UNITED STATES DEPARTMENT OF ENERGY

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NUCLEAR WASTE TECHNICAL REVIEW BOARD

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MEETING OF THE PANEL ON
STRUCTURAL GEOLOGY AND GEOENGINEERING

Stouffer Concourse Hotel
Meeting Room - James
(Lobby Level)
2399 Jefferson Davis Highway
Arlington, Virginia

Monday, July 15, 1991

The above-entitled proceedings commenced at 8:39 o'clock a.m., pursuant to notice, Dr. Don U. Deere, Chairman of the NWTRB, presiding.

PARTICIPANTS:

DON U. DEERE, Chairman of the NWTRB
CLARENCE R. ALLEN, Member of the NWTRB
JOHN E. CANTLON, Member of the NWTRB
D. WARNER NORTH, Member of the NWTRB
DENNIS L. PRICE, Member of the NWTRB
WILLIAM D. BARNARD, Executive Director, NWTRB
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SHERWOOD C. CHU, Senior Professional Staff, NWTRB
EDWARD CORDING, Consultant to the NWTRB
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EDGAR PETRIE, DOE
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WILLIAM LEMESHEWSKY, DOE
MICHAEL DUFFY, Battelle Energy Systems Group
FRANK RIDOLPHI, TRW

I N D E X

P R O C E E D I N G S

[8:39 a.m.]

INTRODUCTION

DR. DEERE: Good morning, ladies and gentlemen.

I am Don Deere, Chairman of the Nuclear Waste Technical Review Board.

Welcome to the first day's meeting of a series of meetings associated with the Technical Review Board's Summer Meeting.

Today's meeting is sponsored by the Panel on Structural Geology and Geoengineering.

The presentations will be made by DOE. Two topics will be covered.

One, the status of the design work for the Exploratory Studies Facility. You will recall, we have had a series of meetings over the past year, year and a half, as these studies have progressed through their various stages. This will be an update as to where they are at the moment and what is coming up in the next few months.

And number two is the explanation for us, in considerable detail, of the MSIS, that is, the Management Systems Improvement Strategy.

Now, I will introduce the Chairman of the Panel on Structural Geology and Geoengineering, Dr. Clarence Allen, who will have a few words to say, and will introduce the various Members of our Board and staff that are present.

I would remind you that the microphones that the speakers have, or that we have on the front table, you must activate by pushing the little button down, and when it turns red, the mike is alive. When you get through with your question or your comments, be sure you turn it back off again.

The other microphone, which is for the audience, when they have occasion to use it, it's live all the time, so you can go ahead and use it directly.

So, Clarence, I will turn the meeting over to you as Chairman of the Panel.

DR. ALLEN: Thank you, Don.

As Chairman of the Panel, let me welcome you here, and let me introduce the other Members of the Board who are present, in addition to Don Deere and myself.

Dr. Dennis Price; Dr. Warner North; Dr. John Cantlon. I guess that's the Board Members present.

Also present is the Executive Director of the Board, Dr. William Barnard. And we have with us, of our Senior Staff Members, Russell McFarland. I guess Woody Chu will be along. And Leon Reiter is sitting back here in the first row, for some reason.

And then we have a couple of consultants, Dr. Edward Cording and Wolter Fabrycky.

Have I forgotten anyone?

Okay. I think without further ado, we will proceed with the program.

Ted, are you going to be in charge for the DOE? Let me turn it over to you.

EXPLORATORY STUDIES FACILITY (ESF) DESIGN STATUS
OPENING REMARKS

[Slide.]

MR. PETRIE: My name is Ted Petrie. I'm the Acting Director for Engineering and Development at the Yucca Mountain Site Characterization Project, Las Vegas.

I see on the agenda that I have 15 minutes to start and 15 minutes a couple hours from now. I'll probably take a little bit more than that at the beginning, and a little bit less at the end, if that's all right.

I guess nobody has a problem. I don't hear anything.

[Slide.]

MR. PETRIE: Today we have just had a partial design review, partial review of our design studies, leading into what the Department calls Title II design. And what I thought I would do is to first tell you a little bit about what's happened over the last six months, really over the last three months, and then give you a little summary of where we were two years from now, and where we are now.

At that point, then, Dick Bullock will pick it up and speak a little bit about the review itself, and then Bruce Stanley will talk a little about that. And then Dwight Shelor will pick up later on with the MSIS activities.

The design chronology. In January of 1991 -- the findings were completed not in 1990 but in 1991. OGD presented the findings to Dr. Bartlett on January 14th, and we were directed to initiate design studies, focusing on the favorable features of the highest-ranked options. You may recall what that was all about.

[Slide.]

MR. PETRIE: We were given guidance as to how to proceed focusing on the favorable features of the highest ranked ESF alternatives. As you recall, they were like 34 different options we were looking at at that time. Directions to proceed with the design study based on the latest information we had, plus of course, whatever other information we might have had. The alternative studies, the Calico Hills study and provide the flexibility to penetrate the Calico Hills as early as we could. And to prepare plans for our phased approach to design, that is, how many various integrated steps or systematic steps in the construction zone process.

[Slide.]

MR. PETRIE: Okay, and just quickly, where we've been, where we are and where we intend to go.

[Slide.]

MR. PETRIE: Our present baseline configuration consists of two 12-foot shafts. They are both excavated to the Topopah Spring level. They are both 12 foot in diameter and they're about 1,000 feet deep. So that's in our present baseline. That's what we had two years ago when we started to reconsider what we should be doing.

[Slide.]

MR. PETRIE: This is an isometric of that, of the baseline. Things I would like for you to notice on that is that the -- well, it consists of the two shafts in here, a couple of MPBHs or bore holes, multipurpose bore holes, the test level is as indicated here. There was a modest amount of drifting to the three faults. All in the Topopah Springs level. And those are the major issues that we would like to note in this, where we were -- well, where we are really today. That's still our baseline as of this minute. [Slide.]

MR. PETRIE: In those drifts I just mentioned, and the main test area drifts consist of about 9,000 total feet of drifting.

[Slide.]

MR. PETRIE: The reference design concept that we are working on at the moment, preparing for the start of Title Two, currently has two 25 foot diameter ramps, two 16 -- that go from the surface to the Topopah Springs, two 16 foot diameter ramps down to the Calico Hills, and one 16 foot diameter shaft, which is an optional item. And the expanded acreage for the testing facilities and expanded acreage for the surface facilities because of the greater distance between the portals and in fact there's now two portals.

[Slide.]

MR. PETRIE: This is the reference design concept and you can quickly compare this to the one I just showed you, which was our present baseline. Obviously the two portals, here and here, the two 25-foot ramps, two 16-foot ramps into the Calico Hills, access to the fault zone in both the Topopah Springs and Calico Hills area, and the optional shaft indicator over here. And this is the MTL, the main test level at this point. You can see some of the substantial difference between what we had in our present baseline and what we are talking about today.

Let me just indicate the phases while I've got that up there. The phases we talked about are these elements labelled one, two, three, four, five, here and so on. Those would be the phase design construction elements of the exploratory studies facility. Plot being that you would do one, two, three or four of those phases, evaluate where you are as you did those phases, and then proceed on as you found out that things were suitable, or whatever you found.

[Slide.]

MR. PETRIE: And just some titles on them. The next page indicates the titles of those phases, and I won't go through those. You can just read those at your leisure.

[Slide.]

MR. PETRIE: Now, the major differences or advantages to the new configuration, one, we get access to Calico Hills, we get visual access to three faults at the Topopah Springs and at the Calico Hills. TBMs provide us a schedule advantage of about three years. And the ramp accesses are coordinated with the physical access requirements of a conceptual repository design.

[Slide.]

MR. PETRIE: A few statistics about the differences between the baseline and the design study. The primary construction technique for the baseline is drill and blast, and for the design study it's mechanical mining methods, the length of drifting, ramp shaft, and so on. It's two miles from the baseline, possibly 13 miles from the design study, amount of muck removal, 130,000 cubic yards compared to about 900,000 cubic yards. The surface area facilities went from 20 acres to about 70 acres. The test drift area, that's the main test level, went from about 27 acres to 92 acres. This gives you some idea of the changes in the design.

[Slide.]

MR. PETRIE: Now I'm going to talk to you a little bit about the reviews we do have or plan to have of this design study and its general arrangement drawings.

[Slide.]

MR. PETRIE: First, we need to understand a little bit about what the DOE does in the way of a design. Every organization does things somewhat differently.

The work we're doing now is a preliminary design activity which leads to revisions of the document we call the design summary report. That design summary report provides sufficient technical detail such that concerns with feasibility of the ESF are adequately bounded.

[Slide.]

MR. PETRIE: By this, we mean that we can convince our management that we know enough about the project that we can tell them what the cost is and what the schedule is with a reasonable amount of confidence, and they can report to the Congress or whoever their boss is and say, yes, the folks know what they're doing, they have a good idea of what the cost is going to be, you shouldn't get major surprises as time goes by. But this is not the final design.

The scope of the studies -- and they're still in arrangement drawings which provide their versions to the design summary report, and I mentioned that one before. It provides draft portions of the design summary information which would go into the report, and for this first review we just had, it covers the north area, Phases 1, 2 and 5. If you went back to the isometric and looked at the phases 1, 2, and 5, that's what we're talking about. That's what we talked about in our recent design review. And maybe I'll put that back up again just for a minute.

[Slide.]

MR. PETRIE: And you can see here Phases 1, 2 and 5.

[Slide.]

MR. PETRIE: Well, what do we do in the design review? We see if we did what we planned to do. We were going to try to find out if we had sufficient information to determine the feasibility of the design and that's, of course, what we do. Do we have the needed information for the title and design report? Identify major technical concerns, incorporate revised design criteria, recognizing that the MSIS activity provide the requirements baseline.

We provide a forum for differing viewpoints regarding design solution and analytical techniques. As you are well aware, we have two different designers and there are more than one way of skinning any cat. We will no doubt hear some alternate proposals.

[Slide.]

MR. PETRIE: Generally, during this part of the program we have two kinds of reviews. We have a management review, which is a little bit of a misnomer because this is a technical review, but on this project we have something like eight major participants. All during the design studies phase, these participants have been working with the A/E in the development of this preliminary design.

This management review is accomplished to allow those participants to take one more look, one final look -- I wouldn't say final, one look at this -- another look at this preliminary design prior to the independent review to assure themselves that the A/E has in fact accomplished what they wanted to have accomplished.

Then we have the independent review which is accomplished by individuals knowledgeable of design technical disciplines. Qualifications and training is documented as QA records. And it provides management with the assurance that the criteria used will yield a feasible product. That's what we're looking for, as I mentioned earlier, that's what we're trying to get out of these studies at this point.

[Slide.]

MR. PETRIE: Well, I mentioned what the feasible product was. Here it is written down. It meets the mission needs, it complies with federal and state regulations and it complies with DOE orders. So you meet the mission consistent with the constraints laid upon you. That's what we are asking our reviewers to look for.

[Slide.]

MR. PETRIE: Just a little bit about the requirements and sources that we're using at this point. And you're going to be discussing the emphasis a little bit later in the program. But for the design studies this is the hierarchy of requirements documents which is in place today. They are not baseline, they are controlled documents. That is, the design is under control. The design is being made to perform to provide a system which meets the requirements as defined by these documents.

I think we've been through this before, but let me just flip through it quickly again. There is a WMSR or waste management system requirements Volume I, which is a high level document. There is a Volume IV, which is associated with the MGDS. There is a system requirements document associated with the Yucca Mountain site characterization project. There is a repository design requirements, site characterization program baseline which is the test, in effect, the testing requirements in all those leading to an exploratory studies facility design requirements at the lower level of the chain.

I won't say too much about these, but this is the management structure that provides the resources in order to perform this task in here.

So, in effect, we have our A/E working to -- in fact, all of our participants are working to this document here.

[Slide.]

MR. PETRIE: I've gone through this kind of quickly, but here this again is the document descriptions. I won't spend too much time on that, if that's okay. Anybody have a problem with going on?

[Slide.]

MR. PETRIE: A little bit about our transition requirements for ESF design, which will be discussed in more detail later for the whole effort on the emphasis we discuss later on this afternoon. This is our kind of design process going across the middle here, and the emphasis or the baseline -- eventually our baseline requirements are developed in similar to this kind of block and feeds into the design at the point of Title II, at the start of or shortly after the Title II. And you'll notice that we have a north area design study and a review associated with that, and a north and south area design review and reviews associated with that.

This is the one which has been completed, this is the one which will be taking place in August. The management review starts July 29th and two weeks later we start the independent review.

[Slide.]

MR. PETRIE: A little bit about some post-review activities from north and south areas.

The revised Title I design summary report will be accepted by the project office. The exploratory studies facility concept will be selected and approved by the director of OCRWM.

The ESAAB, which is an internal DOE board, will act on a request to proceed with the Title II and long lead procurement. They, in effect, say to the Secretary that it's okay to proceed. And to us it's okay to proceed. They, in effect, represent the Secretary. And Title II design will be initiated.

[Slide.]

MR. PETRIE: And just Title II design phase includes these elements:

A detailed analysis of the project participant design inputs, verification of design input analysis, preparation of the detailed design, verification of the detailed design and acceptance for construction.

This is all during what we call Title II, that's down the road. That starts around October and it's about a two or three year program.

I want to make that clear that verification, in the NRC sense, doesn't take place now. That's during Title II, when we have a final design.

That's what I had prepared for an introduction and if there's no questions --

DR. PRICE: Let me ask you a question. On this documentation that you just traced through, is it possible to trace through and get the entire mission and systems for the overall system, total system, and then ultimately show how it fits in with the exploratory studies facility? In other words --

MR. PETRIE: Okay.

DR. PRICE: -- is there a linkage constantly up through the documents?

MR. PETRIE: Yes. There is a complete linkage through the document, top to bottom, bottom to top. This is not complete in the sense that the waste package, for example, is not completed here. Now there should be -- there would be a waste package requirement document if we were complete. That's not included in this -- that is not under change control at this point. The reason being that there are really no direct requirements from the waste package into the exploratory studies facility. There are test requirements, but they come in through the site characterization program baseline, and if that's a problem, I'll go back to the chart; otherwise, I'll just continue.

But there are -- the point is, that anything associated with the site characterization, the ESF rather, is included in those control documents.

Yes, sir.

DR. DEERE: Yes. Don Deere.

Could you go back to the one that says document descriptions?

[Slide.]

MR. PETRIE: Okay.

DR. DEERE: Now, the last document, the exploratory studies facility design requirements document, is this the one in which the 25-foot diameter for the access ramps is selected?

