It's like in many ways like mother and apple pie, but how is
7 it laid out? What role does the Calico Hills play in this
8 thing?

9 MS. JONES: At the moment it is considered a primary
10 natural barrier.

11 DR. REITER: Is it the primary barrier?

12 MR. STATTON: I would say today in the SCP, in our
13 baseline, not just the SCP, in our baseline it is the primary
14 barrier. Now, we're constantly trying to reevaluate that.
15 Matter of fact, one of the goals for the year is before we
16 embark on the design and construction activity for Calico
17 Hills, is to go back and make sure that we're still
18 comfortable with the decision that was made back in 1988.
19 Which is not to question whether or not in fact that was a
20 good decision, it's to get ahead of the power curve once and
21 say I can sit down and specifically think about whether
22 that's the resource allocation I need to make based on my
23 overall strategy. Today's strategy for this program is
24 represented in the baseline. It is not that it isn't
25 questioned all the time. The way we got from ESF shafts down

1 to ESF loop is in fact that questioning, sometimes prompted
2 questioning, and I grant that. But nonetheless, we sit and
3 revisit those decisions. That's a big decision going to
4 Calico Hills. So, it is intended to very specifically make
5 sure that it was the right decision given today's knowledge,
6 but it is not to call into question that it's part of the
7 baseline, because today it is.

8 DR. REITER: And is the engineered barrier still
9 considered secondary to the geologic barrier?

10 MR. STATTON: I think the engineered barrier is an
11 additional component. They're being handled nominally
12 independently and they have to be handled independently. We
13 have some engineered barrier requirements. We've struggled
14 with what the engineered barrier system is and some of its
15 terminology; what an altered zone is and does it go all the
16 way to the surface, or does it go all the way to Pahrump, or
17 something like that. But nonetheless, the strategy, the
18 approach to the engineered barrier system is while integrated
19 independent from the natural barrier system, both of which
20 are being developed to be as robust as possible, that's I
21 think today's strategy.

22 DR. NORTH: I'd like to add a further comment and invite
23 comments from Susan Jones and from you, Tom. In the first
24 meetings of this board we were introduced to the term
25 performance allocation as how one gets beyond the concept of

1 multiple barriers down to the specifics of what are you
2 relying on to what degree among the multiple barriers. I
3 haven't heard anybody from the DOE program use that term in
4 quite a lot while, but I think the concept it represents is
5 what's your strategy when you go in with a license
6 application? What is the mix of elements that will lead you,
7 or should we say will lead to a case that's very convincing
8 that the site is licensable if indeed you believe that to be
9 the case? And then that drives your data acquisition. What
10 do you need to be able to confirm? So, for example, is it
11 very important to get a drift down into the Calico Hills and
12 get all the data that will come from that exercise, or is it
13 in fact not absolutely necessary and the program might be
14 better off using the money for other purposes?

15 Now, I see the virtue of the sausages and fish
16 hooks as maybe it will allow you to address that question in
17 a somewhat more organized way than what we've observed over
18 the last five years, which is why I very much like the
19 concept. What I hope we are going to get in future meetings
20 of this kind is going beyond the theory and going beyond my
21 frustration at not being able to see what is the increment in
22 the strategy as opposed to the site characterization plan
23 which is now quite old. I'd like to see the 25 page current
24 implementation of fish hooks and sausages for long-range
25 planning, and if that document exists, I don't know where to

1 find it.

2 MR. STATTON: You'll know where to find it next spring.

3 MS. JONES: And I was going to make a slight joke here.

4 I've never seen a 25 page document. But, you're right; we
5 need a clear, articulate--clear way of articulating what that
6 plan is. And, to the best of my knowledge, we have not made
7 a complete pass through the performance allocation exercise
8 since the SCP.

9 DR. REITER: Thank you. That's a very clear response to
10 my query.

11 MS. JONES: And we have not done it.

12 DR. REITER: And you are, therefore, assuring us that in
13 the near future we may expect that void to be filled.

14 MS. JONES: Define near.

15 MR. STATTON: But it's a topic that clearly does have to
16 be addressed as we begin to put the real meat on this
17 framework. So I think it's within the system of the program
18 to help articulate those strategies. I think we may be a
19 little early in that process as to the robustness of what a
20 waste package is likely to produce versus the robustness of
21 what a site is likely to produce. And we may end up finding
22 that they both produce such robustness the overlay doesn't
23 matter.

24 DR. CORDING: Okay. Any other questions? I'd like to
25 thank you very much, Tom, for your presentation and we're

1 ready now to go to our final closing remarks. As I've
2 indicated, I'm not sure on the schedule who is making that.
3 Susan are you--Dennis, are you doing that?

4 MS. JONES: Since I just walked in, I will gladly defer
5 to Dennis.

6 DR. CORDING: Okay. Dennis Williams.

7 MR. WILLIAMS: Okay. I'll make the closing remarks on
8 behalf of Russ and the DOE. I won't stand up; I'll just do
9 it from a sitting position if that's okay.

10 Of course, Russ sends his regrets that he wasn't
11 able to be here. I think as we all know, the newly appointed
12 deputy director--acting--director, we have so many deputies
13 and we have so many actings I'm having trouble with these at
14 times. But anyway, he is in town and that part of duty
15 called.

16 I don't think I can do much more as far as wrapping
17 up the technical part of this session. Tom did an excellent
18 job on presenting the intellectual framework. I'm happy to
19 see that there's somebody that does appreciate--diagrams
20 sausages and fish hooks as much as a few of us others do.
21 That's probably why we have Tom as kind of the chief
22 integrator on the program. That particular talk isn't that
23 easy to give. I know from experience I tried to give part of
24 it in Reno and abruptly passed out, so--I've had better talks
25 to give today or in this session.

1 I hope that we've conveyed some sense of the
2 collective planned thought and coordination that has gone
3 into this program here of late, and basically in regard to
4 the ESF testing and construction, how we're trying to tie
5 that together and also tie that into the surface-based
6 testing program. Of course, that's again when we get back to
7 how we tie the whole together. That's the most important
8 part of it, because the pieces really aren't going to mean
9 anything to us in the end if we can't do something with it.

10 We sense a need from the Board for a more expanded
11 comprehensive strategy on the part of DOE, or perhaps a
12 better articulation of the expanded comprehensive strategy
13 that we do have in place.

14 There were a couple of areas that I think deserve
15 some specific comment, one with regard to PA. We talked
16 about that quite a little bit. In the round-table discussion
17 I think Jerry Boak may be over here and I would like for him,
18 if you would like, to talk a little bit about his total
19 systems performance assessment road trip that he had
20 recently. Maybe that will offer us a little bit more insight
21 on what we're actually doing in PA.

22 The other item has to do with regard to a comment
23 made by Larry Hayes yesterday where he expressed a concern
24 shared by some of us in YMPO, that the time and effort put
25 into these meetings would result in a more meaningful or

1 should result in a more meaningful communication. We would
2 like to work on that a little bit and we would like to
3 clarify the needs and expectations of some of the people,
4 especially the Board, whenever we hold these meetings. And
5 Susan has indicated that with the concurrence of the Board,
6 she would like to enter into some discussions later on to see
7 if we can get a little better organization in that fashion.

8 With that, I'd like to close with just a thank you
9 on the part of all the participants, everyone that has made
10 presentations here, and especially the people, the invisible
11 people that we don't see that help us put all this together
12 and have helped put together the program that Tom has
13 articulated up here, and really a special thanks to the Board
14 for their patience and understanding in trying to sort out
15 some of these very difficult issues.

16 With that, I'll turn it back over to the chair.

17 DR. CORDING: Okay. Thank you. We're going to have
18 some final comments later, after our round-table discussion
19 from our chairman, but in terms of the session this morning,
20 I think I very much appreciated much of the--I appreciate the
21 information that was presented and the way it was presented.
22 I think it helped us get an insight into some of the testing
23 that I thought was quite valuable, and so for my part, I'd
24 like to thank you for some excellent presentations today. At
25 least in terms of my responsibility as session chairman, I

1 really did appreciate those presentations.

2 We're going to be breaking now for fifteen minutes.
3 We're going to set up for the round-table, and I would like
4 people who have been participants so far to be seated near
5 the front, and the others of you should be not more than a
6 couple of steps from microphones so that you can also
7 participate. We haven't had a chance for you all to discuss
8 things as much we would like, and we want you to participate
9 in this round-table in fifteen minutes.

10 (Whereupon, a recess was taken.)

11 DR. CORDING: We're ready to reconvene. We do have
12 tables here now, so we're ready for our round-table
13 discussion. If the presenters from this morning would come
14 up to the front also and sit at the table, that would be I
15 think appropriate. We have a couple more places up front for
16 people that may have made presentations yesterday, today;
17 PIs.

18 Well, let's start. There's several items that
19 we've been discussing obviously in the last two days, and I
20 thought I'd just indicate a few of these general categories
21 that we might find of some interest in discussing and getting
22 more interaction on, and one is the overall strategy for the
23 site characterization, it's implementation and presentation,
24 how can it be summarized in a way that--and well it can be
25 summarized in a way that will help guide the program and

1 provide information to groups reviewing and evaluating the
2 program.

3 Another item that I think deserves discussion is
4 this integration of construction and testing, and we have
5 people here both from the testing community and the
6 construction people who are quite familiar with underground
7 construction and who are in the process of setting up the
8 underground construction excavation process for the tunnel
9 boring machine. And I'd like to have some discussion on that
10 as well.

11 And then some of the other areas we've had quite a
12 bit of discussion on has to do with the whole area of
13 hydrologic testing, pneumatic testing, the integration of
14 surface-based and underground testing for that purpose.

15 And then finally, the thermal testing and thermal
16 strategy. I know we've had most of our discussion on that in
17 previous meetings, just one presentation of Dale Wilder on
18 that, but I'm interested in perhaps some discussion regarding
19 the long-term approach to the thermal testing and the
20 immediate actions being taken in that area as well.

21 So, let's go back to the first item, the overall
22 strategy, some things we were really discussing as we
23 finished the presentations this afternoon with Tom Statton.

24 Is the overall strategy that Tom has presented and
25 the way it's organized, the way you see it being organized

1 from your own viewpoint, is this appropriate? Are there
2 other things that are being done that we don't know about
3 that we need to discuss, other things we need to be doing?

4 MR. WILLIAMS: Dennis Williams, DOE. I was wondering if
5 this is the point that maybe we wanted to discuss a little
6 bit of the performance assessment aspects. Jerry Boak isn't
7 here but Jean Younker can talk to that particular subject I
8 do believe.

9 DR. CORDING: All right.

10 MS. YOUNKER: Jerry had some other obligations, so he
11 asked me to speak on his behalf a little bit. We have tried
12 really hard as we put this past total system performance
13 assessment together, which we're completing right now, and
14 the previous one that was done back in '91. We've tried very
15 hard to get as much both informal and formal interactions
16 with participants and the characterization program as we can.
17 This time we did make a real attempt. We took a road show
18 that Dennis mentioned of about I think seven or eight of the
19 key people that worked on the TSPA that was done this summer
20 out to USGS as well as to Los Alamos and got a lot of the key
21 PIs in the room. Talked about what we had done in the
22 previous TSPA, what we were doing in this one, and just
23 brainstormed ideas as to what made sense and what didn't make
24 sense. So I think, Mike, you probably weren't there right at
25 that point in time, as I recall, because I can't remember who

1 was all was there. I know Alan was there. Alan Flint was
2 there. And I don't recall who all was available then but we
3 got as many people together as we could. So, you know, I
4 think the flavor that comes across sometimes when you ask
5 somebody like Mike, well, did someone specifically ask you
6 about your study plan or talk about what specifically they
7 needed from you, well, I think in a sense at least it kind of
8 comes across that, well, just because we didn't talk to that
9 one person we didn't have those interfaces.