MR. PETRIE: No. We do not tell the A/E to use a 25-foot diameter shaft. He performs trade studies to determine whether or not what that -- or ramp rather, he performs trade studies to determine what the ramp diameter should be.

DR. DEERE: Are there any technical requirements that have been given him that would lead him to 25-foot rather than 22-foot or 20-foot?

MR. PETRIE: Yes, there are some. Probably -- well, he has to be compatible -- I don't want to use the word "compatible," I'm not sure -- that's not the right word, but there are words with respect to compatibility with the repository. That would be one thing which might lead him there. And there are some holdovers from previous project requirements that say that the shafts must be treated as, and ramps, must be treated as permanent components of the repository. Those were DOE decisions quite some time ago.

But he makes trade studies, and if he were to decide that some other size were appropriate, he ought to tell us.

DR. DEERE: Right. The reason I bring it up is in the workshop on the engineered barrier system a couple of weeks ago, there are a number of presentations and some discussion about not necessarily using a vertical emplacement hole for the canisters. And if one were to go with ones that were simply left inside the room and then backfilled around that, you wouldn't have the drilling requirements, you wouldn't have the necessity to set the canister in a vertical position and require the dimensions. So there could be in the studies that are going to be done in the future perhaps a change in the need for larger openings.

But I wondered how soon does this get locked in or do we truly have flexibility?

MR. PETRIE: It gets locked in when we order the TBM.

DR. DEERE: That's what I was afraid of.

MR. PETRIE: That's not tomorrow or the next day, that's some time in the next year.

DR. DEERE: But I do think that this is a question we should be looking at in the next few months, is 25 there because of some requirement in the design of a repository that may indeed be changed?

MR. PETRIE: Well, Dr. Bullock may be able to address that somewhat since he has some --

DR. DEERE: If he doesn't, we'll ask him to.

MR. PETRIE: Well, I might also say that from my understanding, it's generally based upon the transport equipment coming into the facility from the surface rather than the emplacement equipment. Do you know what I'm talking about?

DR. DEERE: Yes.

MR. PETRIE: But Dr. Bullock could probably discuss that a little more.

DR. DEERE: Thank you.

MR. PETRIE: Ed?

DR. CORDING: Ed Cording.

The question I had was in regard to the independent review. Could you describe a little what that consist of or who is involved in that review? What type of review is it?

DR. BULLOCK: I will be covering that in my talk if you would just hold your question. Thank you.

DR. CORDING: Thank you.

MR. PETRIE: Okay. Anything else?

All right, then, we'll proceed with Dr. Bullock.

STATUS REPORT ON COMPLETED ESF DESIGN STUDIES AND RESULTS OF NORTH AREA REVIEW

DR. BULLOCK: Thank you. I'm Dick Bullock with the TPO for Raytheon Services-Nevada, the A/E for this particular project. I'll be covering the study and its relationship to Title I and Title II, elaborating a little bit more than Ted did in the differences to the design study in Title I and Title II.

[Slide.]

DR. BULLOCK: I'll talk about the design study status, describe the specific areas that will be involved, the design study participants' interfaces that we have worked with, the type of deliverables, the number of deliverables and some type of feeling of what they cover; major open issues that are not yet addressed, and we'll be talking then about the design review itself, both the management and the independent, and I will cover the participants that participated in these two reviews.

I would also like to talk a little bit about the A/E's tracking of requirements. That's something that we've never talked about before and I thought you might be interested on how we track requirements from the A/E point of view.

[Slide.]

DR. BULLOCK: Repeating a little bit of what Ted said, this is a preliminary design and it's equivalent in detail to the Title I, which means there's considerable work that has to be done between now and the time you actually go for procurement and construction. It is strictly a preliminary design.

[Slide.]

DR. BULLOCK: And for those of you who are not familiar necessarily with the DOE nomenclature of Title I and Title II, the preliminary design for Title I utilizes the design concepts and the design criteria that's given to the A/E to produce a preliminary design basis in sufficient detail to perform and illustrate the extent of the construction features, and also do a cost estimate and with contingency, then you are able to pretty well project what the project will cost.

[Slide.]

DR. BULLOCK: Compared to the Title II level of detail, which is done -- the final design done for procurement and construction, and your restudy and redesign work resulting from changes as may be required from preliminary design, and that's where this -- if we get into many of the aspects in more detail and do more trade-off studies and finalize the design.

Development of working drawings and specification for procurement, development of construction labor take-offs, development of detail for construction costs and preparation of analysis and environmental safety and health, and operational aspects of the project.

[Slide.]

DR. BULLOCK: This is a little bit different concept or pictorial of what you've seen before. And as Ted pointed out, the principal area of this initial phase of the design covers the North Portal area, the north ramp to the Topopah Springs and then on down to the Calico Hills. Because for ventilation studies we needed to go ahead and locate the South Portal to get its link and so forth, we also did a siting study on the South Portal and we located that portal, and it's somewhat slightly different than what it use to be on the conceptual design that was -- or the reference design, excuse me, the reference design that was given to us, and we also went ahead and located some buildings in a preliminary manner, and the stockpiles. And I'll show you more about those later.

[Slide.]

DR. BULLOCK: The North Area contains -- there were things that were considered, the access roads, utilities, portal paths, portal buildings, the ramp to the Topopah Springs, the ramp to the Calico Hills, revised design summary report draft, and bear in mind the procedure is to -- since Title I is baselined, we must come up with a new equivalent to the Title I in the design study, wrap all this information into the design summary report, and that's what makes the official change from the old Title I to the new Title I that can then allow us to proceed with Title II.

We've completed 10 preliminary trade-off studies, the muck pile location and the location of the South Portal. Bruce Stanley, after I finish, will be talking to you about those siting reports for the North Portal, the South Portal, and the alternate shaft, if one is chosen, to go at a later date.

[Slide.]

DR. BULLOCK: We interfaced with these participants, in particular in this phase of the design, with LANL for testing, USGS for ramp drills, soils and rock study and geological mapping, Bureau of Reclamation for geological engineering information, particularly in the siting area, SAIC for the geotechnical help, Sandia's performance assessment, water and seals, and Parsons Brinkerhoff for the repository interface, the conceptual potential repository interface.

[Slide.]

DR. BULLOCK: Our deliverables were drawings, studies, analyses and calculations, and what also want to be on that viewgraph is the first draft of the design summary report which was completed. It contained very little information about the south, but it contained much more about the north, and most of the sections of the book were pretty well put in draft form. That's the design summary report.

[Slide.]

DR. BULLOCK: Of the drawings, there were 34 civil drawings, 13 electrical, 13 mechanical, 11 mining, 21 structural/architectural, for a total of 92. Now, this is just those areas which I discussed, basically the north end and some south end portal locations.

[Slide.]

DR. BULLOCK: The roads coming into the project and the roads going to the muck pile and roads going to the South Portal were also included.

Bear in mind, the general arrangements were preliminary and not in any way detailed. They were simply showing the major systems, and these major systems were supported by trade-off studies.

I've already talked about the interface with the other participants. And we did document all meetings with meeting notes and minutes so we would have continuity of where the input came from.

[Slide.]

DR. BULLOCK: Trade-off studies, North Ramp, South Ramp siting, optional shaft collar siting, and those three were done strictly from the engineering aspects, and they are rolled into the preliminary access siting report, and Bruce will explain to you how the other participants looked at other aspects other than engineering for the siting studies.

The shaft sizing report, the ramp sizing report for the Topopah Springs, North Ramp, and the ramp sizing report for the Calico Hills, transportation methods within the underground facility. The ramp functional analysis and the underground functional analysis, as far as we went. Preliminary excavation plan and power load study.

From the reviews, there were many comments that affected us, of course, and two them in particular caused us to -- we wanted to continue that north ramp portal siting to better document the areas that were looked at in earlier years which led to that North Ramp Portal siting. And we also are taking another look at the grade and layout of the north ramp.

[Slide.]

DR. BULLOCK: The design summary report is being prepared in parallel with the design so it's being updated constantly. Of course, it was the first draft for the review. It has very limited information on the south. And I will not read all the chapters, but you can see it pretty completely covers the entire design concept of the ESF. This document will be totally completed by September. And that's what we spoke of as going forward to headquarters for Mr. Bartlett's and others' approval as they accept the concept.

[Slide.]

DR. BULLOCK: There were two sections that were not covered in the the north end review, the acquisition strategy, which is primarily the subcontract strategy that will be used by DOE and REECo, and the operations aspect of the facility. These have now been written since the review and are ready to be put in the design summary report.

[Slide.]

DR. BULLOCK: I apologize for the quality of the viewgraph, it's not all that great. But I did want to show you geographically the location between the north portal and the ramp, the roads that come in to the facility that have been laid out in a preliminary design. This is the stockpile area and the south ramp and south portal -- or the south portal and the south ramp. There are other things shown on here, but they're preliminary in nature and they'll probably get moved in the final analysis.

[Slide.]

DR. BULLOCK: The north ramp portal area, we have preliminarily laid out the surface buildings. There is nothing set in concrete about the size or their particular location. It was one concept. This building here being the change house, this being the project support area with offices for the various participants that need to be up close to the portal. This being the building that supports the IDS, integrated data system, to collect the data that comes from all the tests they'll be running in the ramps in the underground structure, the microwave tower.

This is the control building for the entrance into the portal. This is the shop building and the warehouse, this is the electrical switch gear. This little building is the substation control and, of course, the tower for transferring wastes on the belt and the belt drive.

[Slide.]

DR. BULLOCK: I apologize, it's not a particularly -- it's a very poor print, but basically this is the switch gear building, this is the combination shop and warehouse, and on the south portal, they won't need as many facilities, as many people will be there, so everything is somewhat smaller. This is the shop and warehouse, this is the change house and some offices, and the transfer house and belt drives and the control house lies right here for the airlocked portal. And you notice two ventilation fans, this is airlocked, which will eventually bring the air completely through the facility. Once you make the connection between the two portals, this will be the exhaust in this end, that's the airlocked portal.

[Slide.]

DR. BULLOCK: Now we come to the point of Dr. Deere's question.

The diameter is 25 feet. This is the diameter that was given in the reference study that we are following. When we look at the size of the opening, we put a conveyor system in it, and we feel that it doesn't necessitate a roadbed for people, because this is primarily a route for bringing scientists in and out of there. We think that we need a roadbed in there of some 13 to 14 foot wide which brings it up somewhat from the bottom.

And then you must remember that we have to eventually bring the equipment that's going to develop all the alcoves and the test mine, and we're talking as one possibility -- I've forgotten the miner's name now, but it's a tunnel boring machine -- a smaller tunnel boring machine which can cut very sharp corners. We must bring that also down through there -- mobile miner, thank you -- the mobile miner which is one possibility, built by Robins. There may be others that we'll consider, but that has to come also down through there either disassembled or assembled, and so it only leaves you a 13 foot wide roadway to get down through there. So it may very well be we could go smaller and we will be looking at these things particularly before that tunnel boring machine is ordered. But right now it looks like you need the 25 foot.

And, of course, should there be a repository off in the future, the original conceptual design did call for a 25-foot ramp. If we went with a 16-foot and it became a repository some day, then they would have to go back and remount the ramp. This would be a time-consuming job, probably not a whole lot more expensive, but then doing it all at once, but it would consume a lot of time. And we'll be looking at the schedules to see if there's a possibility of doing that also.

The length and slope, you see a star by each of those numbers. During the review, the independent technical review, there were questions raised on the grade of the ramp.

Again, this was a factor that had been through the conceptual design of the potential repository and it had been accepted, more or less, by many people over the years and not really challenged. And then we got to thinking about it, that conceptual design never really had been through a review such as we've been through. So people now have a chance to look at this and really think about whether we could possibly make it a lower ramp grade.

They had studied grade angles between 10 and 20 percent. They had not studied back in the history of lower angles because you really have to stretch the ramp out. This will go to approximately 11,000 feet to get this down to about 5 percent. And it's nothing you can't do. It's just a matter of how you configure the ramp as it goes to the Topopah Spring.

The turning radius is 600 feet and this can go larger. Right now the total project group are looking at raising the north end of the potential repository level or the level of the Topopah Springs. If this should take place, that could come up as much as two or three hundred feet on the north end. That would greatly help decreasing that grade, and that's one of the potentials that lies ahead of us.

The equipment in the ramp was the ventilation system, conveyors and utilities, of course. Also, of course, much testing will go on all the way down that ramp.

[Slide.]

DR. BULLOCK: The north ramp in the Calico Hills, the diameter is 16 feet, the length of 5300 feet, 10 percent grade, 300 foot radius. That, too, could change.

There were several comments, we had the conveyor located in the -- high in the arch above the spring line basically, you're up pretty high. The top belt was at the spring line and there were a lot of operating people who objected to carrying the conveyor that high, being as it would be more difficult to get to it and service. If you lower that conveyor down to the man's working level, that gives you difficulty in leaving enough road space with a 16-foot diameter, and we're looking at what it would take, and we think it would take an 18-foot if you bring that conveyor down.

So, these things are not set in concrete yet. We are still looking at them.

[Slide.]

DR. BULLOCK: The access roads coming from H on the NTS are a 4,000 foot roadway, 24 foot wide pavement, utilities, fresh water provisions have been considered, and the waste water provisions have been considered.

[Slide.]

DR. BULLOCK: These next viewgraphs I've already talked about the buildings and I'll not go back over.

The same with the next one, this is just talking about more of the buildings at the north portal pad.

[Slide.]

DR. BULLOCK: The stockpiles are really two separate areas. The top soil storage is about 20 acres, not particularly deep. The muck pile storage is about 55 acres, it's approximately 50 foot high and the top soil is about six feet high.

There is a run-off berm as required by the environmental people. There's a retention pond for any run-off that comes along, and it will have an impervious liner. We don't know yet what kind, probably a combination of clay and plastic.

[Slide.]

DR. BULLOCK: The major open issues, we must have soil and rock information, geotechnical information before we can finally locate those portal areas.

We don't anticipate any problems with our location, but it's just something that good engineers must have when you design, is you must have rock and soil information, and we have been unable to get to the field to do these until now. And so they will give us some information on rock and soil.

The other thing, of course, we'll drill out the ramp and the center line of the ramps will be drilled, and we really won't be positive that they're in the right locations until those are complete.

The intercept between where the take-off goes to the Calico Hills location has not been finalized. We've shown a point on drawings, but this is not necessarily where they must go. And that has yet to be finalized.