10 Well, the PA people and my team as well as in the
11 Sandia team, as they're going along and trying to establish
12 the data base that is available to them, they're on the phone
13 daily with the PIs trying to find out what's coming down,
14 something that isn't even available yet, what we could
15 possibly get our hands on. So there's a lot of informal as
16 well as this one formal road show that we did have. So I
17 think, you know, as I think Tom was saying, we probably
18 haven't done a good job of letting you all know exactly the
19 kinds of things we do try to do to get that interaction
20 going. And I'd be certainly willing to answer any other
21 questions or give you any other feedback that might help.

22 MR. WILLIAMS: Jean, one thing that I saw on my desk is
23 --don't you have a local version of that road show starting
24 tomorrow?

1 MS. YOUNKER: Yes. As a matter of fact, I think there's
2 a chance that Leon Reiter may be going to sit in on some of
3 that. What we've done is we've tried to set some milestones
4 where we would hold meetings that were open to anyone who
5 wanted to come to listen to kind of our status as we stand
6 right now. We're almost done with the TSPA that we've done
7 this year, and so this is kind of a time when all of the
8 people who participated at the analyst level are going to
9 give presentations of their parts of the work and listen to
10 each other as well as there will be some of the managers
11 there to listen to it for the first time really. So it's
12 really our first internal set of presentations on this year's
13 TSPA.

14 MR. LeCAIN: Excuse me for interrupting here. I'm PI of
15 a couple of projects and I don't think I've ever talked to
16 anybody in performance assessment.

17 MS. YOUNKER: And I think that's fair enough. I could
18 look over to Alan Flint and say how many times have you been
19 called by either Mike or by Holly Dockery from Sandia to ask
20 you questions about some of the data that we might be able to
21 use from some of your work recently.

22 DR. FLINT: What a wonderful opportunity. Alan Flint
23 with the USGS, and I do remember this road show. I was
24 involved in it. I was very confused by it and I don't think
25 I came out with a lot better understanding of the way things

1 were going to be done, but I think that there is a key
2 problem that we had--there were several questions I guess
3 that were brought up today by members of the Board and asked
4 if we had changed our study plans based on performance
5 assessment modeling. And I think that the performance
6 assessment modeling is not looking at anything that we're
7 doing particularly, and the work that we're trying to
8 accomplish and the methods and the data we're using is not as
9 well integrated perhaps with performance assessment as we
10 would like. And on many occasions we've asked that
11 performance assessment be involved in what we're doing and
12 help us in making these decisions, because I think that's a
13 real important part. We collect data; we have ideas. We
14 would hope that the performance assessment modelers would
15 take those and test them out in their modeling and then see
16 how important they are to the other parts of the program when
17 they're trying to put all this together. And I don't think
18 we've quite gotten to that point. But one other thing is
19 that we did sit together, many of us, with performance
20 assessment.

21 There were I think five big projects that we
22 decided to tackle, the importance of the PTN and there were
23 several other ones. I think I was the only PI involved on
24 any of those and the only one of those five that was
25 accomplished, was accomplished because I stayed involved in

1 it. And I think that the performance assessment people have
2 to identify principal investigators and work specifically
3 with them on specific problems. I don't think it gets done
4 by just calling them, giving them a couple pieces of data and
5 going away for a year.

6 MS. YOUNKER: Can I make one more comment on that? I
7 think what you point out is exactly right. I mean, obviously
8 we have to have some very strong relationships developed, but
9 I do think that one of the reasons why you probably--what you
10 describe is the case is if Jerry was here, he'd talk about
11 the pyramid, you know, the PA pyramid that we presented to
12 the Board a number of times. And that is that right now
13 we've been--for some reasons I think that are good ones--
14 emphasizing the total system performance assessment which
15 sits right at the top of that pyramid and you're operating
16 with one-dimensional, you know, extremely abstractive, highly
17 abstractive models where there's really not very much process
18 in those models for the most part. There's some in the
19 Sandia ones and the ones that--the RIP that we use. You
20 know, it's a very abstract model so that you run many
21 realizations and get some sensitivity studies out of it but
22 at a very high level. I think when you're operating at that
23 level, the link takes a lot more effort because there's some
24 subsystem process models that you have to work through in
25 order to get down to the ones you guys are working with, and,

1 you know, it's a big effort. I mean, I think we're working
2 on it but I don't think the connection is, you know, really
3 easy.

4 DR. FLINT: I'd like to address that point because I
5 think that's a real important point and I see that myself as
6 a problem. The PA people are working at the top of this
7 pyramid. I think you remember this idea of abstraction going
8 to the top. The PIs are down at the level trying to
9 understand processes and I do not believe that the
10 performance assessment group have demonstrated that they can
11 roll-up these processes to the top level of the pyramid yet.
12 And yet, that's where they're--I think they need to go back
13 down and work with the PIs and make sure we understand the
14 process models first before we work to the roll-up model.
15 And I also believe that there are many people within the
16 performance assessment that are trying to do that. Bill
17 Nelson is one who has spent a lot of time with my group out
18 in the field trying to understand what we're doing. They're
19 back down at that base level trying to say let's get these
20 models working first before we start abstracting. And I do
21 think he's right. I think we need to move at that level.

22 MS. YUNKER: I think--just one last comment. That
23 there's certainly a question on DOE to have some kind of a
24 way of showing some status of compliance with something like
25 a total system performance criterion, so I think you have to

1 look back at why we did the total system performance
2 assessment in '91 and why we did another one this year. You
3 can't answer the kinds of questions about how's this site
4 looking with regard to compliance with the regulations down
5 at the process model level. And so, of course, DOE has had
6 to make some difficult decisions about where they want a
7 performance assessment to focus. The emphasis at the top of
8 the pyramid does allow you to, granted with some
9 uncertainties in your process models, does allow you to get
10 at the question of how's the site looking with regards to
11 compliance with total system requirements. So there's a
12 balance and there's definitely been difficult decisions made
13 by performance assessment management within DOE has to how
14 that balance should be played out.

15 MR. DYER: This is Russ Dyer from DOE. I'll take the
16 blame for that since it was done essentially at my direction,
17 but we came to a realization that we had to work on all
18 levels of the pyramid simultaneously and we constructed some
19 PA models at the top of the pyramid, high level abstractions,
20 with little confidence that we could trace the connection
21 between the top of the pyramid and the bottom of the pyramid.
22 We realize that that has to be done and it's going--Alan,
23 you're absolutely right. It's going to be a long struggle
24 trying to demonstrate that we have incorporated all of the
25 important processes from the process level models into both

1 the intermediate and upper level models. We can't do that
2 now. We're going to have to be able to demonstrate that at
3 some point in the future. But we felt we had to put together
4 some kind of a tool that could give us a yardstick that could
5 give us some idea of where we stood and that we could use to
6 try to feed back and give perhaps some large-scale
7 sensitivity studies to the system as a whole. What part of
8 the system is really the most critical part of the system?
9 Can we make that determination yet and can we believe it.
10 Right now we may get results out of the models but even those
11 results have a certain--a large amount of uncertainty
12 associated with them because we aren't confident we have
13 built into the top level models everything that needs to be
14 there.

15 MS. YOUNKER: And I think, Russ, if Jerry was here, what
16 Jerry would want to remind you is one of his presentations--I
17 think at the Reno meeting he tried to be very clear you'll
18 never incorporate all of the processes. What you're going to
19 do is figure out which ones it's okay to leave out.

20 DR. FLINT: Yes. I agree with what has to be done and
21 the direction you're going, and there are certain aspects of
22 it and we've argued this before and this may not be the
23 forum, but, you know, we're looking at next year's total
24 system performance modeling. It's a series of one-
25 dimensional models and I think that we've shown to a large

1 extent in professional papers that we've written, people in
2 the USGS, that this is a two-dimensional system in many, many
3 cases. And one-dimensional models can apply and can work if
4 you're working at the right location. For instance, at UZ-16
5 the best information we have is you could do a one-
6 dimensional model there. But if you're using 14, if you're
7 in the north part, that one-dimensional model will not work
8 and unfortunately that's several of the locations where the
9 one-dimensional modeling is going after. But I think that
10 kind of information has gone back and forth between total
11 total system performance assessment and some of the PIs that
12 have never been resolved. And whether or not we have to
13 resolve it, that's something that I guess you have to decide.
14 But that's argument that we've made and that we wanted to
15 see a more realistic system where we had two-dimensionality
16 to it.

17 DR. CORDING: I had a question for Tom Statton. You
18 show these loops and fish hooks and sausages. Have you been
19 able to use performance assessment as a tool in your work at
20 this point, or is what you're doing you're really trying to
21 get inputs into that. You don't find it as much of a tool in
22 your planning at this point. How does that fit into what
23 you're trying to do, Tom?

24 MR. STATTON: Is this on? Quite clearly the link
25 between performance assessment and the planning of the

1 program has not been as tight as it perhaps ought to have
2 been. I think that was John's comment earlier. I think the
3 organization that's set now has a couple of advantages, one
4 of which is performance assessment becomes a very active
5 participant in laying out the plan, as well as do the PI
6 organizations. Such that as performance assessment
7 articulates its long-term goals, as it articulates
8 specifically the focus of the next TSPA, vis-a-vis the
9 sensitivities identified in the last one, then it becomes
10 truly a program driver. And I think in part, Alan's comments
11 work perhaps more strongly as we begin to understand the
12 specifics of what the next TSPA is. The performance
13 assessment part of this program is in fact laying out a road
14 map for what's coming next. It's laying out its plan as to
15 what parts of the last assessment are taking more focus in
16 the future.

17 MS. YUNKER: And I think one other comment on that,
18 that goes along with what Tom just said you saw feed into
19 that planning process, was this integrated test evaluation
20 activity that we've had ongoing in support of Russ'
21 prioritization. In that we had performance assessment people
22 from both Sandia and the M&O as active participants such that
23 the priorities that we fed to Russ--recommendations we fed to
24 him were based on the best intelligence we could get on
25 performance assessment data needs. So, you know, it came in

1 from that route as well.

2 MR. STATTON: And in the last prioritization, the one we
3 talked about in Reno, if you remember some of those data
4 sheets, in fact the ITE evaluations of each of the various
5 program activities that were being considered for funding in
6 fact was part of the decision making process. So it wasn't
7 simply a new design. It's also how badly do I need this
8 data, how relevant is this data at this point in time to what
9 goes next. So the link in fact with performance assessment
10 while existing, came through I think in part tools like ITE
11 where we may not have had as much face-to-face interaction
12 between the PI and the total system performance assessor, and
13 that's something that I think will get supplemented with the
14 upcoming program.

15 DR. CORDING: Bill?

16 DR. DUDLEY: Yeah. Bill Dudley, the USGS. Is this on?
17 The ITE that Jean referred to, integrated test evaluation,
18 stated rather specifically in its reports that the linkage
19 between the lower part of the pyramid, the data collection,
20 and the performance assessment up in the apex of the pyramid
21 was assumed to be fully funded and ongoing. And certainly
22 this is the part of the overall site characterization program
23 that has helped in design of the current testing. The
24 performance assessment models are, of course, too general to
25 really get or provide much help in test design and the

1 exploratories you have, whereas, the process models which in
2 some cases may be a back of the envelope analytical
3 calculation were indeed used. We do tend particularly when
4 funds are short, as was referred to repeatedly yesterday,
5 find that some of these synthesis and modeling activities
6 that result in the level two milestone for unsaturated zone
7 hydrology, for instance, have gone by the wayside in current
8 project planning. Dr. North said will anything fall by the
9 wayside because long-range planning tends to get put off my
10 closer-in planning. Tom said of course not. I would have to
11 say that they're right, Tom. I think the unsaturated zone
12 modeling program, the survey and LBL in cooperation has been
13 rather severely crippled in this year's planning, and it's
14 the type of thing we have to watch out for. Certainly the
15 long-range planning as of a few years ago recognized that the
16 exploratory shaft facility was a small vertical shaft going
17 down to the very limited underground test area. As Ned
18 mentioned, a thousand days of testing delay. There was no
19 question but what the surface-based pneumatic testing
20 characterizing the mountain as it exists with this ambient
21 condition today, had plenty of time before the impact of that
22 underground facility would be felt by the mountain. We did
23 not adequately keep track of everything that was happening
24 when we went from that small shaft to a drift, or ramp and
25 drift, and then when the concept came up of moving through

1 the TBM loop and opening up the entire mountain before we
2 could really get time for a significant testing, and as Larry
3 mentioned and others have mentioned, the survey strongly
4 supported Carl Johnson's warning that we need to be thinking
5 about establishing the ambient conditions before opening up
6 the mountain in the long-range planning sense because it is
7 those fragile or transient ambient conditions that provide
8 the record today of what has gone on pneumatically and
9 hydrologically in that mountain in the last several thousand
10 years at least. And once we destroy the capability to
11 examine the as nearly undisturbed moisture conditions as well
12 as we can, to examine the geochemical conditions as well as
13 we can, and the thermal conditions as well as we can, once
14 we've lost that opportunity we're not going to get it back.
15 So that we need to seriously look at many of places where our
16 long-range planning may indeed be falling by the wayside.

17 DR. CORDING: Yes, Pat Domenico.

18 MR. DOMENICO: I said something yesterday. I said I've
19 seen four or five performance assessment models. They're all
20 transport models. They're all one-dimensional. They have
21 little dispersion in it. They have constant velocity in it,
22 and there's nothing in the field that you need to put in that
23 model. There's nothing you need from a core. You don't even
24 need any field data because the model is too insensitive. So
25 if you're looking--and I heard and the point was well taken.

1 I heard some people understood that. So if you look at it
2 that way, unless you get more sophisticated transport models,
3 require certain things, you're going to need one porosity
4 value. You'll confuse them if you give them two. So if you
5 look at it that way, you're never going to integrate the top
6 and the bottom pyramid.

7 Now, if performance assessment starts to ask some
8 good questions which are not regulatory questions but which
9 bear on regulatory procedures because the transport model is
10 going to be the key to the release, and that's critical. But
11 if you start to ask how's this system going to respond if we
12 go into a thermal load and Tiva Canyon is impermeable, and
13 how much condensation is going to take place up there, how
14 much moisture's going to move up there and how much water am
15 I going to have to send up to the repository. Ask that
16 question and then you'll run to Al and say, give me your
17 stuff. Give me your data. I need your stuff. Now I've
18 asked the real scientific question and I got a model that's
19 going to address a point like that, which is to me a very
20 critical point. You know, so I think once you get out of the
21 field of developing a transport code just to check releases,
22 regulatory releases to see if you can comply, then you'll be
23 needing that other data.

24 Now, like I said, if you develop a sophisticated
25 transport core now which I think this is going to be kind of

1 difficult, you may need some of that data. Now, in that
2 case, performance assessment needs should drive the program.
3 I mean, that's the way it should be from that pyramid. The
4 performance assessment says here's what I need for regulatory
5 purposes and PI's got to deliver that stuff. But right now,
6 the performance assessment needs are nothing because the
7 models are too trivial. But ask some good questions that
8 pertain to performance and then you'll find that a lot of
9 that information will be very helpful.

10 MR. NELSON: I appreciate a lot the comment that was
11 made, this last one. I think it's very true and I'd like to
12 respond going on from one of the things that Bill Dudley
13 said. There's been some questions asked about our ability to
14 move up and down in this pyramid and it's very interesting
15 that this one study 2.2.9 that was mentioned here has in it
16 the plan, and I suggest that you got to spend some time to do
17 it, that that USGS plan has the prescription built into it
18 for going up and down in this pyramid. This isn't a mystery.
19 We understand how to do it. We've got to decide that we
20 want to do it and are going to do it, and I would suggest
21 that until we do, the haunting question is for any of the
22 rolled-up models, what is the undergirding evaluations that
23 justify what you've done, and if you can't answer that, you
24 cannot use the final answer that comes out of it.

25 The methods are here. We're not reading some of

1 the very best study plans that are coming out of this and the
2 thing that scares the living daylights out of me is that
3 those are the ones that in this priority sequence were zeroed
4 out this year.

5 Now, let me suggest in summary that PA is not a
6 one-step process as it is now being visualized by too many in
7 the program. It is a three-step process where you work with
8 the process models at the lower level and through a
9 combination of hypothesis testing and sensitivity, and we've
10 got to do the sensitivity now because we don't have all of
11 the data ranges that we need, but you do it in the range of
12 data needs that are needed to establish what the appropriate
13 conceptual model at the process level or models you have to
14 use in order to represent what's going on appropriately in
15 the mountain. Once one establishes that role, that becomes
16 the basis for testing the roll-ups and the abstractions that
17 we're using. And I would strongly recommend that we better
18 do the three-step process and not rely just on the one run.
19 I shudder.

20 Let's see now. I guess this is--well, I guess why
21 not go ahead and say it. If you believe it, you better say
22 it. I shudder at our position as NRC which has very capable
23 and competent staff review the official document that's going
24 representing the present TSPA. We very likely--oh, boy. I
25 dislike saying this. You're going to want to shoot the

1 messenger now. Very likely we are going to be literally
2 slaughtered by the questioning processes there and they all
3 center around what is the basis or the undergirding
4 evaluations that justify the roll-ups and the abstractions
5 that are being used in this. And if we don't know what they
6 are, how in the world are you going to expect us to use the
7 results that come out.

8 DR. CORDING: Thank you.

9 DR. NORTH: I can't resist following up on that. It's
10 very much on point and well taken that you and the program,
11 as you go forward with the output of the TSPA process toward
12 a license application and the site suitability findings, are
13 going to be subjected to criticism and scrutiny of a level
14 that you probably can't even imagine. And what you get from
15 this board and these kinds of meetings is very friendly
16 coaching relative to what you're going to run into then. So
17 if some of us seem to be a bit critical and frank, take it as
18 very constructive, because where you're going, you're going
19 to need all the practice and all of the sharpening of your
20 tools and your capabilities that you can get in this
21 relatively protected period before you descend into the
22 maelstrom.

23 I'd like to suggest that performance assessment
24 ought to be used not just in carrying out these big overall
25 exercises like TSPA-2, but in dealing with specific questions

1 and problems regarding Yucca Mountain, where there are
2 hypotheses to be tested and distinguishing among those
3 hypotheses may involve new data needs which then become very
4 important opportunities for the program. The one I'd like to
5 suggest to you for making the discussion we've had in the
6 last twenty minutes very specific is the set of hypotheses
7 that were presented on slide--let's see, this appears to be
8 SCTUZ 1419125. This is Dick Luckey's presentation. It's
9 titled Conclusions, and he has as a third bullet possible
10 interpretations. This is with respect to UZ-14 and the
11 perched water. And the hypotheses are: fluid is only
12 degraded G-1 drilling fluid, fluid is contaminated perched
13 water, or fluid is contaminated water table. Now, I look at
14 this from my perspective and say, gee, that's a very
15 important question. If in fact you've got contaminated water
16 table there, that has potentially some very strong
17 implications for the suitability of a rather large part of
18 the repository footprint. So maybe we ought to figure out
19 what do we know about this issue and have the performance
20 assessment people work with I'll call it the PIs and their
21 staffs to try to unravel what's going on here.

22 Now, this is a situation where the flow is clearly
23 not just vertical or horizontal. We may look at competing
24 flow paths and along a flow path we can conceive of it being
25 one-dimensional, but the trick is where in the geometry do

1 you reduce the three-dimensions to one flow path and how
2 might you be able to test that. What other data might allow
3 you to discriminate among these hypotheses. Do you need, for
4 example, to go out and do a lot of isotopic sampling which is
5 quite expensive and not in the budget for several years? Is
6 that worthwhile doing for the program? And these then become
7 very important management questions that ought to be in the
8 one to three plan or the annual plan, and I'll bet right now
9 they're not there because nobody has put them on the list.

10 So I would think it would be very valuable to have
11 some workshops between the performance assessment people and
12 the PIs and their scientific colleagues that are relatively
13 tightly focused on specific questions of hypothesis testing.
14 But what you're in fact looking at links between the upper
15 levels of the pyramid and the base of the pyramid and asking
16 questions essentially in where do we want to invest in better
17 data and better modeling so that we have a better story to
18 support programmatic decision making. And not programmatic
19 decision making that's out five, ten years or whatever but
20 program decisions that ought to be looked at in the near
21 future such as what do we do to have a better story with
22 respect to the perched water question on UZ-14.

23 DR. FLINT: I'd like to just spend a minute or two
24 talking about that particular issue and the idea, and I think
25 there are several people here who have heard me say this

1 before. I'd like to have one of these PA modelers assigned
2 to me so I can give them some real challenges in
3 understanding some concepts about what's happening at Yucca
4 Mountain specifically. Fortunately, in this characterization
5 program we only have one site to look at. We know where it
6 is. We know a lot about the geometry of the site and we can
7 work with that.

8 We have in the case of the UZ-14 are setting up a
9 paper that we're writing now for the High Level Waste
10 conference next year to address the issue of the potential
11 for perched water and why it occurs. We're taking those
12 surface boundary conditions and we were putting them in the
13 LBL USGS three-dimensional model of the site to look at where
14 one-dimensional, two-dimensional and three-dimensional
15 modeling will work and where it won't work, and how we can
16 try to resolve that particular issue. We think we have a
17 good plan for it, but as Bill mentioned, that was one of the
18 programs that was zeroed out and that's one of the programs
19 that is I think being funded now or in the process of being
20 funded, but it is an essential part of the program to answer
21 that specific question.

22 We have the information right now without
23 collecting any more field data to model in one, two and
24 three-dimensions the site and the processes that we think are
25 involved that cause the perched water to occur where it does.