As I mentioned earlier, the potential repository elevation dip and strike is under consideration right now, so the final layout of the ramp hasn't been definitely finalized on the north end.

The final designation of the location of the potential repository seals cannot be located until we have better information on the contact between the PAH Canyon member and the Topopah Springs.

It says in the requirements document that we cannot do any grouting within 50 feet above or below that contact where the seal will be, so when the ramp is drilled out, we'll get the geologic information and pinpoint very accurately and then we can locate where those seals will be.

[Slide.]

DR. BULLOCK: Well, bringing all this together then, the management review was held June 3rd in Las Vegas, and it was primarily a chance for those people that had worked very closely with us, according to the size of the comments, maybe not close enough, but they had worked with us in the design being sure we were designing things to meet their needs. And of course, participating with the project office, Sandia National Laboratories, Los Alamos, USGS, Bureau of Reclamation, REECo and SAIC. All of these people, and many of these are more than one person, had people that were coming to us on a weekly basis and sitting down and going over the preliminary design as it progressed.

Also, of course, the project quality assurance were looking over our shoulder during the review, and we invited the new M&O contractor, TRW, to sit in and review also on the preliminary design.

[Slide.]

DR. BULLOCK: The design criteria that we asked the people to use were these items. And we didn't necessarily say are these things included, we asked is there anything that prohibits these things from being included?

The regulatory considerations, can they be implemented?

Can site characterization tests be implemented?

Can the design be accomplished consistent with MSHA and OSHA?

Is there reliability and operating ability that can be implemented into the design?

Can stress and thermal considerations be implemented in this design?

Is it constructable?

Have we considered the environmental considerations and the socio-economic?

Now, these were by no means the limit of the comments that came in. Everybody had their own criteria that they also commented on and they were free to comment on things which really weren't Title I design, but were really to be covered in Title II. But if they felt they wanted to put them down, then that was fine also and we accepted all comments, no matter what they were.

[Slide.]

DR. BULLOCK: On the 92 drawings we had 250 comments; on the trade-off studies we had 76 comments. On the design summary report we had 164 comments, for a total of 496.

All of these comments reached resolution within the week of the review.

Applicable to Title I detail, there were 365, and of those, 79 of those comments required no change in the design. There were 131 comments that were applicable to Title II detail. In other words, there are things that if we didn't get to it now, we will get to it in Title II.

I listed a few examples just to give you a flavor of the types of things that would come in. One said the fireplugs should be 45 foot from the building and they are absolutely right. This was something we would have picked up in Title II, but we did not pick it up here. And the water sprays need to be at transfer points between conveyors. Yes, they certainly must be. And we did not show that.

Examples of significant comments:

They asked us to restudy the location of the water tank in the borrow pits located on the reference -- the site characterization study. This is a good point, that we had the water tanks sitting over the area and we have to relook at this. If there was a rupture in the water tank we would flood one portion of the area which is of interest. And we should reconsider moving that so that we would not have any possibility of harming that site. And the same with the borrow pit.

And we were asked to re-evaluate the probable maximum flood between the various confidence levels, which the way it was done originally was not done between confidence levels. And that's being looked at at the present time by Bureau of Reclamation.

And there were no new trade studies that were generated from these comments.

[Slide.]

DR. BULLOCK: We had a week to take all those corrections, if you will, or new resolutions with the comments and crank them into the documents, reduce some of the drawings, the trade studies, and so forth, and then the following week, June 17th, the independent technical review took place in Las Vegas.

[Slide.]

DR. BULLOCK: The disciplines that were covered were civil, electrical, mechanical, mining, structural. These were done by a Raytheon group which came out of central engineering at NTS. In every case none of these people had had anything to do with the ESF design prior to this. So it was all new to them. They had not seen any of the drawings or read the discussions or trade-off studies before.

LANL test managers reported that review.

Sandia had a person looking at performance assessment.

Project office again looked at quality assurance. REECo person looked at constructability aspects. Repository interface was looked at by TRW, and T&MSS looked at maintainability, operability, environmental and regulatory. And an RSN safety person looked at the safety aspects of the design.

In many cases there were more than one person involved in this list.

[Slide.]

DR. BULLOCK: We also had observers who could issue comments through DOE to us, and they were made up, of course, of the project office themselves, OCRWM and Weston representatives, the Nevada test site office representative, MSHA, U.S. Bureau of Mines, State of Nevada. Two of the counties had people there and, of course, the TRB had a representative there, as did NRC, which had, I think, five representatives there.

So all total, there were about 30 people there that turned in comments on this preliminary north area design.

[Slide.]

DR. BULLOCK: We asked them to look at the same criteria. I won't go over it, but it was the same criteria as before, and again people did comment on the criteria, but they also had their own agenda that they felt they wanted to comment to also and we accepted those.

[Slide.]

DR. BULLOCK: There were 102 comments on the drawings, 128 on the trade studies, and 116 on the design summary report, for a total of 346.

All of these comments were resolved, though it did take a couple of days into the next week before we had resolved all the comments.

There were 252 that were applicable to Title I, and 129 of those required no change in design. 94 of those comments were Title II type comments.

Again, I gave you some examples, nothing particularly really significant in those minor comments. Someone suggested a two-wheel drive vehicle instead of a four-wheel. That's fine. Line weights on drawings should be varied. We're in the process of changing our CAD system and we were using a -- at the time not the state-of-the-art technology, and now we have the new CAD system just about installed so we'll do better in that area. Someone wanted the conveyor system changed from 15 to 13 degrees.

A significant comment which led to a study is that they suggested that the 10 percent ramp might be too steep, should this become a future waste ramp route. So we're going back and looking at that and looking at a study between five and 10 percent for that particular ramp.

The two studies that were affected by the comments, the grade difference between five and 10 percent, as I just mentioned, and we agreed to continue the north siting report to include the documentation and do a better job of documenting why that north portal was sited where it was, if indeed that's the place it ends up.

[Slide.]

DR. BULLOCK: The other area that I would like to talk to you about is the way the A/E tracks requirements. This has been an issue, particularly since the original Title I was done. We didn't have a -- I don't consider it a proper system in place. We were doing it, but the system wasn't there.

Now when we decide on a deliverable that must be produced, a drawing or a trade-off study or whatever it might be, the engineer writes up a description of this deliverable, what it's going to do, the purpose of it, what it's going to accomplish, some of the assumptions that are there. But they also talk about the requirements that this particular drawing addresses or this particular trade-off study addresses.

The other thing is that our configuration management group tracks those requirements into particular documents. And I'll give you an example of each one of those things.

[Slide.]

DR. BULLOCK: This first page is just the upper part of our form that the engineer fills out. It has nothing to do with the requirements, but it talks about what he thinks is going to be in that document when it's completed.

[Slide.]

DR. BULLOCK: On the top of the second page of that, you see listed the criteria requirements. These are out of the ESFDR, and list all of the requirements that's going to be addressed or partially covered by that particular document. And in the ESFDR, there is also a crosswalk between those numbers and the upper tier requirements such as 10 CFR 60. So I think one could trace, very easily, any requirement to where it ends up in our documents.

[Slide.]

DR. BULLOCK: The other example I want to show you is what our configuration management group does, is they simply -- this is just a one-page example. It will be many pages long when we really get into Title II. But we list the requirements down one column and list all the deliverable documents on the right-hand side. You can see some of them only have one document per requirement. Others may have as many as three, at least in this preliminary design of the requirement.

So, we are trying to do a systems job of tracking requirements as we think we should.

And that concludes what I have and I'll entertain any questions you might have.

DR. ALLEN: Dr. Price?

DR. PRICE: I believe, if my memory serves me right, that in the Asse Gorleben area in Germany they had an early shaft and an accident involving the loss of life which shut them down, I think, for quite some length of time. And I was glad to see you're incorporating MSHA, OSHA and so forth considerations in what you are doing.

Along that line, did you do, or do you have associated with this design, failure modes and effects analysis or criticality analysis, events analysis, fault tree analysis, any of these that might be leading to these kinds of events and showing up in your design where these vulnerabilities are?

DR. BULLOCK: Yes, sir. In the original Title I it was then Fenix and Scisson, did a risk analysis of the original Title I. We are at the present time going back and relooking at that and updating it to the present configuration, and even through Title II we will do a risk analysis on all of our design.

DR. PRICE: Could you explain what you mean by risk analysis?

DR. BULLOCK: Well, using your best judgment to measure against the mode of accident that could happen and the probability of it happening and what you would do to mitigate it. This was a part of the original Title I and we'll do it again. So we look at the -- and we use a lot of MSHA and Bureau of Mines statistics to back up what we think is the probability of having an accident in any given activity. So we do it by the activity that will be being conducted.

DR. ALLEN: Other questions? Dr. Cording?

DR. CORDING: The independent review, is there another one coming in Phase I -- in Title I?

DR. BULLOCK: Yes. Ted spoke of it. There's a magnet review which is July 29th, and I believe it's August 12th -- I think that's correct -- the independent review will happen again. They're only two weeks apart and the same system will follow, we'll take comments and try to incorporate them in all the documents before the independent review, and the independent reviewers will be there then on approximately the 12th of August and we'll have a week's review then.

DR. CORDING: Will that be basically the same group or do you have other groups that you've determined should be participating in that?

DR. BULLOCK: We certainly could have. At the present time I think the thought was to have maybe not the same people, but the same types of people. We're open to suggestions to look at this.

Bear in mind that this is the preliminary design, it's not the final -- not the Title II, and certainly with the verification, we must go through we would look to much more technically strong people to look at the verification.   DR. CORDING: One question I have is in regard to the timing of an analysis that looks at different ways of, for example, handling TBMs and the slopes, the sequencing of the TBMs, things like that, that go into the schedule and cost.

Now, some of that I know gets into a Title II, but some of it also has something to do with how you lay the facility out, and I was wondering at what phase that comes in, and certainly people with that TBM experience are helpful in this type of evaluation. Actually, the sort of thing a contractor might do in terms of cost and schedule?

DR. BULLOCK: Yes.

DR. CORDING: In looking at these alternatives and testing them against cost and schedule in regard to the TBM operation.

DR. BULLOCK: At the present time, going on as a project effort, they're looking at scheduling. We've looked at it, REECo has looked at it, but it's being coordinated and they're looking at other potential possibilities, different combinations of tunnel boring machines, not necessarily for, but looking at the combinations of using two, how you would progress, they are looking at those things. And we are involved in it. It's just not completed yet.

This also, of course, drastically affects power, which we are prepared to -- we know what it's going to take for four. We were also looking at what it would take for three or two or even one.

There has been work on a schedule and, of course, there has been work on costs. We will have a cost estimate ready by the end of August.

DR. CORDING: When you were talking about the ramp slopes being affected by later operational requirements and there could be some trade-off there even with the excavation also as to what -- a steeper ramp is not as fast in terms of excavation as a flatter ramp and there might be some balance there as well on the TBMs. So those sorts of studies, I think, could be a very useful part of this evaluation of the ramps.

DR. BULLOCK: Well, we'll certainly consider them. In defense of the steeper ramp, the original layout of the type of truck they were going to use, it had a triple braking system on it and it was only -- the speed was supposed to be five miles an hour, so it was quite slow. I mean they recognized the potential problem there and they had addressed these things in their studies. It's just that now we want to take another look at another possibility of the ramp grade.

DR. ALLEN: Dr. Deere, go ahead.

DR. DEERE: Don Deere.

Was anybody involved in your design studies or in the review that had actually worked with the TBM on a decline? Because we have hundreds of tunnels in the United States, most of them are horizontal one percent, something like that.

DR. BULLOCK: Yes, sir. We have a mining engineer who came out of the Stillwater property where they had been using a tunnel boring machine. One of our design engineers came off of that job.

DR. DEERE: In a decline?

DR. BULLOCK: Oh, not in a decline, no, sir. Excuse me, I misunderstood you.

DR. DEERE: I was specifically asking that question.

DR. BULLOCK: No. No. There is not -- I don't think we have anybody. No, we don't. I don't think anybody has ever worked on a tunnel boring machine in a decline.

DR. DEERE: Because when you look at grades of five percent or 10 percent or 16 percent as proposed in the south ramp, you really have to take into consideration the operation of the machine.

DR. BULLOCK: Oh, yes.

DR. DEERE: Because this grade for truck haulage doesn't come for 10 or 15 years, if it comes then.

DR. BULLOCK: Yes. Yes.

DR. DEERE: But it is going to exist in the exploratory phase for the TBM.

DR. BULLOCK: We have quizzed the manufacturers and at least two different consultants very hard on this point and they assure us there's no problem. And all through the alternate studies, if you remember, some of those grades went up to, I think 15 or 16 percent, much to my chagrin, but they did during the alternate studies, and we quizzed the consultants at that time if this was a particular problem for tunnel boring machines. They assured us it was not. There are documented cases where tunnel boring machines have operated in these conditions, but it certainly isn't ideal, one in South Africa, for one.

Excuse me, go ahead.

DR. ALLEN: Dr. Cording?

DR. CORDING: It may not be that there -- it's not that they can't -- it can't be done, it's the efficiency that you just pointed out?

DR. BULLOCK: Yes. The flatter the better. It's just like if I was driving it conventionally, it would be the same story, the flatter the better.

DR. ALLEN: Dr. Reiter had a question or two.

DR. REITER: I had a question about to what extent the design or the ramps are tied in with the operational phase of the repository and specifically, use during that phase. It's typically if a problem occurs say with Midway Valley, for some reason you find it's not the appropriate place for the surface facilities area, how would that affect your present design?

DR. BULLOCK: Well, if Midway Valley turned out to -- something was discovered that that's not a good place to put the surface facilities, then you would certainly be stronger looking at some of the other areas.

In the original work that Sandia and Parsons Brinkerhoff did, there were other surface sites besides the one that was selected. This particular site, though, is ideal for the surface facilities from what it looks like. And one would have to go back and look at the other surface areas. I doubt that you will find one with near as much room as you have in Midway Valley. But I don't know if that answers your questions.

DR. REITER: It seems to me you're banking on Midway Valley being an acceptable site. What I'm saying is that the ramps, if I understand the exploratory shaft ramps, also were going to be used during the operations phase and if something happens that Midway Valley is not found to be appropriate, is that a serious problem?

DR. BULLOCK: I don't think so. I think there's other spots it can be placed in. I'm not sure that the south ramp wouldn't be a good location also, because you're looking at about a one and a half, two percent grade down that decline, and if there seems to be room down there one could flatten off.

I don't think it's a show stopper. It may cause you to change your plans, which you should do if Midway Valley is not suitable.

DR. ALLEN: Dennis Price.