1 And we've already modeled UZ-14, I have anyway, and found
2 that that's where perched water should occur. We published a
3 paper last year on high level waste that suggested that that
4 zone where it occurred is where it should occur under certain
5 circumstances and UZ-14 was one of the circumstances, and we
6 should have seen it and we knew that from UZ-1. But we have
7 the ability to do this but we're working in our own USGS
8 program and with Sandia to a certain extent in making the
9 connection with the performance assessment modelers in Sandia
10 and now they're at the M&O, and we don't know who they all
11 are yet, is something we have to get across. But I
12 understand the argument that we work at the top of the
13 pyramid, but from my perspective, I have some real
14 challenging questions that were asked by Pat that I think we
15 can ask those questions and I think we have the information
16 available to test some of our ideas about this without a lot
17 of trouble, without a lot of money. I think we're ready to
18 do that. How we do that is something that we're going to
19 have to decide as a group, but I think we're ready to do it
20 now.

21 DR. NORTH: So your position is you feel that given the
22 opportunity to run this slate of models, one, two and three-
23 dimensional, you can come up with a good story now in terms
24 of which of these hypotheses is correct such that you could
25 defend that against criticism and--

1 DR. FLINT: I do. I believe that we have enough
2 information, enough understanding to tackle the problem. We
3 have hypotheses that are testable with the information we
4 have today. We also have these tests that will predict in
5 our modeling where we should see other perched water, and we
6 should do that before. It's the same thing with our drilling
7 program. We should predict what we're going to see in the
8 boreholes before we drill them. We should predict where
9 we're going to see perched water before we get there. We
10 should have a model that goes through the ramp and says what
11 are we going to hit, because if we hit the perched water and
12 didn't know about it, that's a problem. If we predicted it
13 ahead of time and see it, that's wonderful information.
14 Perched water is not a problem if we know why it occurs and
15 can explain it and show how it effects a repository. But I
16 don't think I'm going to get a PA modeler assigned to me, but
17 I'd like one.

18 DR. NORTH: Sounds to me like it would be a very good
19 idea to have some communication on this specific issue, and I
20 would hope somebody's budget could afford it. I realize that
21 may be very difficult. What are you going to give up?

22 DR. FLINT: They're going to take it from mine, I'm
23 sure.

24 DR. NORTH: I think that Alan's point is very much on
25 target. Just imagine how things are going to play if perched

1 water is found as a surprise as opposed to finding perched
2 water validates the prediction of an analysis.

3 MR. STATTON: The first thing I can say is I'm delighted
4 to hear somebody who wants somebody assigned to them other
5 than an integrator. I think we all ought to have a PA guy
6 and I'll go look for mine. In our own bumbling way, I mean,
7 the prediction of perched water in UZ-14 was there. It was
8 not only there, there was a whole suite of plans that were in
9 fact in place because of that anticipation. So I think even
10 though, as I tried to get at earlier, we sort of punctuate
11 what it is we've planned and prethought, and it may not look
12 very coherent, we've either been extraordinarily lucky as in
13 the case of UZ-14 where a plan was there and in fact
14 exercises were there not only on what to do once we got it,
15 but what to do to progress after we hit it, which was the--
16 program--I think predictions of what we expect along the ESF
17 exists in nominally the same way. Perhaps at this point in
18 punctuated ways where it's not coherently knit together, I
19 believe this vehicle of knitting together our plan, our
20 strategy, our expectations, whether it's a one year bite, a
21 three year bite, or a long-range bite will help transmit that
22 information, and back to John's comment, both internally as
23 well as externally. And I think the Board and DOE concluded
24 that this strategy needed a different vehicle than it
25 currently had, and consequently that's why we've organized to

1 produce this vehicle, to try to get that information
2 disbursed.

3 DR. CORDING: And you'll have to produce something
4 before you got as complete a pyramid as you'd like to have or
5 may ever have.

6 MR. STATTON: Yeah. Pat's observation earlier to me is
7 exactly a correct one. That we've been dealing at the top of
8 the pyramid and in fact what we've been doing in the
9 executables is trying to examine the bottom of the pyramid.
10 That lack of handshake has led us to an operating philosophy
11 that said seeing as we haven't too coherent long-range
12 visions of where we're going, why don't we at the bottom of
13 the pyramid organize a program such that we can articulate
14 what it is we are going to find that maybe helps formulate
15 the plan, the intellectual pathway of the performance
16 assessment activities. And maybe we're about to cross over
17 that to where the performance assessment activities can now
18 articulate a plan and the handshake becomes complete and we
19 can now drive the underpinnings to meet that.

20 DR. CORDING: Thank you.

21 Russ, you had a question or comment.

22 MR. DYER: Russ Dyer, DOE. Two points I want to make,
23 one of which I think we're wrestling with--right now with
24 probably the most difficult part of this whole project, and
25 that is evaluating state of knowledge and intellectual

1 progress. How do you do it and how do you evaluate where you
2 are and where you need to go and what things do you need to
3 do next. And I don't have an answer for you. I think PA is
4 an important tool that must be used in that process, but I
5 don't think in and of itself it is a panacea. I would like
6 to give you an example of where performance assessment has
7 been useful to me as a manager, at least I think it's been
8 useful.

9 Bill Dudley and Alan both talked about areas where
10 there were funding shortfalls in our original planning for
11 this year. It was a PA person that came to me and pleaded
12 the case that those activities needed to be funded and we
13 scraped up the dollars out of somewhere else to get the money
14 in the program for those activities, and those are primarily
15 the modeling activities that we're talking about that are so
16 critical.

17 DR. CORDING: Okay. Carl?

18 MR. JOHNSON: Just before we close off maybe this
19 section, I wanted to make a comment on a point that Alan made
20 earlier, and that relates to predictive modeling. I have--
21 listening to the discussions over the last two days, I see
22 that as a glaring omission here and I have yet to figure out
23 why the Board over the last few years has visited the foreign
24 countries which have active repository programs going and
25 that seems to be a cornerstone of all of those programs and

1 that is predictive modeling. But I have heard zero certainly
2 from the program as to any plans to develop such a predictive
3 model, especially of the ESF tunnel before the switch of the
4 TBM is turned on.

5 DR. CORDING: Okay. Any further comment on that?

6 DR. FLINT: I'd just like to make one comment. I have
7 been involved in INTRAVAL, which is the international model
8 validation program [on radionuclide transport in the
9 geosphere] for some time, and in dealing with most of the
10 European countries that are dealing with the issue of nuclear
11 waste, it's my understanding that although Carl is right in a
12 sense, that's an important issue. I don't know that even
13 though we're not doing a lot in predictive modeling, we are
14 doing some and we're not far behind, if we're behind at all,
15 of the international countries, because they're looking at us
16 for the same information because nobody has solved the
17 problem yet. Nobody has. And we're perhaps as close as
18 anybody, if we just make the right steps in the right
19 direction and make them now.

20 MR. DYER: Russ Dyer, DOE. I guess I would take issue
21 with that. In fact, just last night I sent a note to Susan
22 about predicting modeling that I was expecting for some
23 things coming up. Before we drill any borehole, I demand a
24 lithostratigraphic log. Before we put in UZ-14 we ask for
25 predictions of where we might encounter water. Those were

1 done. The procedures were in place. We knew what to
2 anticipate. So far I don't think we have gone outside the
3 bounds of our expectations in UZ-14. There are perhaps a
4 variety of physical properties that we might wish to get some
5 prediction on, perhaps a range of values for different units
6 or so forth, and we may try that on a couple of holes. I'm
7 not sure we want to do it for everything but I agree that
8 there needs to be within the program some demonstration of
9 predictive modeling. I don't see how else we can develop a
10 competence in the models that we are using unless we can use
11 them in this way.

12 DR. FLINT: Actually you took issue with what I was
13 saying but what I was saying is we're actually doing a good
14 job. I hope that's not the issue.

15 MR. DYER: No, I didn't take issue with you.

16 DR. FLINT: I do want to point out what happened at UZ-
17 14 and the difference, and we knew there was perched water
18 there. We knew there was water there. That wasn't an issue.
19 We have UZ-1. We knew what the stratigraphy was like
20 because we had UZ-1 there. The difference in what I try to
21 model when I modeled it was that I tried to explain why it
22 was there and looked at why. We did a predictive model of
23 UZ-16 and stratigraphy. We said that there would be a vitric
24 Calico Hills. There was not any vitric Calico Hills at all.
25 We said that we would hit the water table before we hit the

1 Prow Pass. We hit the Prow Pass well before we hit the water
2 table. But the thing was is that the modeling that was done
3 that Russ is talking about for stratigraphy is important. My
4 view is that that predictive model shouldn't be the sample
5 management facility looking at related boreholes. That model
6 should be Rick Spengler's three-dimensional geologic model
7 because that's the one we're going to use for site
8 characterization. That's the one we're going to use for
9 licensing. That's the model we should be testing and running
10 now. His model should predict the unit contacts of the next
11 borehole we drill out there. It's that model and that's how
12 we're really going to find out how things are working, with
13 that model.

14 DR. CORDING: We're going to wrap this part of our
15 session up and go on to some other items.

16 DR. DOMENICO: Domenico. Let me tell you what I think
17 predictive modeling. I think that's fine but when Carl
18 Johnson made everybody aware of the fact that tunnel may
19 penetrate the Tiva I believe it was, nothing really happened.
20 But what could have happened was that you could have taken
21 Ben Ross' model, opened it up and opened up the Tiva and see
22 what would have happened to the pressures. You could have
23 taken anybody's model of air flow in the mountain, imposed
24 that condition and in one day you would be able to address
25 Carl. Say, Carl, you're wrong, or, Carl, you're right.

1 That's predictive modeling. You got a steep hydraulic
2 gradient there. It's very important. Matter of fact, in a
3 letter from the National Academy someone said it was one of
4 the most important issues. I don't believe it's one of the
5 most important issues. I think they said if it's a dam and
6 it busts, you inundate the repository. Everybody's waiting
7 to drill it. Well, I got two students. I give them some of
8 my walk-around money and they model it. We've been able to
9 reproduce that gradient just by doing some modeling and using
10 information that's already available to everybody. So we've
11 been able to reproduce that model a couple of different ways.
12 One way suggested by Bill and the other way with the fault.
13 There's no evidence for a fault. There's a lot of evidence
14 for your suggestion, and we've been able to reproduce it.
15 That's what I mean by predictive model. And like I said, I
16 got walk-around money and I give it to kids to do. So, it's
17 not a question of what I'm going to hit in the field I think.
18 It's a question of asking questions; like my problem that I
19 have with thermal load and the water accumulation, my problem
20 I had with the steep gradient, my problem I had with what
21 would happen to that tunnel. That's predictive modeling and
22 someone's got to take the lead on that, you know, and it's
23 got to be I think a geologist hydrologist in performance
24 assessment because I think that's what it is.

25 DR. CORDING: Just one more on this item. Dwayne

1 Chestnut.

2 MR. CHESTNUT: Lawrence Livermore. I would like to kind
3 of amplify a little bit what Pat was saying because it's
4 occurred to me more and more recently that what models are
5 most good for is helping you ask the right questions that you
6 can go out and test something in the field with some real
7 data. And if the model can help us to formulate three or
8 four different things that we can go out and test in the
9 field like the list of things that Dick had up there about
10 possible explanations for UZ-14. Now, Alan's model may tell
11 us something about the lithologic conditions that allowed
12 that water to perch there, but it still never gets back and
13 answers the question is this drilling water, is it
14 contaminated perched water, is it from the water table, or
15 what have you. And so we need to use the model to define the
16 next experiment that'll help us to tell the difference among
17 those three different alternatives.