DR. PRICE: I would like to follow up on my earlier one and ask, since you indicated you do have failure modes and effects or events analysis or a fault tree or so forth for hazard identification and risk assessment, I assume that's documented.

DR. BULLOCK: Yes. The original one was. We did the original risk analysis. We used a consultant to help us, Arthur D. Little, but that original work is documented and found its way into the PSAR, which was put together by the project office.

DR. PRICE: I wonder if we could --

MR. PETRIE: This is Ted Petrie speaking.

That document is not released. It's in a draft form. So, obviously, you can have draft information, if you want it.

DR. PRICE: Yes, I'd like to see it. Pardon me for failing to push the button here. Yes, I would like to see that in draft form, understood.

DR. BULLOCK: Bear in mind, that was originally on the two shafts, two vertical shafts on the original project, and we're in the process, just now, of updating it.

DR. PRICE: I see. So, there is nothing on ramps, as such.

DR. BULLOCK: Not yet. They're in the process of updating it right now, as we speak.

DR. PRICE: Good. I guess I would still like to see that draft, if you can give us a copy of it, and then, certainly, when the other comes.

DR. BULLOCK: Yes, sir.

DR. ALLEN: Okay. Thank you.

Ted, is it okay to take the break now, as scheduled?

MR. PETRIE: Yes.

DR. ALLEN: Okay. Let's take a break.

[Recess.]

DR. ALLEN: May we reconvene, please?

Ted, do you wish to introduce the next speaker?

MR. PETRIE: I will just make a quick introduction.

The next talk will be given by Bruce Stanley of Raytheon Services, Nevada, and he will discuss the alternative studies on the South Portal, the location of the South Portal in the shaft.

DESIGN ALTERNATIVES STUDY ON SOUTH PORTAL AND SHAFT

[Slide.]

MR. STANLEY: I want to begin by saying, in response, further, to Dr. Cording's question a little bit earlier, that there is a study undergoing right now that does consider about seven or eight different options for different equipment to be used in our preliminary studies, and that also considers multiple TBMs, numbers of TBMs, alternate types of mechanical excavation equipment, and the sequence for excavating the entire property.

So, that is undergoing at this time, and it would be -- it's not really scheduled for delivery at any particular time, but I can generally say that it will occur sometime in the fall.

My name is Bruce Stanley. I'd like to present to you this morning an overview of the trade studies which were performed in locating the south ramp portal, the north ramp portal, and the optional shaft collar.

[Slide.]

MR. STANLEY: For this effort, we had a Preliminary Access Siting Report. The Preliminary Access Siting Report is based on a systems engineering approach.

We are required, when we have major systems, subsystems, or components, to try to implement a systems engineering approach where we fulfill certain functions and requirements for those functions.

Here we have a major component in the north ramp, south ramp, and in the optional shaft. The effort is divided into two major reports.

One is a preliminary report, and that is of which I speak this morning. It's a preliminary report. It's not designed to be final, because we intend to have further input on this and review parts of those reports.

The second part is a final report scheduled for completion in fall of '91.

As I said, there was three separate report efforts done. One was addressing the north ramp portal siting; second, the south ramp portal siting; and the third, the optional shaft siting.

The basis of the trade studies focus on the most favorable features of the highest-ranked options in the alternatives studies which were done earlier this year and last year.

As a result of that alternatives study, the option number 30, with certain enhancements, proved to be the selection, preliminary selection, to be detailed further on within preliminary designs.

[Slide.]

MR. STANLEY: Option number 30 is, for the most part, shown here. This was put up once before.

As we can see, we have the features of the north ramp, the south ramp, and the optional shaft. Whereas, in the alternatives studies, we had a main test area located in the south, we now had the main test area located in the north.

Whereas in the alternatives studies, there was no optional shaft, now we have an optional shaft located in the north area, and I want to remind everyone that the purpose of Option 30, the main thrust of Option 30, was to gain rapid access to the Calico Hills on a non-interference basis, with access and excavation on the Topopah Springs level.

[Slide.]

MR. STANLEY: I would like to have had a second overhead here to keep this up, but you may keep your finger on this page in the report.

This shows the various alternate locations for the north ramp, for the shaft, the south ramp, etcetera.

We can see here, starting at the north ramp, that we chose the same location which was reported in the conceptual design report.

We have other areas located, as you can see here, outlined, number two, three, four, five, eight, and seven --number one and six are located up here somewhere -- for the north ramp, and those areas were derived from the Sandia report which was done approximately six years ago, and this is where the options or alternatives were chosen, but you can see, in red, that this was the final selection.

The X's show the optional locations for the shaft siting. You can see, right over here, that site number one was on top of the ridge.

Site number two is an area around the old ES-1/ES-2 location in Coyote Wash. I want to emphasize that it is an area, and I will get to that a little bit later, why that is.

Number five is down on a hillside. Number three is across and outside of the block and located near to the valley floor. Number four is located on a ridge outside of the proposed repository block.

For the south ramp, we had alternate locations of Solitario Canyon, which starts on the other side of Yucca Mountain and drifting essentially straight in.

We had what we call a Ghost Dance fault location as number two, ramping down at approximately 6 percent and about 6,500 feet, and then we had the boundary ridge location shown in red, which was the final selection, and the length on this ramp is approximately 9,200 feet in length at a gradient of -1.6 percent, essentially road grade.

As you can see over in this area of the viewgraph, we have in crosshatch the location for the muck piles, the excavated material pile. So, under consideration was how to transport this material cross-country to these pile areas.

There again, the ones marked in red were the ones that were finally selected.

DR. DEERE: A question before you remove that?

MR. STANLEY: Sure.

DR. DEERE: Did I understand you correctly? The grade on the south ramp is what?

MR. STANLEY: It's -1.6 percent, 1.57 percent.

DR. DEERE: Quite a change.

MR. STANLEY: It's essentially road grade. That's right.

DR. DEERE: And how about the north ramp then?

MR. STANLEY: The north ramp is 9.57 percent.

DR. DEERE: And its length?

MR. STANLEY: Its length is approximately 5,600 feet.

DR. DEERE: Thank you.

DR. BULLOCK: Bruce, you might point out those two Xs which you have labeled number two are not the old ES-1/ES-2.

MR. STANLEY: These two Xs that are shown here are not the location for ES-1/ES-2, as previously located, but this is an area around the same general vicinity of that Coyote Wash area.

I show two Xs in there because there are alternate locations for the shaft as it fits with the underground layout of the main test area.

[Slide.]

MR. STANLEY: As in any good systems engineering approach, we try to fulfill the function requirement answer or alternative and then answer or type format.

I wanted to put up here and show to you some major functional requirements. These are not the total -- all of the functional requirements, but some of the major ones. We must provide facilities for in situ characterization. We must provide for the incorporation of the ESF into the potential repository. In other words, we must not preclude inclusion into a potential repository.

To fulfill those functions, I wanted to point out two major performance criteria. We have performance criteria, we have constraints and assumptions. Performance criteria being tradable, constraints being non-tradable, assumptions being provable in the future.

To the extent practical, exploratory boreholes and shafts in the geologic repository are planned for underground facility construction and operation or where large unexcavated pillars are planned. Flow down from 10 CFR 60.15(c)(3) -- it's a constraint.

Second one, subsurface exploratory drilling, excavation and in situ testing before and during construction shall be planned and coordinated with the geologic repository operations area design and construction, 10 CFR 60.15(c)(4). I believe that this addresses an earlier question that was asked of Ted Petrie.

[Slide.]

MR. STANLEY: The approach to the trade studies for the south ramp access and optional shaft was that an initial list of screening criteria was developed and agreed upon by all of the participants. Possible sites were then screened. What I mean by the initial list of screening criteria, the portals fall above the probable maximum flood zone, for example, or the portals founded in solid rock and not on a fault zone -- major drop dead criteria. Each participant was allowed to participate in the screening of that.

By the way, this is a project level type of a report, and all participants were asked to contribute to this report. We had Raytheon Services in Nevada, we had Los Alamos National Lab, Sandia National Labs and we had USGS, U.S. Bureau of Reclamation, the interface with the repository designers also; not to forget SAIC who provided geotechnical input.

Each participant was subsequently asked to perform their own figure of merit study to attack the problem and selection problem from their own point of view. Now, I realize that this is a very simplistic method, but it would seem appropriate for our purposes.

For example, each participant would develop discriminators or factors relative to their own area of expertise. Raytheon would handle engineering, which included geology and geotechnical considerations; Los Alamos would consider testing; Sandia, performance assessment; USGS, surface-based testing.

Each organization would assign the relative weights of importance to each one of their discriminators or factors. The selections of the options would be scored and then a computed weighted value would be the result.

[Slide.]

MR. STANLEY: After each participant had completed their own selection, an independent panel of participant representatives were convened to assign relative weights to the engineering, to the performance assessment, underground testing and surface-based testing inputs to a combined figure of merit approach, this independent panel as independent as possible. These were people who did not participate in the selection of these alternative sites, and had no vested interest.

From that combined figure of merit, we computed an overall weighted value, using the participant figure of merit weights. Then the winners were selected on the basis of the highest score.

[Slide.]

MR. STANLEY: As I had mentioned before, each participant had their own responsibility. Raytheon was responsible for engineering, including repository interface. For geology, we had input from the U.S. Bureau of Reclamation, who did literature research and did physical field work for each location, each alternate location. We had geophysical input from SAIC, and we had topographical information, in the form of input from EG&G Aerial Surveys. Los Alamos provided information for underground testing. Sandia National Labs provided their own figure of merit, based on performance assessment considerations. USGS provided their own input, based on surface based testing considerations.

[Slide.]

MR. STANLEY: The methodology that was used here was the same for the south and for the optional shaft.

I want to begin by showing you some of the results of these figure or merit charts. This was the engineering evaluation results. Engineering considered as discriminators: Portal access road construction, portal pad high wall construction, portal construction itself, ramp construction, ramp length, radiant, repository integration impacts and ESF repository logistics. Each was assigned a weighting factor by a panel which was independent of a panel which did the scoring.

As you can see, each was designed -- computed for each -- one was computed a weighted value. The winner here, from the engineering standpoint, was the Ghost Dance portal location, which was the central location. I have to remind you, this was not the final selection; but this won slightly over the longer boundary Ridge location.

[Slide.]

MR. STANLEY: Moving on to performance assessment. Sandia National Labs considered as their discriminators, liquid reaching the repository horizon and gas escaping from the repository horizon. They did the same exercise, and they chose the Solitario Canyon or the very shortest ramp, which was located -- the portal site was located on the other side of Yucca Mountain. But, it was a very narrow winner over the Boundary Ridge location.

[Slide.]

MR. STANLEY: Underground testing was evaluated by Los Alamos National Labs.

They considered representativeness of the site, information that would be complementary to all other information they would receive, and any possible interference with testing that the ramps might provide.

Their analysis overwhelmingly selected the Boundary Ridge location, followed by the Ghost Dance location, and this location, Solitario, was a loser.

[Slide.]

MR. STANLEY: Similarly, surface-based testing, evaluated by USGS, considered interference, complementary information, and muck pile location, where the excavated material could be stored, and would that be interfering with any surface-based testing activities?

The final analysis here showed that they selected Boundary Ridge location, or the longest ramp, followed by Ghost Dance, and then Solitario was the clear loser again.

[Slide.]

MR. STANLEY: Combining the information into the rolled-up figure of merit activity, you can see that engineering, performance assessment, and underground testing and surface-based testing were the factors considered.

As I said before, an independent panel was convened to assign relative weights to each one of these areas, and then the results from each one of these figure of merit activities were put in place here for each alternate location.

The final weighted value was computed, and what is boxed is the winner location, the Boundary Ridge location. This is how it was selected, as the longer ramp, 9,200 feet in length, and a 1.6-percent decline grade.

You can see that it was a substantial winner by the total weighted value, followed by Ghost Dance area, followed by Solitario.

Now, one might question whether, if those weights had been different, would there be different results?

[Slide.]

MR. STANLEY: So, we embarked upon a sensitivity analysis, because during the process, when the panel was convened to assign these weights, there were a number of different weight scenarios which were put up on the board, and of course, we all agreed on the one that was chosen, but nevertheless, the other weight scenarios still exist, and we wanted to see if that would alter our outcome. So, we have four different cases.

Case number one showed where all the weighting factors were essentially the same followed by surface-based testing. The result was, again, that the Boundary Ridge location was the overall winner, followed second by Ghost Dance, followed third by Solitario Canyon.

[Slide.]

MR. STANLEY: Next, what would happen if we gave a little bit less emphasis to engineering and increased the importance of performance assessment and underground testing?

This was okay with engineering in Raytheon, because we made the statement during that panel that we could pretty much engineer a ramp and a portal area in any one of these selected sites, because we went through this initial screening process.

So, we said any one of the sites is fine with us, but we do have some input.

As you can see here, again, Boundary Ridge was located first, Ghost Dance second, Solitario Canyon third.

[Slide.]

MR. STANLEY: Another alternative was that Sandia mentioned we think that performance assessment is extremely important, and since engineering said that they could engineer around anything, we'll keep them down around .23, we'll increase performance assessment.

Again, you can see the results: Boundary Ridge, Ghost Dance fault, Solitario, same pattern.

By the way, I should mention that when one looks at surface-based testing and you might question why is this so low, it was considered that the combination of surface-based and underground testing really constituted the testing effort.

So, when we combined, let's say, .1 and .27, we came up with a result of .37, which was very comparable with the other factors.

[Slide.]

MR. STANLEY: The fourth and final sensitivity was where underground testing was given great consideration, performance assessment also a fairly good consideration, and engineering was cut back to .2 percent.

As we see, the winners did not change at all, still the same pattern: Boundary Ridge, Ghost Dance, Solitario Canyon.

So, that provided us with fairly substantial results on where the south ramp portal should be.

[Slide.]

MR. STANLEY: Optional Shaft Siting Engineering Evaluation results -- now we're moving over to the shaft consideration.

As we had mentioned before, we had five alternate sites for the shaft.

Engineering considered collar access road, shaft site pad construction, collar construction, shaft geology --which is extremely important -- repository integration impacts, ESF/repository logistics, and shaft depth.

Same pattern occurred. Results here showed that the site number two, the area that I had put up there before with the red circle around it, was the selected site.

It was followed very closely, as you can see, by a drillhole area, site number three, and you may start to see a pattern in some of these charts, which I will bring up if no one else does.

[Slide.]

MR. STANLEY: Performance Assessment, in their evaluation, considered liquid reaching repository horizon, gas escaping, same discriminators as used in the ramp.