18 The other thing on the foreign program, I'm pretty
19 deeply involved in both the Swedish and the Swiss nuclear
20 waste program, I'm on a couple of technical advisory
21 committees, and they're using predictive modeling in a sense
22 of let's do a large-scale site investigation, regional. See
23 what we can determine from surface mapping, aeromagnetic
24 surveys so we make some predictions about what we're going to
25 see on a smaller and more detailed scale. We go get some

1 more data, we see how that works until we finally get down to
2 the one meter scale down in the underground repository. The
3 difference is that they've had the opportunity to conduct a
4 program and get underground in a relatively short period of
5 time and actually start testing some of these models. Now,
6 they can make good predictions of the percentages of the
7 different rock they're going to find in the hundred meters of
8 tunnel; however, it has very little to do with the
9 performance of the repository. It only gives you some
10 confidence that you have some picture of what the geology
11 looks like.

12 Another thing they've been able to do is say we
13 know about where the major fracture zones are going to be,
14 but however, they don't put their construction schedule on
15 the line based on surface mapping of where a fault zone's
16 going to be. They drill ahead of the tunnel face and test it
17 to see what the transmissivity and the pressures are going to
18 be when they get into that zone. So they've got a continuing
19 program with the various levels of detail to test those
20 predictions before they get into it in a situation where
21 they're going to have the Baltic Sea coming--so I think we
22 have to be a little careful about what we're asking of
23 predictive models because I don't think you can predict
24 everything ahead of time.

25 DR. CORDING: Now, I think we're just about--we need to

1 be done. Alan, you just had a quick response to that. If we
2 could end with that.

3 DR. FLINT: Yeah, I'm sorry. What I wanted--my models
4 are not stratigraphic models. The models are hydrologic that
5 explain that it's a perched water body and why and whether
6 you need two-dimensional or three-dimensional models to model
7 it. I'm trying to use more abstractive models to a certain
8 extent to explain the large-scale process. And I'm not
9 talking about necessarily predicting each borehole, although
10 I did say that. I'm talking about having a model that will
11 predict what--we're only going to have a small percentage of
12 the area touched. We need to know by the time we have the
13 last hole drilled that we understand how it happened to be
14 the way it is. I'm looking at a large process, not just
15 lithostratigraphic process.

16 DR. CORDING: Okay. Well, let's go on to another topic
17 that Dwayne Chestnut was referring to: going underground, and
18 I'd like to discuss a little bit this integration between
19 testing and excavation, underground exploration and the
20 excavation process. And we have people that have been
21 involved in the presentations. For example, Dan McKenzie
22 with M&O has been making presentations regarding the
23 underground excavation work and the design aspects of that.
24 And we also have others who haven't been making presentations
25 here and to my left is Dan Koss with REECO and also to his

1 left then is Lance Destalinski from Kiewit-Parsons-
2 Brinkenhoeft and other--and we have Bill Hansmire from Kiewit
3 PB in the audience, and I'm sure there are others here as
4 well. So perhaps we could discuss some of these aspects of
5 the testing of--the excavation process and how we're going to
6 fit this testing into it in a way that we remain efficient in
7 the tunneling and meet the objectives of the exploration
8 program.

9 One of the items has to do with the alcoves,
10 installation of alcoves and then there's some other questions
11 about drilling out ahead of the tunnel boring machine in
12 order to be able to sample faults before the machine gets
13 there. And I think these items can have a very major impact
14 on the construction schedule, and I think the best efforts of
15 everyone are needed to help make it--do it in such a way that
16 it can fit into the construction and you still achieve the
17 testing requirements or testing needs.

18 So I guess going to this question on alcoves, we've
19 talked about--Ned Elkins talked about an alcove, for example,
20 at the Bow Ridge fault, and there may be others that we're
21 going to need--and then talking also about alcoves in order
22 to explore other major faults as you go through the system.
23 Presently how is it envisioned that these excavations will be
24 made and what is it going to do to the construction schedule.
25 I'm not sure which side of the fence--

1 MR. MCKENZIE: I can tell you what we're planning on
2 right now is if we have to put an alcove in it, if it's one
3 that's required, it's as you would imagine, it's sort of
4 brute force. We're going to stop, we're going to take the
5 tubing and the conveyor and the utilities out of the way.
6 We're going to have to shoot as many rounds as we need to
7 shoot to clear the tunnel to get out of the way of it, then
8 we can put the utilities back in and go. So it is a delay.
9 That's why we don't want to build 45 of them or 50 of them on
10 the way around the loop.

11 DR. CORDING: So you cannot maintain the machine
12 progress because you have to take out the utilities, you have
13 to take out the conveyor in order to do that.

14 MR. MCKENZIE: Well, there may be some ways to
15 streamline it but I really don't see any feasible way of
16 doing it without some reasonably substantial delay.

17 DR. CORDING: Lance?

18 MR. DESTALINSKI: Yeah. You know, there are some ways
19 to work around things. There is going to be a delay.
20 There's no question about that. You know, basically all the
21 alcoves are going to be on the opposite side of the conveyor.
22 The conveyor can be protected. I mean, you can make a
23 screen. Basically the fan lines are going to be on the right
24 side, it's going to be very close to the alcove. It probably
25 won't be affected if it is--utilities will go basically

1 above. The big thing is you can't have rail haulage while
2 you're shooting. Now, we can look at schedule-wise of doing
3 things on weekends, going to a seven day a week, still
4 keeping the TBM on fives. There's some things there I think
5 that we really haven't sat down and talked about with the M&O
6 or anybody else. The question is, do you want to go drill
7 and shoot or do you want to go mechanical. In our original
8 proposal to REECO we suggested some mechanical methods that
9 do exist now.

10 The question is, how big an alcove do you need? I
11 mean, if you're talking about eight to ten feet, there are
12 some mechanical methods that can be used that exist at this
13 time, and the question is they are generally expensive. I
14 mean, machines just like any other machines, they're not
15 cheap. And under the current procurement system, they are a
16 long-lead time item. But I think there's a lot of need to
17 sit down and probably sit down with the M&O and the
18 scientific group and work out some things.

19 I think there are some things we can do to minimize
20 the impact. There will be an impact. No question about it.

21 DR. CORDING: If you are stopping the machine and your
22 crews are going on standby and all, what sort of costs are we
23 talking about or what's involved with that?

24 MR. DESTALINSKI: I really can't tell you right--you
25 know, my guess right now, we got some estimates and of course

1 I didn't bring them with me. I think you're talking forty,
2 fifty thousand dollars a day. Here again, my suggestion is
3 if we stop the machines, just don't put the crews on
4 standbys. Let's use our crews to excavate the alcoves.
5 Therefore you may delay the overall project, but you're not
6 impacting total cost. I mean, you got to look at it from--I
7 come from basically a competitive world and hard money
8 contracts, and we're doing quite a bit of work with the super
9 collider things. There are times when we have to do things
10 to slow things down but you look at maximize and minimize
11 your costs, put your people to work and what's the best
12 flexibility, and I think there's some things we can do there.
13 We just got to sit down together and talk about it, work it
14 out.

15 MR. WILLIAMS: Dennis Williams here, DOE. Maybe a
16 perspective on that, I know that Ned has talked a lot about
17 the alcoves that we're going to put in, but I think in large
18 part we're talking about deferrable alcoves. So we aren't
19 dealing with alcoves that are going to be put in and delay
20 the construction of that primary loop. Was I missing the
21 point there, Ned? I mean, this is what we've talked about
22 for two and a half, three years. The deferrability of these
23 major excavations adjacent to the TBM drive. So I guess I
24 appreciate all of our people looking at what we may have to
25 do if we need to go into an alcove and prepare for that, but

1 I don't think there's going to be that many alcoves on this
2 first loop.

3 MR. DESTALINSKI: The statement's been made to me that
4 there most likely will be some, not none. Is that correct?

5 MR. ELKINS: Let me take a shot at this at this point
6 because we have identified preliminarily just based on
7 targets of opportunity and data needs from our underground
8 program, numerous alcoves potentially in the north ramp, the
9 main Topopah Spring drive in south ramp, the total of in
10 excess of forty alcoves that could be constructed. Ongoing
11 early testing and results of testing will dictate ultimately
12 how many of those alcoves we ultimately need, how many of
13 those test locations must truly be tested, because there's a
14 possibility we wouldn't test in every location that
15 preliminarily we've identified. As important as that, and I
16 think what Dennis is going to at, at this angle, is how many
17 of those alcoves have to be put in during the actual time of
18 construction of the main, and during my talks today I tried
19 to at least allude to the fact that the majority of our test
20 program, compared to back to the old shaft days, is already
21 in a deferred mode. And most of our alcove tests are clearly
22 going to be deferred.

23 Some of the ones we're most concerned about is,
24 however, some of our hydrologic response tests, some of the
25 USGS testing. And as hopefully our discussion cleared here

1 today, we can't say with confidence today if all of those
2 alcoves can be deferred. We're trying to get the one alcove
3 in now to answer some early questions on exactly what the
4 impact of some time between construction and testing is and
5 quantify the potential impacts or what we anticipate those
6 impacts to be. We believe that getting a very early start on
7 the next alcove at the Bow Ridge fault to do some similar
8 testing at that anomaly is also very important to us to
9 answer some questions on really the ultimate deferrability of
10 these. However, we think there is a good likelihood that
11 during the construction of the loop there will be some
12 targets of opportunity that the test community feels very
13 strongly we need to accelerate or get an early look at which
14 are going to require an alcove just to get those activities
15 out of the main. And so, it is for a very small percentage
16 of our testing that we ask these questions, but we do believe
17 that the need will be there to, in as streamlined a fashion
18 as possible, integrate a test alcove development with a TBM
19 operation, even though it may only be for three, four or five
20 alcoves during that loop. We believe they're important to
21 take a look at.

22 DR. CORDING: I think that the impression I got in
23 recent months and in the discussion today was that it's going
24 to be more--there's going to be more of these alcoves and
25 more drilling required that would affect or could affect the

1 TBM progress than perhaps I had thought maybe six months ago
2 or a year ago from our discussions. But the discussion of,
3 for example, the fact that you want to look at the borehole--
4 you want to look at the faults before you encounter them with
5 borehole drilling, and that leads you to thinking now when we
6 talk about a fault, what are we talking about? Are we
7 talking about a series of sheers and fractured zones which
8 total up to several hundred feet, or are we talking about
9 having to penetrate those before the TBM arrives, and then
10 recognizing that if one were to try to set up to do that,
11 that the actual drilling of those is slower than--for the
12 most part would be slower than the advance of the machine,
13 and to set an alcove in there you're talking, you know, those
14 sorts of interferences. You could talk about a week or so to
15 even get an alcove in. You know, those things will start to
16 add up and what we--I mean, part of it has to do with how
17 we're defining this as to what is a minor interference and
18 what's--every time we hit a fault that one has to do that.
19 Now, if you had to do these things, you have to do them. But
20 I think it's time now to look at a realistic view of what is
21 there, potentially what is there, how wide are these faults,
22 how much do you have to do to look at them, and how's that
23 going to affect the construction. And we had--I made a
24 suggestion that we consider, for example, with the large
25 tunnel that is there, there's space in that for certain

1 drilling activities behind the machine. Well, you could set
2 up and do drilling, for example, off of a preestablished
3 platform off to the side, for example, to hit a fault, or you
4 could drill ahead of the machine. That requires stopping the
5 machine to do those machines. But one should be set up to do
6 the things that you might have to do and now's the time to
7 take a realistic look at it because you're not set up to do
8 it. It won't happen properly. It will delay the project too
9 much or delay the advance too much.