Their selection resulted in the drillhole wash area on the top of a ridge which was outside of the potential repository block, followed by the second site, which was also outside of the block area, just down the hillside. It did not choose ES-2 Vicinity.

[Slide.]

MR. STANLEY: Underground testing evaluation results: Underground testing considered representativeness, interference, and isolation.

As you can see here, the winner was the Coyote Wash area located within the potential repository block across the main to the west -- it was outside of the main test area, as a matter of fact -- followed by the ES-2 area, which was the final selection, and then the others strung along behind.

[Slide.]

MR. STANLEY: Surface-based testing considered interference and complementary information. The results on surface-based testing shows site number five, which was located off of the ESF potential repository block to the east, followed closely by the ES-2 Vicinity location.

[Slide.]

MR. STANLEY: We rolled them all up and put them together. And the final selection resulted in the ES-2 vicinity, coming out highest, as far as the total weight of value is concerned.

I'm sure everyone by now has noticed that the results on this particular figure of merit exercise were so close that we had to go to the third decimal point in order to make a selection.

So it can be said essentially that it resulted in a "you pick 'em." This area was not essentially that extremely better than the Number 4 location. It wasn't much better than the 5, or any of the other locations. However, this did prove to be the winner, based on the weights assigned to the factors, and the discriminators.

Okay, we said based on that. What about sensitivity?

[Slide.]

MR. STANLEY: We started to perform sensitivity analysis. We also have four here. The sensitivity analyses again giving engineering, performance assessment, underground testing, essentially the same weights, followed by surface-based testing.

And again, I have to remind you that testing in general will compute to be .4.

Here we find the winner to be the Number 4 site, above the Drill-Hole Wash, followed by the Number 3 site, followed by, in third place, our finally-selected site in the ES-2 vicinity, Coyote Wash vicinity.

[Slide.]

MR. STANLEY: An alternate weighting scheme, with different weighting factors, showed that Number 4 site was selected, followed by Number 3 site, followed by Number 2 site.

So it seems to be that these three sites are falling fairly close to all being desired.

[Slide.]

MR. STANLEY: But now we say, what about underground testing? Let's consider it very heavily at .65, testing in general .65, engineering low, and performance assessment let's forget about for the time

Now, we have a winner of the ES-2 vicinity, followed again very closely by this Number 1, within the potential repository block. So you can see that that might have been a driver.

[Slide.]

MR. STANLEY: Just another combination of various weights that you can see here, still with testing being the highest. And this was because the optional shaft was considered for testing purposes, at this time.

The results here showed that the ES-2 vicinity was the winner. It's a close winner. It's a clear winner, but it still is a close winner, followed by Site Number 5, in this case. And then the other three were all essentially the same.

[Slide.]

MR. STANLEY: Moving on to the North Ramp access.

The first thing I wanted to mention is that the study is being revisited and rewritten to address concerns expressed during the recent management and technical reviews.

I think the concerns that were raised were very valid and were very helpful, and it steered us in different directions. The siting evaluation on the North Ramp will be revisited, and come out at a later date, in the final report.

As it was done, to date, the siting evaluation included information derived from previous Sandia reports:

Sandia-2015, which provided the location recommendations for the surface facilities. It also provided those eight different optional locations, which I put up earlier;

Sandia-2641, the conceptual design report, which outlined the conditions around the portal as chosen;

The repository design requirements document;

And the preliminary validation of geology report.

In addition, Los Alamos was asked to prepare a test planning package for the North Ramp, to see if the North Ramp was suitable for site characterization purposes.

They determined, implicitly and explicitly, that this ramp was suitable for their purposes, that a test plan could be, in fact, incorporated into that design.

SAIC provided geotechnical considerations and review.

U.S. Bureau of Reclamation provided engineering geology reconnaissance.

Parsons Brinkerhoff provided the potential repository design interface and concurrence that nothing would preclude them from including that into a potential repository design.

And Sandia National Labs provided performance assessment concurrence.

Concurrence on the North Ramp location was received from each participant, and was deemed suitable for a preliminary siting analysis at this time.

[Slide.]

MR. STANLEY: In conclusion, I wanted to repeat that the South Ramp portal site selection found that the boundary ridge site location was the best location. It produced a ramp of approximately 9200 feet in length at a low gradient of 1.6 percent decline. It was a clear winner, and it was not affected by alternate weighting schemes.

The optional shaft site selection determined that the old ES-2 vicinity of Coyote Wash was the winner; and it allows flexibility to adjust to the underground drift layout. And that's why I said before that it was an area, not a specific location.

However, this was a marginal winner, and it can be seen that, as I said before also, that it was a "you pick 'em" results that could be significantly altered by different weighting factors and different considerations. If someone or some entity has a strong opinion on where that should be, we would encourage hearing from them.

The North Ramp portal site selection. This report is to be revisited, and based on expanded considerations for the geometry and for the gradient. Some of the considerations that will be done -- and let me put this drawing back up --

[Slide.]

MR. STANLEY: -- will be to see if there is any merit in swinging this ramp out at a much different geometric configuration, to allow for a much lower gradient in the ramp. Even if we doubled the gradient, it would bring it down to -- I mean doubled the length -- it would only bring it down to 5 percent, 6 percent area, which brings up an interesting result of this entire study.

In the past, we have had in the conceptual design report two ramps for the potential repository -- one located here, another located coming in from the North.

Now, we have a South Ramp. This was always considered for future use in a potential repository situation, to handle waste canisters.

This ramp now, as chosen, has a gradient of a minus 1.6 percent, or essentially road grade. This could result in an alteration of the functional performance of each one of these openings. In other words, one might consider switching the function of this ramp to, instead of handling excavated tuff materials, now being the waste transporter ramp.

Also, the location, the relatively close location, logistically, may allow this, and not detract from that possibility.

So this will be revisited, and possibly the CDR will be subject to change as a result of this.

I wanted to remind everybody that this is a location subject to, an area subject to specific location in the future, that all of these shaft locations were very, very close in the resulting figure of merits.

This one was the one that Sandia National Labs liked for performance assessment. This one was the one that Los Alamos preferred for testing, this one for surface-based testing, and this one for engineering, but under the final combination, this one was a slight winner.

I'll leave this up and entertain any questions that anyone might have.

DR. ALLEN: Dr. Price.

DR. PRICE: Just running through that procedure of evaluation again, how many participants were there, providing the weighted -- the scores?

MR. STANLEY: The figure of merits?

DR. PRICE: The scores, yes.

MR. STANLEY: There were four participants, four participant organizations providing a figure of merit.

There was Raytheon; there was Sandia National Labs; Los Alamos National Labs; and USGS.

DR. PRICE: So you had an "N" of four? You had four numbers that you put in and you averaged them for your tables?

MR. STANLEY: Let me turn back to one of the results.

[Slide.]

MR. STANLEY: These numbers were input from the individual's figure of merit results. These weighting factors were derived from an independent panel.

DR. PRICE: Yes, but when you take the numbers that were input, you've only got one number up there. What determined that number, the average?

MR. STANLEY: That number was the result -- for example, let's say surface-based testing -- I don't know if that will interfere.

[Slide.]

MR. STANLEY: .253 here was a number; .253 put in up here. .348 was a number; .348 put in up here. 40 was a number; 40 put up in here.

DR. PRICE: But four organizations provided a number that somehow constituted that number?

MR. STANLEY: Now, this number down here was provided by USGS, which performed their own figure of merit, and I don't know how many people they had on their panel doing this evaluation.

DR. PRICE: So, there was only one input to provide surface-based testing of .253? One organization provided --

MR. STANLEY: For surface-based testing.

DR. PRICE: -- for surface-based testing.

MR. STANLEY: Yes.

DR. PRICE: And then one organization provided something for underground testing?

MR. STANLEY: Another organization, Los Alamos National Labs, provided for underground testing.

DR. PRICE: A figure of merit out to the third level of significance.

MR. STANLEY: This is what they provided to us. I hope that doesn't interfere, again.

DR. PRICE: That made the 1.176?

MR. STANLEY: .176, .176.

DR. PRICE: And likewise, then, there is another organization that provided performance assessment?

MR. STANLEY: Sandia National Labs.

DR. PRICE: And then you combined those or added them up to get a total assessment.

MR. STANLEY: Yes, sir.

MR. CRAIG: Could I clarify something?

MR. STANLEY: Sure.

This is Bob Craig from USGS.

MR. CRAIG: Yes. This is Bob Craig. I am, as of today, actually, acting Deputy TPO for the Nevada Operations Office. I've been the Testing Coordinator for the Survey for some time.

I do want to point out something in terms of the underground testing and surface-based testing, that we're not strictly limited to one organization.

The underground testing, for instance, Los Alamos has. The Test Coordination Office took the lead in preparing that report.

They had representatives from all the scientific participants participate in the development of the factors, the scoring, and the weighting of them for underground testing. The Survey had the lead for the surface-based testing.

We did involve people from Los Alamos and Sandia who have part of the surface-based testing site-characterization program.

Does that help a little bit? I didn't want you to get the idea it was just one organization taking care of it.

DR. PRICE: But in each of these four categories, the end result was one number came from an organization. Is that right? That's how you got the number.

MR. STANLEY: Well, three numbers came from each organization, one for each alternative site.

DR. PRICE: One number came from one organization; that is, the .176 came from an organization. Right?

MR. PETRIE: This is Ted Petrie, DOE.

RSN is the lead organization for performing this study, Raytheon is. Okay? LANL is the lead organization for underground testing. USGS took the lead for surface testing.

So, Raytheon, as the lead organization for the study, went to the lead organizations for those two areas to get the input.

Those two organizations, in turn, went to every organization that was providing support in those two areas and got help in preparing the weighting or the information used ultimately by Raytheon in this study.

So, from a Raytheon viewpoint, it's one organization they go to. From a program or project standpoint, all of the affected organizations are addressed.

DR. PRICE: Okay. But what, really, I'm trying to understand is -- as I would understand it, when this number came that is now included in this report, it probably constituted inputs from a variety of persons who also provided numbers, and somehow that organization came up with .176 to represent the inputs of all of these people.

My next question, then, given this variability of input that has to be behind that number, did you do any statistical testing to determine that there is any difference across these categories?

MR. STANLEY: Categories of?

DR. PRICE: Well, we've got out here numbers that you indicated were third and fourth levels of significance before you could really decide you had a winner, and then you have declared a clear winner, and what I'm saying is these numbers have come from several sources in which there is variance among those inputs that finally determined the final number.

That is, there is variability involved in these numbers. .176 comes from a source that has variability in it, and given that variability, when you consider the variability and you're looking to see is there a difference across these different sites, given that variability, you can't tell if there is a difference across these sites going out to the third level of significance without some kind of statistical evaluation.

MR. STANLEY: Statistical evaluation may be one thing in determining the 1.67, and you're correct that each and every individual organization should provide some sort of a backup for how that was determined and the robustness of that particular figure which they provided in their resulting report, and we do have the resulting reports, by the way, if you wish to see them, as backup material.

Going out to the sites, physically standing on the ground, looking at -- considering geologic information, considering the faulting that you can see cross-country, the geotechnical considerations, and every participant organization and the participants involved in each one of these organizations being involved in the selection, we had overall concurrence that yes, this would be a suitable site location and that we had no overwhelming objection to any of these.

We didn't even have concern in the south ramp.

DR. PRICE: The question I have, though, is whether or not, in fact, you discriminated between site one, site two, and site three.

DR. FABRYCKY: Wolt Fabrycky.

Regarding this question of discrimination, I heard nothing here about cost.

There is a great system engineering principle that there is no such thing as a free lunch, has economic consideration has been brought to the party in discriminating across the mutually-exclusive alternatives?

MR. STANLEY: The only way that cost was brought to consideration in this study was minimally, and it was not a major factor. Cost was considered.

DR. FABRYCKY: Are we saying that cost is no object here?

[Slide.]

MR. STANLEY: We're saying that cost was considered in the engineering aspect when considering ramp length. Of course, cost would be a little bit larger in a longer ramp.

Of course, then you have to consider would cost be greater in a steeper ramp, or would cost be less in a steeper ramp, etcetera, and various combinations.

It was relative cost. It wasn't a finite or deterministic type cost. It was subjective.

Does that answer your question?

DR. FABRYCKY: You're saying that cost was brought to the consideration through judgement?

MR. STANLEY: Through judgement, yes, sir.

DR. FABRYCKY: But not separately considered in a benefit cost or a cost-effectiveness type of analysis.

MR. STANLEY: That's correct.

Now, if someone has a suggestion to alter the study, to alter the approach to the study and to consider other factors such as cost, I would remind everyone that this is a preliminary report, and we would certainly entertain suggestions of that nature.

DR. FABRYCKY: One other dimension would be schedule impact. That could be brought to it.

MR. STANLEY: That's correct.

Yes, sir.

DR. DEERE: Don Deere.

To continue on with that, because I also was examining this same sheet, wondering where cost came in, it seems that items four, five, and six, the ramp construction, ramp length, and ramp gradient, almost balance each other out.

In other words, you're saying, where it's longer, it could be more expensive, but it's a flatter gradient, and where it's steeper, it's shorter, but it's more -- so, when you add the three up, it comes out about 11 against 11, something like that.

So, the particular analysis almost cancelled out in the way they have weighted in in this thing. I think this is a question that perhaps should be looked at a little bit later.

But having gone through something similar in the evaluation of the Super Conducting Super Collider, where we had a number of different panels studying it for several months, at the end, much to my chagrin, I found that cost didn't even enter into the selection.

If you're talking about $200 million, you could increase the cost another $200 million, and it still didn't hardly change the figure, because the other factors that were there were so much more important in the analysis.

The regional resources and the ability to have the airport nearby to attract the people and all of these things just simply overcame any difference.

Well, that was very easy, as an engineer, to accept, that it didn't make any difference if the site cost $200 million for the tunnel or $300 million for the tunnel, because that's money that's going to be spent first, and everybody told me, but the magnets are a billion dollars, so you don't have to worry about the tunnels.

It's a little bit like this in the weighting effect. If you get more information -- and obviously, when we go to the underground testing, that's where they have given the greatest value for the long, flat ramp. It knocks out any cost differential, which here is very small, anyway, rightly or wrongly.

DR. ALLEN: I think we probably ought to be moving on.

MR. GERTZ: This is Carl Gertz with the Department of Energy. I just wanted to clarify a couple of things.

First of all, when Leon talked about Midway Valley and are we committed to that, we are not, as you see here. Should, during the ten years of site characterization, we find that a surface facility would be inappropriate at Midway Valley, for whatever technical reason, we would then have to, of course, adjust our design and find another surface facility and another access to below ground, or another use for that ramp.

So, what we're talking about is our study facility, and that's what we're planning on.

During the studies, we may have to change repository designs significantly, because that's the reason for the studies, is to find out more information, not only about the mountain, but to help us, if the mountain is suitable, with repository design.

Secondly, in response to Ed Cording and yourself, Don, we are bringing on board, through the resources involved with TRW, with the M&O and their teammate Morrison Knudsen, some TBM experts. One of them, in fact, is on board already working with us, and we are looking to bring a couple of others on through their participation in the project. So, we are bringing in some more expertise in that area to the table. I just wanted to make that as a matter of record.

The third thing, I think, Dennis, is -- maybe you and Bob Craig can talk a little bit more about how the different disciplines with the USGS and our other teammates got involved and came up with that one number. Because it was a matter of elicitation, et cetera, et cetera, for them to come up with one number. I understand your concern and perhaps Bob could expand upon that off the side sometime with you.

DR. ALLEN: We have one quick question there.

MR. NATARAJA: Mr. Nataraja from NRC.

I would just like to clarify whether you took into account the NRC objection to the shaft location in your consideration of the alternatives? For example, the shaded area that you are showing is close to the location of the earlier shafts for which the NRC had objected.

MR. STANLEY: Can you be more specific in your objection -- in the NRC objection?

MR. NATARAJA: The objection was the location, that you are now selecting the same location, or at least in the vicinity of that.

MR. STANLEY: I believe the location, or the objection to that location was that not enough geotechnical consideration was given, not enough geologic consideration was given, or the literature had not been sufficiently researched, prior to the selection process, or during the selection process of this area.

During this selection, we asked the U.S. Bureau of Reclamation, USGS, to go out and to do actual field work, do a field study to see if there's any physical feature that they could recognize that would contribute to information for or against the selection of this site.

In addition, we asked that they do literature research. So, they researched past geologic interpretations of this site. Still, they did a report and they came up with no significant objection to this site location.

Third, we asked SAIC's Geotechnical Department to take into consideration geotechnical information and studies that had been done in the past concerning actually all of the sites.

Yes, we did take into consideration the objection of the NRC. We want to be very careful to say that we did cover their concerns. We have more information available that you are certainly welcome to review, and we can discuss that with you.

MR. NATARAJA: Thank you.

MR. FRISHMAN: My name is Steve Frishman, the State of Nevada.

Did that field study resolve the geophysical anomaly that's known to be there? And if it did, what is the resolution of it?

MR. STANLEY: The geophysical anomaly in the --

MR. FRISHMAN: In the ES-1/ES-2 area?

MR. STANLEY: That was addressed. The exact result of that, I would have to go back and look at the reports. I believe that Forrest Peters might be able to better answer this question. Forrest Peters is a representative from SAIC, who provided much of our information. He is walking up behind you right now, and may be able to --

MR. FRISHMAN: It would be interesting to know the resolution, if there is one.

MR. STANLEY: I understand, yes.

MR. GERTZ: This is Carl Gertz again.

Forrest, before you start, once again, we would like to point out that this is just an optional shaft, only to be constructed if the ramps don't provide us enough scientific data. By that time, we would probably have a lot more data about a good location for the shaft and the geotechnical considerations. But it is just purely an option at this time.

Go ahead, Forrest.

MR. PETERS: To answer the question two ways: There was a technical assessment review that was done on the ES-1 and ES-2 shaft locations here sometime ago. I believe that is available to everybody, which specifically addresses the question of the geophysical anomaly which was on the geo-electrical work that was done a long time ago.

Now, for this particular two locations here, in the red, I myself was not involved in the actual geologic field work there. So I don't know what the results, with respect to the geology, the surface geology, are for those two areas. I believe that the Bureau of Reclamation was directly responsible for the geologic field investigation of the red area.

So there are really two questions here. The technical assessment review addresses specifically the geophysical anomalies, but the Bureau of Reclamation did the actual field work for that red area.

MR. FRISHMAN: I raised the question only because it surprises me a little bit that of all the sites, you end up with the one that has the best known unknown.

MR. STANLEY: That comment has been recurring as a result of this presentation or this selection. Other people have said, gee, it's amazing that you have chosen the same site all over again. I attempted in this presentation to point out that we went through a process of evaluating alternate sites, as well as this area -- and please understand that it's an area, and that the "winner" was this area, but it wasn't a very robust winner. It was, as I said before, "you pick 'em." We could just as easily pick this site, this site, or this site.

Number three, by the way, is a little bit less advantageous because we don't have complete information on a new probable maximum flood study that is being done at this time. As you can see, it is a little bit further on down the hill. So, since we have one close enough to it --

MR. FRISHMAN: For purposes of the Board, I bring this all up because -- maybe it's not the result that is the problem, maybe it is the process that is the problem, that would arrive at something like this --

MR. PETRIE: Well, are you saying that the anomaly is really a problem?

This is Ted Petrie, with DOE.

Is that your position? Is that the state's position?

MR. FRISHMAN: The anomaly is a problem only because we know there is something there and we don't know what it is and we don't know what its significance is.

DR. ALLEN: Okay. Thank you.

A final comment from Don Deere.

DR. DEERE: I just wish to acknowledge the comment that Carl Gertz made, that they are bringing aboard a number of experienced TBM engineers and construction men. I think, at this stage, going into such a large program with these accesses, this is a very good idea. It is one that the Board has been interested in in all of the studies, that they get as much outside expertise to review and to give opinions on this. I think this is a good step.

MR. STANLEY: In addition to that help, which Mr. Gertz mentioned, we are also attempting to acquire the services of the Earth Mechanics Institute of Colorado School of Mines to do a number of evaluations and input, give us a number of inputs.

DR. ALLEN: Thank you.

Ted, do you wish to summarize?

MR. PETRIE: Yes. Thank you.

SUMMARY

[Slide.]

MR. PETRIE: I won't bother to introduce myself again.

[Slide.]

MR. PETRIE: But let me just say that all specific comments on the design studies at this point are certainly accepted, and we will attempt to address, and we will address every single one of them.

And I would particularly address the state, and ask them to make sure that when they attend the reviews in the future, that they, if they have a problem, tell us about it, and we will make sure it gets addressed.

As in the tentative schedule of future reviews, the management review is scheduled to start July 29th; technical review would be August 12th, and this QMP-0604 is an internal Project Office review, which will take place the week of August 26th.

[Slide.]

MR. PETRIE: The review package, at this point, will include the drawings for the North and the South Portals and Ramps, a design summary report, and examples of outline specifications.

[Slide.]

MR. PETRIE: And in summary, our future plans are to start Title II design October 1st, start site prep. in June of '92, and to start portal construction in November of '92. Those are still our plans.

In summary, that's where we're going.

Are there any other questions?

DR. ALLEN: Dr. Cording.

DR. CORDING: Yes. One question on the specifications and construction contract.

Do you have some plans at this point for the form of the contract? What are you planning in that regard, and how will the contract be carried out? What sort of invitations, and what sort of --

MR. PETRIE: I can tell you the planning at this point.

DR. CORDING: Right.

MR. PETRIE: And no one should assume that therefore, that's the way the contract will be written.

We have put in the "Commerce Business Daily" request for expressions of interest. We have received expressions of interest from something like 20 different organizations.

This was broadly written, but in general, what it says is, we are looking for a contractor who would provide us with the underground facility. And that would include, well, of course, assistance with constructability issues during our design phase. We expect to have him on-board well before the finalization of any of the underground designs.

Does that answer your question? I don't think I want to talk about whether this would be a CPFF or an award fee, or a fixed price, or whatever. I'd prefer not to talk about that.

Does that answer your questions?

MR. GERTZ: This is Carl Gertz. Let me just add a little bit to the broader philosophy that we're looking at.

In effect, we're looking to buy maybe a hole in the ground, 14-mile hole in the ground, and having a contractor tell us how he is going to provide us that hole in the ground.

Of course, we'll have to give him certain specifications and parameters, such as there are certain ramp sizes we need specifically, or ranges. We'll provide that to him.

But we're constructing our RFP, our formal RFP, right now. It will be some type of cost-reimbursable contract, because it would be unrealistic to go to a fixed-priced contract where we're depending upon scientists.

Scientific investigation is the only reason we're doing it. There's no production purpose to do 13 miles of tunnels. We're only doing the tunnels so we can conduct the science.

DR. CORDING: Prior to that selection process, it would involve the technical proposals from these potential contractors.

MR. GERTZ: Certainly. The way the Department does business on non-fixed price contract is the technical qualifications, technical proposals, evaluation of the personnel, corporate history, things like that. Going through our current construction, at times they would, in effect, be letting the RFP under our direction. That would be our mechanism for bringing a contractor in.

DR. ALLEN: May we move on?

[Discussion off the record.]

DR. ALLEN: We will take a luncheon recess, and be back at 12:30.

[Whereupon, at 11:25 a.m., the meeting was recessed for lunch, to reconvene the same day, Monday, July 15, 1991, at 12:30 p.m.]

AFTERNOON SESSION

[12:34 p.m.]

DR. ALLEN: May we resume, please.

Dwight Shelor has the floor.

MANAGEMENT SYSTEMS IMPROVEMENT STRATEGY (MSIS)
STATUS AND IMPLEMENTATION

[Slide.]

MR. SHELOR: Now that we've all had a relaxing lunch, we can be in for a long afternoon.

Dr. Allen, I want to apologize up front. We have a lot of material. If we're running too long, tell us, and we'll try to condense it, but we haven't had an opportunity to spend a great deal of time with the Board, so we want to try to go through a lot of things this afternoon.

My objective for our briefing today is to introduce people who will, first of all, describe the status of the management system and improvement strategy initiatives

[Slide.]

MR. SHELOR: As you recall, on March 26th, at the meeting, we described to you an approach that we had developed, which is a very comprehensive approach involving the establishment of a framework for analysis of the programmatic system and the physical system leading to a set of documentation that would provide system and component-level requirements for the program and, equally important, to describe those processes that we could use to bring the physical system into being.

Today, we have an opportunity to describe to you products that have been nearly completed or are nearly completed, and it's a very opportune time to do this.

In this description this afternoon, we will not have the opportunity to go through the complete set of documentation, but we have picked out specific examples of how this approach has been implemented in the physical and the programmatic analysis, and last but certainly not least, you will have a presentation by Frank Ridolphi on the respective role of the new M&O contractor in terms of the implementation of these -- integration and implementation of the MSIS initiatives.

[Slide.]

MR. SHELOR: I would like to put up a graphic that you have seen before in the March 26th presentation and just simply indicate that, of the 12 or so initiatives that we outline, again, to put this in the proper framework, we have an ongoing program.

There are a set of requirements there. We are in the process now of going back and doing a functional analysis of both the programmatic functions and the physical system and doing this, as you know, in a very systematic, deliberate approach, so that we can end up with a documented and traceable set of requirements and an integrated, programmatic system to manage the program.

This was based, as you know, earlier, on the Secretary's initiatives back in November of '89.

Stated briefly, the three primary initiatives were to focus the activities at Yucca Mountain on scientific investigation and to provide for the early acceptance of waste from the utilities and to improve the management of the program, and these initiatives, then, were identified shortly after or in conjunction with the reorganization which has taken place.

So, this afternoon, you will hear descriptions of the functional analysis of the physical system and the preparation of the requirements documents, along with the conduct of the programmatic functional analysis and our plans for preparation of these programmatic function plans, and then, obviously, the role of the M&O, then, will be combined in with the lower initiative.

[Slide.]

MR. SHELOR: I'll very quickly just review for you again from our presentation in March the fact that in the development of both programmatic and physical system requirements or process documents, we first of all establish a management plan, and then we actually implement the management plan in doing the functional analysis and preparing reports, and then we go through a technical review process, and ultimately, before they become controlling documents for the program and baseline, then they go through a Change Control Board action and to the baseline documents, with their appropriate contents.

[Slide.]

MR. SHELOR: We have come to an interim -- this is not really -- well, I think it's best to call it an interim physical system/technical requirement document hierarchy, beginning with the overall system broken down into four main Level 1 activities.

These, again, will be system requirements, the physical system requirements for the exploratory studies facility. There will be a description this afternoon of how that was developed and an example of some of those activities which involve the mission analysis for the ESF.

Then, the M&O will describe their activities in developing and providing for a baseline of the system-level specifications and the design specifications.

[Slide.]

MR. SHELOR: I want to point out one very important activity.

In the work that's been conducted to date on the programmatic analysis, they have identified 16 Level 1 programmatic functions, and those that have a checkmark -- there are seven checkmarks -- are the analyses that have been completed to date, and that documentation is in the process of being reviewed and finalized.

We are going to do -- I think Tom Woods will explain to you -- some integration of these seven at this time. We considered these seven programmatic functions as the higher priority, and then we will plan to complete the others as soon as possible.

[Slide.]

MR. SHELOR: You will note in the physical system requirements documents that our process that we have implemented does try to separate only all of those requirements, performance requirements, if you will, and other requirements for the physical system from the programmatic requirements that would be required in order to implement that system.

We have tried to separate the requirements to the functions of the system. Therefore, in order to baseline these documents and replace the existing WMSR series, we have to have a place to put those appropriate programmatic requirements that would be associated.

We are in the process of compiling a series of -- several volumes of a document that will be called "Programmatic Requirements" that we will utilize in the interim, until we complete the programmatic functional analysis and allocate these requirements to specific functions, which we intend to do, but in the interim, we will have a compilation of all of those requirements, and they will be segregated.

For example, for the programmatic requirements that would be associated with transport waste, they would be in a separate volume which, combined with the overall system then, at least has a compilation of all programmatic requirements.

This is an interim measure, and we will ultimately include all of those programmatic requirements with the appropriate programmatic functions.

[Slide.]

MR. SHELOR: For example, when a process is complete, there will be specific documents that describe the programmatic functions and have their associated requirements.

[Slide.]

MR. SHELOR: I don't want to spend a great deal of time. I think it is important for you to hear from other people who have been directly involved in managing and implementing the process. So, it is my pleasure today to introduce, specifically, and I will take the time to do it here, Steve Gomberg, with the Office of Systems and Compliance, to give an introduction and overview of the programmatic functional analysis, and Tom Woods, who has a group at Westinghouse Hanford, have been specifically addressing the programmatic functional analysis. Tom will follow Steve.