10 Planning now will help and I think that there's a
11 real concern here. I have a real concern about how much
12 we're really talking about here. I don't think that--I'm
13 hearing several different things as to what this impact could
14 be and what's really a small impact versus large.

15 MR. ELKINS: I think, Ed, that one of the things that I
16 want to amplify on what you've just said is we are talking
17 about two different potential impacts here; one is the
18 construction of an alcove, the second is drilling ahead of
19 the TBM operations for an anticipated feature. Of those two,
20 the one that I think most concerns us in the immediate time
21 frame that we need to really begin to address is the drilling
22 of boreholes in advance of construction. I truly believe
23 there's much greater opportunity for construction impact in
24 that process than there is in the development of alcoves.
25 One is the nature of our test program. The alcoves we

1 believe will allow deferrability better.

2 The real concern that I think we've identified and
3 have begun to work now is just exactly what must we do in
4 terms of advance drilling and how could we perform that
5 advance drilling. Couldn't agree with you more and the DOE
6 has recognized that along with the testing community. We
7 have now got the construction, the subcontractor on board.
8 We got the right people involved, the design group is up, the
9 test community has polarized on the issue, and I assure you
10 that we will be spending a tremendous amount of time with
11 this question of advance drilling in the near future.

12 MR. CHESTNUT: Well, on the subject--Dwayne Chestnut,
13 Lawrence Livermore. On the subject of drilling ahead, might
14 be of interest that, if you're not aware, the hard rock
15 laboratory in Sweden is going to use tunnel boring machine
16 for the last part of their tunnel, for their laboratory. And
17 they, as I understand it, are making provisions to allow
18 drilling ahead of the face. So this should give us some
19 direct field experience with--

20 DR. CORDING: I think there's a lot of experience in the
21 U.S. with this also. I mean, it's not uncommon to drill
22 ahead when you have to take care of water conditions, but it
23 does dramatically slow progress of the machine. And it's
24 something that I think if you're trying to get out ahead and
25 find it, find these conditions, it's just how far are you

1 going to drill. Are you going to drill a hundred feet ahead,
2 two hundred feet ahead? You going to drill ahead every day?
3 If you're doing that, you cut the speed of the machine and
4 the advance rate of the machine at least in half, if not
5 more.

6 I'm pleased that we're going to look carefully at
7 it but I think that the possibility of going in with side
8 drifts where you can then hit the fault on a side drift where
9 you can take time to do those things, take it out of the
10 main--the construction cycle of bringing the main TBM through
11 the facility. Then that would I think do a lot to mitigate
12 some of these impacts.

13 MR. DESTALINSKI: Lance Destalinski with Kiewit. Just,
14 I think, a few things just so the Board does know as far as
15 coordinations and working. There has been a great deal of
16 discussion with the M&O and us and I think we're pretty well
17 in agreement now. One thing we are going to do is go with a
18 double rail system in the tunnel. Now, the reason for this,
19 one, it gives us the versatility of sidetracking, leaving a
20 sidetrack for a drill rig, for access into alcoves. It also
21 would allow us to have a platform drawn on the outside two
22 rails and we'll run on the inside. This double track will
23 basically be a 36 inch gage between all three systems so you
24 can run the center two tracks or you can run double track on
25 the outside. So it gives us a lot of flexibility. The

1 other thing it'll do later on, it'll allow us to run two
2 operations. If we go with an eighteen foot machine later on
3 and want to go drill and shoot or whatever else in
4 development of the main test area, you know, it's a lot safer
5 to run a train system that goes in on one track, comes out on
6 the other. Or, you can basically isolate them to one work
7 area. So those types of things have been talked about.

8 The TBM does have the capability--it has the room right
9 now to mount a drilling system. The drilling system itself
10 has not been procured because of funding. We've been asked
11 do we need the drill. As a contractor, no, I do not need the
12 drill. But if the scientific community wants to put it on,
13 facilities are there to install it.

14 MR. MCKENZIE: The spec was written so that it would
15 house the drill, but the drill itself wasn't bought with the
16 machine. But the ability to mount it on there is there.

17 DR. CORDING: With a double track system, then, you can
18 be putting some sort of a--as you point out, you can put a
19 drill or a platform back where that could be operating even
20 while you operate your machine.

21 MR. DESTALINSKI: Correct. Yes. And it still gives us
22 the--it could either go around it, you can set it on one side
23 or the other if they want to drill, say, the--we could set it
24 up or we can build a platform--basically another gantry that
25 ran on the outside rails and we'd go between them. So it

1 does give us quite a bit of versatility and not only from a
2 pure construction point of view but as far as supporting the
3 scientific community.

4 DR. CORDING: Seemed to me that would allow reduction in
5 the number of alcoves and you could do that for some of these
6 radial borehole tests, for example, without having to put
7 alcoves in. If you had to do those, you know, in the process
8 of advancing the main TBM, or perhaps even later when one is
9 doing other activities after you've gotten through the loop.

10 MR. DESTALINSKI: It's a possibility. We just have to
11 look at the space available when it gets down to planning
12 things.

13 DR. CORDING: Okay. Fine.

14 Other comments from the testing group here on what
15 you see with these impacts or what you need?

16 MR. LeCAIN: If I could--Gary LeCain, USGS. A lot of
17 the use of the alcove is because there has to be a field crew
18 in there assembling equipment and putting it into the
19 boreholes. Somebody would have to show me some details on
20 how that could be done without an alcove before I think we
21 could agree to anything like that.

22 DR. CORDING: Perhaps a dedicated platform that's got a
23 door on it or something.

24 MR. LeCAIN: As long as the crew's safe.

1 DR. CORDING: Okay.

2 MR. DESTALINSKI: Yeah. Bring up another, I guess, one
3 of our sore points between Dan and I. We've been pushing a
4 great deal for the use of diesel locomotives and
5 transportation systems. Right now we're basically kind of
6 being told we have to go with the trolley system. And once
7 we put that trolley wire system up, it does limit access up
8 into the top of the tunnel. It also creates a safety
9 problem.

10 As far as the mining operations and that, we have
11 no problem safety-wise with our people in dealing with
12 trolleys. It's not common in civilian construction but it
13 sure is in mining. We've had the opportunity to visit the
14 mine and talk to people that use it, and I think a lot of my
15 concerns about the safety have gone away. But it does limit
16 your ability to use the tunnel behind you to a great deal.
17 Right now we're looking at probably the trolley system being
18 1,500 feet behind the TBM trailing gear so that's, say, 2,000
19 feet from the face. But there's another question in--this
20 whole question of diesel use underground I know is one that
21 is serious to a lot of people. I don't totally understand it
22 and why not, and that has never been explained to us.

23 DR. CORDING: In terms of your ability to control the
24 diesel and scrubbers and those sorts of things, what can you
25 do in that regard?

1 MR. DESTALINSKI: Well, basically, I mean, diesel
2 locomotives are common tools in every mining civil
3 construction project in this country. I mean, basically the
4 scrubbers and that are basically controlled by the Bureau of
5 Mines. People adapt to that. Ventilation becomes a key
6 point of view but here, you know, the ventilation is--what
7 they have is very significant. They've taken a very
8 conservative attitude about it and I have no problem with
9 that. I think it's more than adequate for the uses we do
10 need. But that becomes a question. If you want the
11 versatility, you sometimes have to give up something else.
12 And if we wanted to give the community access behind us, the
13 work platforms, we can do those kind of things. But once you
14 put the trolley in, we're going to somewhat limit ourselves.

15 MR. MCKENZIE: The use of diesel or lack of the use of
16 diesel is thrust on us, like he said, by performance
17 assessment. A preliminary evaluation what they did which
18 said that carbon accumulations, soot and whatnot, are a bad
19 thing. And that trolley locomotives, trolley electric would
20 fix that situation. The evaluation that they did was pretty
21 preliminary and they didn't use any kind of scrubber. They
22 assumed the output of soot and whatnot from an engine, a well
23 tuned engine but one that had no ceramic filter or no
24 scrubber or anything on it. So it was a pretty rigorous
25 treatment, but nonetheless, we are building a laboratory and

1 with the ultimate goal that the site is suitable building a
2 repository and we don't want to do something that's going to
3 ultimately cause a early corrosion of the waste packages
4 which is apparently the concern, the carbon and what it does.
5 But I don't know if we have anybody here that can really
6 address the how and why of how the study was done.

7 DR. CORDING: We've had discussions on some of the
8 effects of organics and colloidal transport and all, and so
9 there's been discussion on that and I think the question
10 would be how much of an impact this is.

11 DR. NORTH: The issue is mobilization of radionuclide
12 transport. If your radionuclides will complex with organic
13 materials and that allows them to migrate many orders of
14 magnitude faster than they would in the absence of the
15 organics, that becomes an important issue. And how
16 significant it is I think is something where you want a
17 calculation, bring in performance assessment and let's test
18 hypotheses. But I think it would be very unwise for the
19 program to go about making this kind of a decision without
20 doing that analysis. So there's a task for a few more
21 performance assessment people.

22 MR. FRIANT: Okay. Jim Friant. I was thinking the
23 Board might be interested in a little bit of the work that we
24 have done recently at Colorado School of Mines on this alcove
25 subject. We just submitted a little final report on a study

1 of--one of the things in many of the writings that we're all
2 working to, CFR 60, look at all the technologies, and so we
3 looked at mechanical techniques of cutting an alcove. What's
4 on the market now looks like a road header, but to get one
5 that's powerful enough is 40 feet long, pretty tough to put
6 that in a 25 foot tunnel. And Robbins has a thing called a
7 mobile miner which weighs 324 tons, not exactly my definition
8 of mobile. And Wirth has one that's a relative lightweight.
9 It's only about 200 tons and it does a unique technique of
10 cutting. Now, you know, our marching orders were to stick
11 with existing technology, but what we did find was a parallel
12 program going on in the micro tunneling field that utilizes a
13 very small but high capacity disc cutter. I almost think
14 it's kind of funny because what was discovered was a steak
15 knife works better than a butter knife on a tough piece of
16 meat. This is a little cutter and it's very sharp and it--we
17 tested it against the standard cutters. It takes about one-
18 fifth of the pressure. This gave us the idea that, okay, if
19 we use those kinds of cutters, we can get the forces we need
20 to cut this TSw₂ and that relates back to the chassis size.
21 So I had only about a 50/50 feeling that this might be
22 successful and I'm quite encouraged at this time. The
23 machine looks quite feasible. We went through a concept
24 study and to keep the power low we kept only about 120
25 horsepower on this machine. It looks like it would weigh

1 about 25 tons. I'm talking about machinery and I really
2 shouldn't because what we did was look at what the rock wants
3 first. We looked at a cutter head and fortunately this
4 testing was going on in the micro tunneling area, so we were
5 to take that actual data and apply it to a small machine and
6 how the cutter head should be held against the rock. And
7 then all we did was look at what kind of a chassis would hold
8 that cutter head up against the rock the way the rock wants
9 it to be held there. And at any rate, this does use the
10 outside of the four track system. It would appear that one
11 shift would clear the tracks. Again, just something that
12 Lance mentioned, you have the option. We clog up one side,
13 one set of tracks but the machinery, the little train that
14 brings this--would bring this thing down would come down on
15 the outside of the four rails and as soon as it's in six
16 feet, one of the tracks then is clear. This thing functions
17 as a bridge and the supply train could go up the ramp,
18 through the train and down the other side. So you would
19 establish one-way traffic. You don't have to take the
20 conveyers down. You don't mess with the trolley wires. You
21 don't have to take the ventilation tube down. It really
22 looks encouraging. I'm sure there will be more briefings on
23 this. Like I say, we only delivered this report a day ago.