Bill Lemeshewsky, in the Office of Systems and Compliance, on the end, will present an overview and approach that was used in the physical system functional analysis in the development of the requirements. Dr. Mike Duffy will provide examples of that implementation and an explanation. All of this then to be followed by Frank Ridolphi, who will tell us more about the role of the M&O and the integration and implementation of these activities.

So, we will move right on into Steve.

PROGRAMMATIC FUNCTIONAL ANALYSIS - SCOPE 1 APPROACH/PARTICIPATION

[Slide.]

MR. GOMBERG: Good afternoon. My name is Steve Gomberg, and I'm the Acting Chief of the Systems Planning and Integration Branch. I will be talking today about the scope and the approach of the programmatic functional analysis effort.

[Slide.]

MR. GOMBERG: Back in August of 1990, the program issued a management systems improvement strategy in which it identified two different types of functions that apply to the program, physical system functions and programmatic functions. It specifically defines programmatic functions as those functions required to bring into being the physical elements, subsystems and components of an operational system, reflecting the unique nature of the program.

We committed to conducting functional analyses to identify all the programmatic functions and subfunctions and the dependencies among them. The analogy that we like to use is to compare the physical system functions to the Pontiac and the programmatic functions to GM, which markets, designs, operates, sells, gives loans for the physical piece of equipment.

[Slide.]

MR. GOMBERG: We developed a hierarchy, initiating from the MSIS, which identifies programmatic functions and physical system functions, and we have conveniently broken those out into four general groups: Those that comprise systems configuration, system implementation, external interactions and management support.

As you can see, the configuration includes systems engineering and design, testing and site characterization, external interactions, regulatory compliance, international programs and external interactions; and management support, including quality assurance.

[Slide.]

MR. GOMBERG: Now, these 16 functions are decomposed to the subfunctions to identify the dependencies and the sublevel functions. Basically, the process that we use to do that is described here. Starting from the upper left and going clockwise, we conduct functional analyses, which is basically identify the functional hierarchies, how the upper level functions relate to the lower level functions.

Very importantly, as we define the functions, so that everyone is working from the same level field, we identify interfaces, which are the information flows among and between functions, as inputs or outputs or constraints on the conduct of particular functions. Once we get to a level that we are comfortable with, we allocate the requirements to the appropriate sublevel functions.

Once all of the analyses are completed, we can then integrate among the functions to get meaningful information. Various ways along the process, we can put out interim documentation, as Dwight talked about, programmatic requirements; functional process flows, which describe how a particular function is to be performed, such as system engineering; and the interfaces involved, such as design, regulatory compliance and others.

Ultimately, through the Change Control Board process, we would document the function descriptions and the requirements, in a program management system, and associate documents that come out through the document hierarchy.

[Slide.]

MR. GOMBERG: To repeat, we've conducted seven functional analyses to date. They've been conducted and preliminarily documented. We focused on these first five here, which are from Assistance Configuration Group. We've also decomposed "ensure regulatory compliance and provide program control."

[Slide.]

MR. GOMBERG: We still have to do nine functions. I have grouped "construct, operate and decommission" as one general set of the systems implementation category. We hope to do this in the next fiscal year, so that we can have all 16 functions decomposed and fully integrated.

[Slide.]

MR. GOMBERG: Next, I want to turn the subject a little bit to participation. The Office of Systems and Compliance is responsible for managing the programmatic functional analysis activities. These activities have been broken up into three general support areas.

The Functional Analysis Task Team is led by Tom Woods at Westinghouse Hanford Company. That is basically the facilitator, the systems engineering and the dynamic modeling activities that Tom will talk about a little later in his presentation.

Weston conducts the requirements research. Basically, there are over 250 source documents, statutes, laws, Federal regulations, DOE orders, executive orders, internal requirements that are analyzed, and specific requirements that can be allocated to the appropriate functions are identified.

Finally, to group all of these requirements together, to control them, to make them available to others in the program, and to integrate between the physical and programmatic requirements, everything would be housed together in a systems requirement database, which is currently being operated, in prototype mode, by Westinghouse Hanford Company.

[Slide.]

MR. GOMBERG: Now, very importantly, is to get the technical expertise from within the program to conduct the functional analysis. So, we asked for participation from all of the affected entities within the program, to provide technical or programmatic knowledge, within their functional areas of responsibility, to provide expertise for reviewing functional analysis reports, requirements documents and other related products, and ultimately, to assure that the procedures developed, through the Program Management System Manual or other implementing procedures are implemented by the appropriate line organizations; basically, that they can understand them and implement them.

All OCRWM Office Associate and Office Directors have or will provide support to the functional analysis.

[Slide.]

MR. GROMBERG: Now, the M&O, the Management and Operations contractor is currently transitioning into the program. The functional analysis work started before they came onboard and as part of their startup phase, the M&O participated as technical experts in the workshops or observed the workshops. Ultimately, through the transition phase and during their actual start-or-work phase, the M&O will conduct the functional analysis workshops through -- the workshops will be conducted through external facilitators.

They will provide all of the requirements research. They will operate, maintain and control the systems requirements database and they'll be responsible for generating all established deliverables such as the functional analysis reports and implementation documents such as PMS manuals and procedures.

[Slide.]

MR. GROMBERG: Now, another way to look at the process of the functional analysis is through a three-stage process, beginning with analysis where we actually do the functional analysis and we document those through the functional analysis reports, either for the individual top Level 16 Functions or through an integrated set of functions.

We then come with a need to communicate what the results are. So, our second stage is communication through briefings, through training, through process descriptions or communications packages which describe in -- let me just say it in plain English -- the ultimate process, for example, for conducting systems engineering activities through the three stages of design; those are all communications documentation products.

Ultimately, we would implement these through the PMS manual, the Program Management System Manual. We would provide systems requirements documents and also standard policies, plans and procedures. The implementation phase is where the program elements adopt the results of the functional analysis and they can be controlled in baseline.

[Slide.]

MR. GROMBERG: Finally, the types of planned products that we have include the Program System Manual. I guess you could have already inferred that this pretty much summarizes the management of the overall program through document hierarchies and through identifying work breakdown structure elements that are product-oriented.

The systems engineering is managed through the Systems Engineering Management Plan and that provides the description of the technical baseline, design controls and other related activities related to systems engineering and design. As Dwight has talked about, programmatic requirements documents which capture all the 16 -- which capture the requirements that apply to all the 16 Level programmatic functions grouped for use by the program to be consistent with the physical element document, with the physical system requirements documentation according to overall system -- accept waste, transport waste, store waste and dispose of waste.

Now, Tom Woods is going to talk about the implementation and the status of the Programmatic Functional Analysis. Are there any questions?

DR. ALLEN: Questions from the Board?

[No response.]

DR. ALLEN: Any questions from the audience?

[No response.]

DR. ALLEN: Okay, let's proceed.

PROGRAMMATIC FUNCTIONAL ANALYSIS, IMPLEMENTATION/STATUS SCHEDULE

[Slide.]

MR. WOODS: Good afternoon. While I'm getting ready here, those of you who know me probably fear for the recording and amplification equipment because of the voice that god chose to give me, which generally rises as I get more passionate about the material. I'll try to control it.

[Slide.]

MR. WOODS: Perennially, we've had a lot of questions; why in the world are we doing this kind of analysis? I'll try to help with those questions right off the bat. Everyone, I think, that has been close to systems engineering is quite accustomed to seeing a functional analysis done of the product or the system that has to be produced to fulfill the mission.

People are not accustomed to seeing those kinds of analytical techniques used on the program itself that has to produce that system, but that's exactly what we've done. We reason that just as a repository system or an MRS system or a transportation system has to perform certain functions to achieve its part of the overall system, so then must the program have to say somewhere, regardless of organization --this is quite organization-independent -- but somewhere certain functions have to be performed in programs or there won't be a transportation system or a repository system or anything else.

Those things have to be created by the performance of functions. So, in response to the Secretary's mandate to review the management systems, what we undertook to do is, okay, let's see if all of the functions have been identified that need to be performed someplace in this program, and that the way we've chosen to do business, the collective "we" here, have chosen to do business is working.

This really amounts to what you'll hear me referring to as standard practices. One of the things that became pretty apparent to a lot of observers of the program is that, unlike other established industries, -- steel industries, auto industries, aerospace industries -- that, in fact, we had and were grouping a lot of new disciplines together in this program. They were undertaking something that hadn't been done before.

There weren't bookshelves full of standard practices or practice manuals on how we were to proceed. By looking at the functions and the way the functions are related, we, in effect, are looking at the standard practices in the program and are they working? Of course, that brings into play then, how are the functions related?

As probably comes to no great surprise to anybody, the way program functions are related is with information that is generated by some functions in order that another function can be performed at all. So, what information is that? Is it well-defined? Is it really moving?

The whole object here is to discover whether or not there are any functions or any information that's missing so that some parts of the program -- well, we hope it's not dysfunctional -- but it may not be very robust in certain areas. The selected way of doing business might be able to be improved so that the program can operate better.

These are the reasons that we undertook the analysis. The bottom line, I'm not ignoring. Again, those of you who have been around the program for a period of time, know that the program is heavily, heavily constrained with imposed directives and requirements and regulations and so on. The question remains, is there solution space left after one accommodates all of those requirements and all of those directives and all of those orders?

If there is, then the choices of how the program functions can be performed, are very, very limited. That is quite a different concept than what is usually regarded as, well, there's lots of ways to skin the cat. Yes, there are, but there may not be lots of ways to skin the cat that respond to all of the imposed requirements, particularly when you have to take the functional processes in each of the major areas -- design, site characterization and so on, and the must be compatible with one another. This further constrains the choices in how the functions can be performed and still have an effectively running program.

That is, in a nutshell, why we undertook to do this analysis.

[Slide.]

MR. WOODS: Now, the way we did it -- and I will use these little diagrams to guide us through the way we did it -- the function here being performed is, as you see in the box, to improve the management systems within OCRWM, as mandated by the Management System Improvement Strategy and the Secretary's directives before that.

The inputs -- and again the legend is at the top here -- the inputs from the left, well, what must the program achieve; and the output is as you see it.

The constraining regulations or requirements on the performance of this is the NWPA and the Management System Improvement Strategy itself. The transform mechanism or resources used to perform that function are in these four groups across the bottom.

Now, in the next series of slides, I will take you through a functional decomposition of that task to the first level, and you will see how the thinking, how the concept, how the method, in practice, works.

[Slide.]

MR. WOODS: The first thing that is done is pretty classic, and comes straight out of anybody's textbooks. And that is to identify at each successive level every function that is necessary to perform the parent function, and then to test it to assure that all the functions that are there are sufficient to perform that higher level or parent function.

When one does this, layer by layer, the output is a hierarchy of functions. And you will see here again the software that's being used in this forces us to account for all of the inputs, outputs, and the constraints that were on the parent page. And that's why you see these here. We will, by the time we finish this page, have accommodated all of those.

So what do we get from this functions hierarchy? What does it look like?

A couple of examples. And the purpose of these charts is not to take you through each of the items cited in each of the boxes here, but only to indicate that if we started with an overall mission to execute the NWPA, that its functions are, first of all, performed by physical system as seen on the left, and that's the subject of Bill Lemeshewsky and Mike Duffy's presentations, coming up in a little bit.

What we looked at was what must be done to provide that NWMS, which subdivides, as you see here, or decomposes as you see here, into developing the physical system, and to manage the, to provide the management functions for doing that.

The boldface boxes here, by the way, are those 16 functions as cited in the Management

System Improvement Strategy. The higher-level functions were added in our analysis only for the convenience of modeling and completeness.

[Slide.]

MR. WOODS: The next chart is one of those charts that shouldn't be in a briefing. It's not intended to be read.

But it is intended to show that the regulatory compliance major function, which is the parent function in this case, this is an example of the depth to which the workshops that Steve talked about decomposed one of the major functions.

As you can see, the first layer was decomposed into these five functions; this first one over here into three functions; this one is decomposed into four functions; this one into four; this one into three; so on.

And, in turn, those were decomposed, in this case, into four; this case, this one right here was decomposed into four more.

The point of this chart is that the depth to which the functional analysis was taken was not level, deliberately. We sent selectively to the depth, frankly, that the calendar would allow us to go.

And as we went, and as we learned, we found that there are some functional areas that, frankly, in the coming months, should be extended deeper, because we know that those deeper functions are critical to the operation of the program, and they need further analysis.

So that's a couple of examples of the function hierarchies that were created.

What happens next?

[Slide.]

MR. WOODS: Now, we begin to attack the matter of how are these function related. And we begin to create diagrams, in fact, just like the one you're seeing. And we'll have a more complete example in a moment, where we actually take the functions on this diagram -- so far we have two functions shown -- and we begin to relate them by the information that is generated by one and passed to another.

We not only get written descriptions of each function, that again can presumably be used in later times in writing system engineering management plans, and other policy documents. We not only get written descriptions of each of the functions, we get written definitions, as you see here, of the information that is passed by each function.

Okay.

I think maybe before I leave that one -- yes, I covered the output, and that's what I wanted to make sure I had done.

[Slide.]

MR. WOODS: Now, at the same time that the functional processes are being developed by the Functional Analysis Team and the visiting line organization experts here, as was indicated, Weston is conducting requirements research to determine what requirements, what documents, what DOE orders, what Executive Orders, really constrain the choices we have in the performance of the functions in the program.

That is going on in parallel here, the outputs of which are provided to the Functional Analysis Team, see, because now we've got to look at all those requirements and see if gee, did we leave out a function that, oh, let's say for example, a DOE budgeting manual requires that some function be performed in order that everybody, all DOE programs, submit budgets each year in the correct way.

If we find that there is an order or requirement somewhere that dictates a new function that was not generated in the analysis -- important point here, what generates the functions in the analysis. The parent mission.

Now, the pause here in the pace of my presentation is very, very deliberate, because it's a subtlety, but an extremely important one that escapes an awful lot of folks.

Requirements do not drive the program. And that is a highly, highly misunderstood concept. The job that has to get done drives the program. The requirements constrain how the different functions are permitted to be done. But in the final analysis, it's the job that has to be done. Complying with the requirements, you bet. But it's the job that has to get done.

We have an awful lot of folks, we've found, that think that if we just comply with all of the requirements, whatever they all are, that the job will get done.

Well, if you consider that carefully and logically, there's no way, no matter how much you compile in one spot, and sort, and stack, there's no way that all the authors of all of the directives, in all of the times past, could have anticipated the needs of this programs.

So the functions being performed in the program have to be job-driven, not requirements-driven.

[Slide.]