24 DR. CORDING: Thank you, Jim. It sounds interesting.

25 Yes, Dale?

1 MR. WILDER: Dale Wilder, Lawrence Livermore. I just
2 wanted to follow up very quickly on the question about diesel
3 and so forth and let you know that there is an ongoing study
4 of diesel. Unfortunately we have not been able to look at
5 exhaust, which is the issue that was being discussed. But
6 certainly the diesel fuel itself is being studied. The
7 question of course will be will those studies be completed in
8 time to really be of value in making decisions on
9 construction methods. But there is a man-made material study
10 going on right now which is looking at the diesel fuel and
11 its potential for breaking down in the water.

12 MR. CANTLON: John Cantlon. Let me follow up with that.
13 Is that study going to look at an option where you might use
14 diesel during construction and then switch over to trolley
15 during the operating phase?

16 MR. WILDER: Well, this study is really a scientific
17 study looking at what happens to diesel long term in terms of
18 can we provide a feedstock, if you will, for the organic
19 materials for the biological degradation, so forth, that
20 could either create the colloids for complexing or the
21 corrosion mechanisms. It is not looking at specific
22 construction options, just trying to get a handle on what are
23 the impacts of the diesel.

24 MR. KOSS: I understand you to say that you're looking
25 at just the diesel fuel aspect of it and not diesel exhaust

1 issues?

2 MR. WILDER: That's correct. There is no study
3 currently funded to look at diesel exhaust.

4 MR. NELSON: Just for information. I'm sorry that Jim
5 House, the one who is doing this analysis and also working
6 rather closely with the studies that are being done here,
7 isn't here. We didn't realize that these kind of questions
8 would come up or Jim could have been here and given you much
9 better background for it.

10 DR. CORDING: I think it sounds like another area for
11 interaction in terms of what the construction people think
12 will be produced there and what the science side can say
13 regarding its effect.

14 One other question for the constructors here
15 regarding the schedule for the main loop. It's something on
16 the order of what, twenty months or something? I'm not quite
17 sure of the exact time. Twenty-two months. I just wanted
18 to--just maybe a summary of what the assumptions are there in
19 terms of advance rates, machine utilization and then the down
20 time for the testing.

21 MR. DESTALINSKI: Yeah. We were involved in kind of
22 putting together that schedule that was shown. The
23 assumptions were, one, that we would spend about 25 to 30
24 weeks in initially getting the machine broken in. And that's
25 over really about the first thousand meters of tunnel, a

1 little over 3,000 feet. That was based on really our
2 experiences with a Robbins machine in Boston and also looking
3 at some of the English Channel break-ins with double--for the
4 rest of the north ramp basically we based our production on
5 working three shifts a day, basically taking the day shift
6 for maintenance. The maintenance here is heightened because
7 of the leak mitigation requirements on the machine and with
8 our crew, so there's a greater deal of break-in. Also
9 basically the scientific community, the day shift, to do the
10 photography work. Basically by the time we get to the bottom
11 of the ramp, we think we should have a pretty good working
12 team. They will up that production to twenty hours a day,
13 basically go four hours for maintenance and photography work.
14 If we look at a 50% to 60% utilization, which is high for
15 TBM. Now, we're getting those kind of utilizations in Texas
16 on the super collider in Austin chalk material, which is a
17 lot softer than this but with conveyor systems. Then you're
18 looking at something like 350 feet a week for the sixteen
19 hours working and about 407 feet a day for the twenty hours.
20 So you got about eighteen months worth of work. We put a
21 15% programmatic delay in our estimate and at this point
22 that's a guess. It would seem to be a reasonable agreement
23 with all the parties that that seemed like a reasonable
24 assumption to make at this time. So that's where the 22
25 months came from.

1 DR. CORDING: Thank you. I guess I'd like to turn to
2 one series of questions here regarding how the thermal test
3 program can fit into this excavation of the main loop. I
4 know there was some discussion of the possibility that the
5 thermal testing--different ways of trying to get the thermal
6 testing started before the main loop was completed, and I
7 think Ned referred to a couple of points on that. And then
8 Dale's been thinking about it. Maybe we could have a little
9 discussion of just what might be done, what is going to be
10 considered regarding fielding a major thermal testing effort,
11 recognizing that it looks like it's four years away if you
12 wait until the main loop is done and then build the
13 underground core test area.

14 MR. ELKINS: This is Ned Elkins, Los Alamos. I'm not
15 sure that Lance and Dan were here during the part of the
16 discussion earlier where we at least laid out a couple of
17 things that we need to be looking at, and maybe if I can
18 reiterate those, Ed, it would allow them something to wade
19 into a little bit for us.

20 The two things I mentioned is one is an ongoing
21 uncertainty regarding multiple operations or multiple heading
22 work around the operational constraints that we're going to
23 have, ventilation constraints. The question of whether or
24 not we can start development of an area which would
25 facilitate thermal testing prior to construction of the loop

1 strictly from OSHA, MSHA or Cal tunneling safety
2 considerations or operational constraints continues to be
3 something that we look at and we work towards, but I don't
4 know that we've made a definitive answer yet and maybe Lance
5 especially, with your coming on board, you may have some very
6 specific feelings on that, the ability to get an early start
7 on thermal testing just by being able to prepare an area
8 before or during the process of that loop.

9 The second thing that I mentioned today was the
10 currently proposed revision of the configuration that we're
11 looking at which has north and south ramp extensions that
12 drop through the horizon at TSw₂ off of the currently defined
13 block. We see those as opportunities to take a look at a
14 thermal test program or in situ test program outside of a
15 core test area and perhaps accelerate to some degree our
16 ability to get those tests started just by utilization of
17 some of these excavations that have not been in previous
18 plans. And with those, perhaps maybe you might want to
19 respond or at least give us some information or insight.

20 DR. CORDING: Lance?

21 MR. DESTALINKSI: As far as, you know, going to multiple
22 operations, really it's built into the design. The
23 ventilation is based on multiple operations. The conveyor
24 system is actually based on three operations. There would be
25 some delay but the delay is really just getting yourself in

1 to where you could have an operation run, and that's probably
2 a reasonable delay for the project. I mean, if we can get
3 something else going, we can run a lot of things with the
4 same overhead, it helps on the cost. And it makes it much
5 more effective to do it. It's probably something we have to
6 look at. But if you say we had to shut down the TBM for a
7 month to get a major area open from you and we can use those
8 people to do that work, to me it seems a reasonable thing to
9 do.

10 MR. MCKENZIE: It's certainly not illegal. When we fall
11 back on MSHA, we talk about having two means of ingress and
12 egress. Since this is not a mine and that regulation is kind
13 of gray anyway, there is no legal requirement that really
14 drives us to say that we have to hole out the south portal
15 before we could start another excavation operation. We tend
16 to veer toward the conservative and in this case--guys going
17 to get tired of hearing this, but the funding level doesn't
18 support mobile operations at this point anyway. So we intend
19 to drive the loop pretty much as we stated earlier. If the
20 resources were available, it certainly would be doable to get
21 an early start into the main test area. It would probably
22 enhance the heater test starting date quite a lot.

23 DR. CORDING: One of the things that I've been concerned
24 with is the core test area or the heater test area excavation
25 technique, and just seems to me that in order to properly

1 characterize particularly the near-field conditions around
2 the tunnel, that you need to be using an excavator, a TBM,
3 full face TBM as an excavator of that. And what's the
4 current status of the layout of the core test area and the
5 type of excavation that's being planned for it?

6 MR. KCKENZIE: Okay. Right now the main test area still
7 looks like it did in Title I, which I'm sure you've seen, and
8 it was laid out and the concept of being excavated by a
9 mobile miner, which Mr. Friant described to us as not very
10 mobile and not much of a miner either. But there's only been
11 I think three or four of them built and they haven't gotten
12 progressively better. So right now we're between a rock and
13 a hard place on how to do the MTA. If we want an MTA core
14 area like we had before, the concept, we have to either come
15 up with something, as you say, a TBM that can turn much, much
16 sharper than you think of classically of a TBM turning, or we
17 have to go drill and blast or some more exotic probably disc
18 cutter based technology. There aren't a lot of choices. But
19 the main test area is not due to be designed this year and
20 there's only just a little bit of work next year, FY '95.

21 DR. CORDING: We had some of the consultants that were
22 involved in the November meeting who laid out some plans
23 using short radius TBMs and backing and doing that for a core
24 test. Certainly you reorganize it so you don't put as many
25 cross-drifts in or use limited drill and blast for cross-

1 drifts or something like that. I'm certain there are ways to
2 handle that with current technology. But it does seem that
3 if you look at the funding situation, that the way it's
4 presently planned, that you won't have the opportunity to
5 start another tunnel boring machine into the project at that
6 time.

7 MR. MCKENZIE: That's probably true, but it depends
8 again on which funding scenario you see and it seems like we
9 see two or three a day, and on the revolving fund scenario
10 there would be quite a lot of money available to the SF.
11 Stop me if you heard this before. There's always going to be
12 more money next year. In that case, we would be able to
13 place the order probably next year and avoid a gap basically
14 in excavation once we daylight the south portal. But again,
15 it's totally driven by resources.

16 DR. CORDING: I think one question I had in regard to
17 acquisition of tunnel boring machines, and I'd like some
18 comment here on that, is discussion of very long lead times
19 to acquire machines. In my experience, and for many people
20 in the construction industry, is that a contractor basically
21 provides a machine and that his acquisition is strictly the
22 time it takes for him to order the machine and have it
23 fabricated or rebuilt if he's using a used machine, and that
24 period is something on the order for standard type machines
25 is on the other--well, it's less than a year. And I'm

1 wondering if that type of approach is going to be used or
2 some approach can be used where these very long lead times on
3 acquisition would not be required.

4 MR. MCKENZIE: I'm not an expert in the--I'm not sure
5 what the DOE's position would be on a contractor procured
6 machine. I'm not sure there would be a whole lot of
7 difference in terms of being a large procurement. REECO
8 actually buys the machines now. REECO bought the TBM and
9 they're a contractor and you had a lot of hoops to jump
10 through I know in that procurement. So I'm not sure there
11 would be a lot of difference if we sent Kiewit out to buy one
12 as opposed to us buying one.

13 MR. KOSS: A machine might be available from Kiewit on a
14 smaller diameter. We're talking an eighteen foot, say for
15 example.

16 MR. DESTALINSKI: Yeah, we currently have two of them in
17 Texas that could run at eighteen feet.

18 MR. MCKENZIE: I understand they may be available soon
19 too.

20 MR. DESTALINSKI: That could be. It dawned on me here.
21 We got the bad news yesterday. The House voted against the
22 super collider. Right now it's about a 50/50 chance if the
23 Senate wants to tell the House kind of to go fly a kite and
24 then not pass the bill, then it'll continue. If not, DOE may
25 own four mining machines here in about three weeks. Maybe we

1 can get one of them transferred, simplify our problems.

2 DR. CORDING: I mean, there's a lot of ways of acquiring
3 equipment in various public works and federal projects, and I
4 would think that's an area that could be looked at here in
5 terms of providing things so that certainly--I was somewhat
6 disturbed to see a delay in a schedule I think of a year or
7 something to acquire an eighteen foot machine which would
8 mean that it didn't get into the project a year after the
9 main loop had been excavated.

10 MR. MCKENZIE: That was based on a fairly flat funding
11 scenario, something where the money doesn't increase
12 materially at all over the next four or five years. But
13 yeah, that's the--

14 DR. CORDING: How much money do you need to buy a TBM?
15 It's a small percentage of this project funding.

16 MR. MCKENZIE: The last one was I think 12.7. The next
17 one presumably will be smaller and therefore cheaper.

18 MR. DESTALINSKI: I think you're looking, you know, at
19 probably six or seven million dollars for a new one. You're
20 looking at a used one. But there seems to be problems in
21 buying used equipment under the government procurement
22 system. You know, you're looking at probably under two to
23 three million dollars, you know, ready to work under the
24 criteria you need here.

25 DR. CORDING: Rent the machine to the government.

1 MR. DESTALINSKI: That's a possibility. I mean, that's
2 something we haven't pursued. We got into a discussion last
3 week and we've basically been in an estimating process with
4 DOE here and schedules for about the last three weeks of
5 going through alternatives, you know, based on, one, their
6 funding, and based on, you know, what can we do next year.
7 And there's about three different scenarios. The question
8 was about some equipment, could we actually rent it, and the
9 answer has come back yes, that it can be. Those things can
10 be done. And that's a possibility, that we could basically
11 lease a machine. We do own one that's run at 16.4 right now
12 and it's run at 20 foot 4. It's got the horsepower to do it
13 basically, particularly for the Calico Hills. And there's a
14 lot of scenarios there to look at; new, used, machines we
15 own, machines other people own.

16 DR. CORDING: Other questions on these topics? We've
17 run out of time. Is there any other pressing comment that
18 people want to make and have been prevented from making over
19 the last few days?

20 Yes, Dale?

21 MR. WILDER: If I could just make two quick comments.
22 First is, you'd asked earlier in this session about the
23 schedule for our thermal testing, and I don't know what all
24 the work rounds may end up being, but my only comment would
25 be that if we do experience the kind of slip that was being

1 at least discussed as a possibility, I think we recognize
2 that either one of two things are going to happen. Either
3 we're not going to have the thermal testing completed in time
4 for license application unless the license application slips
5 a comparable amount, or the license application's going to
6 have to proceed at a higher risk without the information.

7 The second comment I was going to make is relative
8 to the question about drill and blast versus a tunnel boring
9 machine in our main test area. Right now, as Dwayne
10 mentioned, the project in Äspö, the hard rock laboratory is
11 going to be looking at trying to make a comparison between
12 the drill and blast versus the tunneling boring machine.
13 Admittedly that's in granite. It's not in welded tuff but
14 the concern that I have with that right now is that they're
15 looking strictly at the geomechanical kinds of impacts.
16 We're trying to work through the international agreement to
17 see if we can encourage them to also look at the hydrologic
18 impacts, and that might give us some information to help make
19 a decision whether it's critical to go tunnel boring machine
20 versus a drill and blast. And I certainly think that that
21 would be a way for us to start to progress, and I would
22 encourage that kind of international cooperation.

23 DR. CORDING: I don't think there's any doubt that the
24 geomechanical effects will be very severe. We're trying to
25 understand what's happening, you know, to the stability and

1 stresses around an opening that's shaped with a drill and
2 blast excavation compared to one that's excavated with a TBM.
3 It's two different worlds. That's one of the perspectives I
4 have on that.

5 Well, we're beyond being out of time and John
6 Cantlon is anxious to close the meeting.

7 DR. CANTLON: Well, I think this has been an extremely
8 interesting and profitable two days certainly for the Board
9 and I hope for other participants. We've had a great deal of
10 very candid exchange. I think one of the virtues of having
11 this discussion session after the formal presentations is
12 that our ability really to put our own political and other
13 kinds of constraints behind us and really sit down and deal
14 with the facts as we perceive them to be in very candid ways
15 is a very useful way to advance this very, very complicated
16 and challenging session and topic.

17 When we set this session up, there was--and this
18 was almost a year--well, it was a year ago, there was a
19 perception of a considerable amount of competition between
20 surface-based testing and the ESF, and we felt that that
21 issue needed to be in a sense aired in a kind of public
22 setting. I think I was comforted to see that at least
23 internally within DOE and its contractors, the intensity of
24 that perception is diminishing. It has disappeared obviously
25 because we're dealing with a zero sum gain, and when you're

1 dealing with the intensity of the budget constraint that this
2 program has been under almost from its beginning, there
3 clearly is going to be this problem. But at least it's in a
4 sense driving better integration I think internally within
5 DOE and with its contractors.

6 On top of that set of issues that led us to set up
7 this session, we put in the later emerging question of the
8 pneumatic properties of the mountain and the interplay
9 between the ESF program and the ability to characterize the
10 natural pneumatic characteristics of the mountain. I think
11 that set of issues got aired in a very candid way and a very
12 useful way. I wouldn't summarize the session to say that
13 everybody came away of one mind about it. On the other hand,
14 I think everybody understands what the level of hard data are
15 on that set of questions and what we need to do to move
16 ahead. There are differences of opinion about how much needs
17 to be done and that's intrinsic to any budget constraint
18 program.

19 I think Larry Hayes' assessment that the Board
20 meetings are generally unproductive, the Board certainly does
21 not share Larry's view in that. I think we could document in
22 many ways real products that this interaction has generated.
23 On the other hand, we don't have time to engage in that. I
24 think that Dennis Williams' statement following up on that,
25 that there probably are ways that we can make these sessions

1 more productive, and I think we should all of us put our
2 minds to that.

3 The sessions today on the planned underground
4 testing program have also been I think illuminating. It's
5 clear that the prioritization and the queuing process is
6 moving ahead, and again, the constraint of inadequate funds
7 does much to order one's mind like being told you're going to
8 be hung in the morning.

9 The Board has, however, continuing concerns that
10 the integration in such a diverse and far-flung population of
11 researches, both research organizations and research
12 individuals, continues to need attention. I think the
13 interchange that we had here this afternoon between Jean
14 Younker and Alan Flint is sort of symptomatic of the
15 realities that exist in projects of this level of complexity,
16 and I talk about that in terms of the technical and
17 scientific complexity. But on top of that, you researchers
18 have to appreciate the fact that the people who are running
19 it at the top live in a much more complicated world of
20 budgets and politics and regulation and so on that the
21 individual researchers really don't have to deal with on a
22 day to day basis. And so, you've got to be a little bit
23 patient with the kind of world that this kind of a project
24 runs in. And I say that with some feeling because for twenty
25 years I was in Central Administration and listened to faculty

1 bitching day in and day out.

2 DR. FLINT: Does that mean I'm going to get hung in the
3 morning?

4 DR. CANTLON: I was threatened several times. I think
5 this afternoon here, while we're looking at this interplay
6 between the challenge of doing the construction of the
7 project, which is a fairly substantial construction project,
8 and the interplay between that and the R&D that has to get
9 done in it, and ways in which we can all of us think of
10 opportunities to optimize those two again very different
11 challenges, how do you move a construction project ahead
12 efficiently and competitively so that Congress, when they
13 look at cost per foot advance, don't blanch and have heart
14 failure or budgeteese or whatever it is they get. We do need
15 to look at how to make that process as efficient as we
16 possibly can. But again, these are important exchanges.

17 I think that Tom Statton's fish hooks and sausages
18 synthesis addresses the issue of integration, coordination, a
19 sense of real coherence that the project isn't drifting, and
20 that's not a very singly held view. There are a lot of
21 people both in Congress and in the public that don't really
22 understand, A, the complexity of the program both technically
23 and scientifically and politically, but then, you know, \$6
24 billion to ask whether or not the place is useful or not
25 isn't a small number. So one can understand the unease. So

1 I think anything that can be done, as Tom's diagrams and his
2 very lucid presentation of the way in which the challenge of
3 integration--anything that moves that challenge ahead is to
4 everybody's advantage. And communicating with external
5 bodies like the Board is one thing, but as you could see here
6 this afternoon, you got an internal problem that is equally
7 challenging.

8 We also had a presentation by NRC in explaining the
9 QA and QC aspects of the deficiencies that they saw in the
10 M&O ESF design efforts, and that I think is illustrative of
11 another aspect of this very important project that we're all
12 concerned about. Recall that the U.S., as contrasted really
13 with all of the other nuclear countries in the world, has the
14 most detailed regulatory framework that exists. DOE did not
15 do itself any favors when it then established internally how
16 it would cope with that. They actually I think have
17 complicated the way in which that process moves ahead. We're
18 now apparently frozen in what is a massive bureaucratic
19 exchange, regulatory exchange, which has an extremely high
20 infrastructure and overhead burden on this whole project
21 dealing with detailed QA and QC of an emerging, changing
22 conceptual design. You know, it's like having multiple
23 auditors looking at every sketch that an inventor makes
24 before you ever get to manufacturing the damn thing. So we
25 have really shot ourselves in the foot in this country for

1 the nuclear program, in the nuclear waste program in many
2 kinds of ways.

3 Now, right at the moment the academy is looking at
4 the technical and scientific basis of the regulation, and it
5 may well be that the climate is right to ask the question,
6 are we forever trapped in this bureaucratic grinding which
7 isn't really paying off in any kind of way except for the
8 people that don't want to see the program go ahead anyway?
9 They're perfectly delighted to see its cost escalate, and
10 it's scheduled to disappear off into the distant future. So
11 I think there is that possibility. I'm not optimistic but I
12 just raise it as one of the interesting things that came into
13 my mind as I listened to this program today.

14 Let me then close by expressing thanks to all of
15 the investigators and the project directors, the
16 administrators, both within DOE, NRC, the various
17 contractors, the State of Nevada, the affected parties, all
18 of who are here and I think contributed to this. I like the
19 level of candor and I do think unlike Larry Flint--or Larry
20 Hayes--sorry about that. It's a helpful hybrid. I do think
21 that these sessions are useful and I thank you very much on
22 behalf of the Board.

23 We're adjourned.

24 DR. NORTH: John, before we adjourn completely, it
25 might be useful to have an announcement from Russ Dyer,

1 something I learned at the coffee break. The CASEY meeting
2 which I think many of us had planned to attend in Pleasanton
3 on the 9th and 10th of November is postponed until February?

4 MR. DYER: Yes. Right now what we're looking at is a
5 program-wide technical review. I can't remember the exact
6 dates. It's at the Stardust. Do you happen to know when it
7 is, Tom? The 8th through the 12th? Approximately that
8 second week in February. And we'll be getting out
9 information to everybody here in the next week or so.

10 (Whereupon, the above-entitled matter was adjourned
11 at 4:15 p.m. on October 20, 1993.)

12

13