MR. WOODS: So from the Requirements Research Team, the Functional Analysis Teams are provided the applicable requirements. And these are done, these have a rough sort, a very rough first-order course sort, done by the Requirements Research Team, just simply sorting budget requirements into a budget pile, design requirements into a design pile, and so on, those first 16 functions.

And those are provided, then, back to the Functional Analysis Team, who now reviews the functions and their functional process flows, to see what's been left out.

Coming out of this, then, are some revisions, in order to accommodate requirements, or accommodate things that we have not thought of, or were not driven in the opinion of the line organization experts, by the mission, to accommodate those. And this modifies the functional processes, which then emerge as processes that not only comply with requirements, but also get the job done, or mission effective, as I have called it here. Well, then, what happens to those two things?

I would also point out that the Functional Analysis Team has now allocated those requirements to the lowest possible level. What does that mean?

That means that, if I am concerned about putting together an annual budget those are the constraining requirements that I want to see. I don't really want to be bothered with the requirements that constrain how engineering is done. What I want to see is all the requirements that anybody imposed on this program on how to build budgets.

Conversely, if I'm in charge of system engineering, I want to know what imposed requirements constrain how I'm allowed to do system engineering. I don't want to see the budget requirements.

So this allocation, then, allocates all of these -- how many was it, 200 and how many documents, Steve?

Okay. By individual count, we're up over 6,000 individual requirements. That means a paragraph, a sentence that says do this or don't do it that way, or whatever. We're something over 6,000 requirements that are being looked at and allocated, and provided then, into a requirements database, which is a concept new to most folks.

[Slide.]

MR. WOODS: We are highly recommending to the program that the management of requirements be done through a relational database. In some 35 years of systems work and many major programs, I have not seen a program that is nearly as constrained as this program is. It makes incredibly difficult, as probably some of our speakers this morning can attest, to understand, A, what requirements apply to my ventilation system; what are they all? I'm not talking about codes and standards, folks. I'm talking about the higher level documents and regulations above the codes and standards level.

What are they all? Whose idea is it as to whether or not snail darter regulations apply to the program, okay? If they apply, how do you read that paragraph? How do reconcile a conflict between this EPA regulation and that NRC regulation and that state of Nevada ordinance?

So, there are conflicts and there are ambiguities that must be sorted out and when you add that body of information, interpretations and so on, to the text of the requirement to begin with, one copy of the program requirements document is now in excess of 2 feet high. It's dynamic; it changes.

That kind of a problem, we think, is solved only by a relational database, not by document control of a 2-feet thick document. Now, what you're hearing from me now is the technical opinion and it has a lot of implementation aspects that, of course, the DOE folks have to look at and haven't looked at yet.

But that's the way we see the requirements picture and that's what that function is. We are now developing a production version of this prototype database that's already being used for this, and we would recommend that the requirements be managed through a database that's available to all participants in the program that has consistent interpretations and resolutions of conflicts among requirements in it.

At the same time, the -- that didn't print there. Convert is the verb on the function; convert these functional processes and their definitions into standard, written standard practices like system engineering management plans, like program management plans, the customary kinds of documents in which you generally find policies and practices for the program. That's pretty much the process, except for one thing.

[Slide.]

MR. WOODS: Steve mentioned that -- well, before we do that, there is a quick slide that tries to provide a graphic on what we mean by a requirements database. Simply, it takes something like the 10 CFR series, the Code of Federal Regulations, and it looks at the individual pieces and parts of each of those and what function in the program or in the physical system that paragraph or even down to a sentence, conceivably, what function does that modify or constrain? That's the information that our people need, and it's a very difficult job to create that and maintain it.

DR. NORTH: I wonder if you could give some more concrete example? I think, for example, of the Carbon 14 gaseous release issue and its effect on the program. Or, pick another one, just at that level of specificity, and give us an idea of what it takes in terms of time and resources to do this? Then if you could give us an idea, if your proposal was accepted to build this relational database and use it, how much is that going to cost?

MR. WOODS: From the back of the question forward, and remembering as best I can, Dr. North, the relational database is using just plain commercial kinds of database managers. INGRES is where we are right now. So, laying on INGRES, the query routines and the report routines and so forth is a fairly simple thing.

Loading the database --

DR. NORTH: Yes, the problem is getting the data to load in.

MR. WOODS: Much of that is done. In the course of finishing the functional analysis, remember, as I said, the Functional Analysis Team, augmented with the line organization expertise, is doing that allocation, okay? So, it's not that far away from being something that is in-hand. In fact, the alternative which, in my experience, has always been paper requirements documents -- the alternative is much further away than the relational database. If one is to squarely face the problem of interpreting -- just like NRC themselves has done an analysis of the uncertainty in their own regulations, if one is to face all of those and sort them out and try to get those interpretations out to everybody in a document, that job is more frightening than just trying to get it done once and into a database and delivered to everyone.

I don't have a cost estimate for you; I'm sorry.

DR. NORTH: The spirit of my question is; are you going to get the right level of detail? You get too much detail and it becomes very expensive. If you don't have enough detail, when your system doesn't wind up being very useful, how are you going to make those tradeoffs?

MR. WOODS: There is a very straightforward answer to that: the 200 and closing on 250 documents, the criteria for selecting what is an applicable document has been something that has been wrestled with, both with DOE and Westinghouse, so, all we're taking is the explicit text in the regulations, the DOE orders and so on, and simply allocating those paragraphs and those sections to the functions that they apply to.

The level of detail is determined for us. It's not really much of a judgment all, although when you get to the outer fringes of snail-darters and land tortoises, one wonders how much further does one go in putting our arms around other regulations and so on, but that's the level of detail. The fidelity of the choice is dictated by the text that's in the regulation.

Now, how it's complied with is another matter, and that may be where you're going.

DR. NORTH: That's where I'm going.

MR. WOODS: Yes, that's another subject.

DR. NORTH: If I take an issue like the Carbon 14 issue, what you're saying the system will do is give us some links for where that issue will impact in various parts of the program. But it says nothing about how that issue might be dealt with and the kinds of data that one might need in order to make the appropriate program adjustment.

MR. WOODS: Bingo! Yes, sir, that's exactly correct. Now, I might also add, if I can think right with you on the thing, that having in hand, if I were that person dealing with that Carbon-14 issue, I would sure like to know what it is that I'm having to comply with while I make all my assessments and choose all the tests and gather all of the data to see if I do comply with it.

I'm only talking about the raw requirements that the program has to meet, that the physical system has to meet. Now, the data that's generated in meeting them is a very nice framework to relate that data back to the function, back to the requirement and so on. There's a very nice framework created, but right now, the relational database that I'm talking about is just the function and the requirements that constrain the function.

Did that clarify that, sir?

DR. NORTH: Yes.

MR. WOODS: I do encourage questions at any point here. I'm very comfortable in a seminar kind of environment, so please bring them up whenever you like.

[Slide.]

MR. WOODS: I mentioned earlier on that not only is the program highly constrained, it's highly complex. What in the world do I mean by that? It's one thing for one with, let's say, a group of very accomplished engineering folks, A/Es and so on, to develop a very insightful and very explicit design process, and that's useful and we've done that.

That's what the workshops do. It's quite another thing to make sure that, as I said once before, that that design process interfaces compatibly with the rest of the program, from site characterization to MRS activities, all across the program. Those interfaces are very, very difficult.

The tool that we have chosen to force us to make sure that all of the information that's flowing is consistent, that really the regulatory compliance people are producing and recognize they're producing explicitly the same information that the designer needs and that the designer is providing explicitly what's needed for that license application back over in that regulatory/compliance function.

What we're finding is that as we work through the workshops, is that there is kind of a fuzzy, yes, we know what we're supposed to provide. But when it comes to the time that the functional process is together, there's a lot of misinformation. The tool we've chosen to do this is a tool that actually takes the software that creates these kinds of figures. This is an example of the first layer breakdown of the design function and actually relates that, builds that into an executable model.

[Slide.]

MR. WOODS: This is very exciting. As valuable as the folks we work with found these diagrams, these static models to be, you've got no sense of timing, you've got no sense of what happens in these nested iterations. There are many, many nested feedback loops, but the simulation, the executable model does.

What you find is that it looks great on paper, but when you try to pass something through it, the model chokes. That's exactly what the program does; the program chokes. We find we need to go back and revise something so that the process can work.

[Slide.]

MR. WOODS: At the same time we're doing that, as this viewgraph says, we are achieving the compatibility among the functions that is so necessary, even in the static models. Steven mentioned that one of the products we're putting out now -- these diagrams are pretty hard for most people to understand, particularly when they go on layer-after-layer.

This is actually what the functional analysis report will be comprised of, together with the written definitions. That's very hard for somebody to sit down and write a system engineering management plan from, even though the functional process is all there, that's hard for most folks.

[Slide.]

MR. WOODS: We take this and convert it to this kind of a flow chart. This is an exact mirror of the chart you just saw.

The only exception is that both are in draft form, and since they're in draft form, there may be, as yet, production differences, but that's the only differences that are intended between the two charts, and this, then, allows, we believe, the author of a system engineering management plan or a management system manual to produce the description of the standard practices that are desired to be produced.

[Slide.]

MR. WOODS: My closing chart is simply a status chart.

As has been indicated, we believe the dominant functions or the functions that dominate the program have been analyzed, and we are completing those this month, and we'll be in the process of producing the deliverables, the documentation for those.

We have provided the standard practices or these process descriptions or communication packages, such as this chart we just looked at, for an interim sample. The final of those will be completed in September.

From those, as Mr. Shelor's chart indicated, there has to be decisions made on what documents receive which functional processes. I mean we're all familiar with system engineering management plans. What else is there?

And there needs to be, if you will, documentation packaging decisions made, information architecture decisions made, and that's the document hierarchy task, a preliminary one of which we have done, and the final is next month, and then the requirements database that's been talked about now already, we also plan to have finished by the end of September.

Finally, we would hope that this isn't a one-time thing but will be made available as future conditions warrant revisiting our system engineering management process or whatever it may be, and before documents are rewritten, we strongly advise somebody to do this kind of an analysis to make sure the processes fit.

Any questions?

DR. NORTH: I'll follow up on my earlier one.

I would very much like to see some examples of how this system is going to work and how it is going to be helpful in terms of tracking a change in the program, and let me submit as candidate examples -- and here, this specific is for illustration only.

My request is that you find a way to deal with some specifics before this system goes too far in, let us say, a general fashion, as opposed to finding out how it works in specific instances.

Example number one is a change in mine safety and health regulation; for example, a change in dust level or required ventilation per underground worker.

I'm not sure what the exact parameters are, but the point is here is something that is very specific, that is one of many such things that the program will have to comply with.

MR. WOODS: Certainly.

DR. NORTH: The second example might be something very broad that is now under debate and discussion at the level of overall criteria for the repository. The Carbon-14 regulation might be an example of this.

To take one that cuts across between the repository and the rest of the OCRWM program, consider an all-purpose or triple-purpose cask.

How would the system function on this kind of an issue? How would you support understanding all of the various ramifications of such an issue on program planning?

MR. WOODS: Okay.

First of all, electronic computer software programs -- there is nothing magic to them, and if a change in regulation, Dr. North, be it for particulate allowables in the underground atmosphere, if that regulation changes, the program is either going to have to cope with it with conventional paper systems or in some other way, and there is nothing about what we are suggesting here that changes or abrogates an insightful change-management system in which those kinds of changes, like Carbon-14, is, first of all, defined, to choose the word carefully, in a change management proposal and impact assessments made as to what is affected in the program, which functions, if you will, are affected in the program or in the repository system or the transportation system, and then an impact assessment made as to how that new requirement or that altered requirement is going to be satisfied, and then a Change Board is going to have to address themselves to it, and at that time, the Change Board shall authorize the inclusion of this altered or new requirement into the reference requirements base, whether it's a paper document or whether it's an electronic base.

So, there is nothing -- this is not anything that changes anything other than the logistics of how one handles the complexity of the constraints on the program. That's all.

DR. NORTH: Yes. It's a change in the logistics.

MR. WOODS: That's right.

DR. NORTH: And my question is how helpful is this going to be to management on very specific items like the mine safety and health regulation or on very broad issues having to do with the NRC and the EPA criteria or the interface between the repository and transportation and storage?

It may be that, in one area, it will be more helpful, and in another area, it would be less helpful, from very specific to very broad, and understanding that, I think, would be a very useful thing for all of us to try to accomplish.

MR. WOODS: Sure. And there may, indeed, be areas that a relational database management requirements would be less helpful, but we haven't found an example of that yet.

In every instance of everything that we can find or the regulatory compliance people, in the workshop with this, when they looked at the prototype we have operating, in all cases, whether it's a new regulation and one wants to quickly find the differences between it and the old regulation, electronic sorting is always faster than a yellow highlighter. Okay?

Whether one wants to find all of the directives, regulations, state ordinances, and DOE orders that affects the design of something or the investigation of a Carbon-14 issue, in all cases, you can always find everything that applies much faster with the help of an electronic searcher than, again, somebody going through 6,000 written-out paper requirements and trying to find the things that count.

We see it as, again, like anything else, just like the database that manages our checking accounts in banks, and that's all it is, this simply searches for the things that apply to the functions that we're trying to bring into being or the functions we're trying to perform in the program.

DR. NORTH: Picking up your analogy there, check-management systems, the relational databases that my company has built, many other examples, what's crucial is the user- computer interface and how well does that work.

MR. WOODS: Of course.

DR. NORTH: And what I submit to you is let's have some early tests on that.

MR. WOODS: Oh, indeed.

DR. NORTH: And I haven't seen that as part of your presentation, and I want to.

MR. WOODS: Oh, well, indeed, that's a whole 'nother subject, and in the interest of, probably, the time, I have taken too much of it already, but indeed, we have already gone to considerably lengths on the user interface, Dr. North, and we need to go a lot further, but yes, your point is very well made, and I support it very much.

DR. NORTH: When Carl Gertz or John Bartlett stands up and says your system is wonderful, it saved me person-years of labor or made it possible to respond three times as fast to this complicated issue, then I think everybody will be declaring your system a terrific help.

At this point, we haven't run the test, is my understanding.

MR. WOODS: Of course, and I agree, and mind you that the requirements database is only a small part of this analysis that we're undertaking.

We're really looking how change management works, design works, budgeting works, everything works, and trying to find areas where we can help make it better.

Thank you for your questions, sir. I think they were right on target.

Any others?

DR. FABRYCKY: Wolt Fabrycky.

As you know, there are commercial packages that do some of what you're mentioning and maybe do some things that you didn't have time to mention, and I assume that either you have looked into these and brought them onboard or DOE people have done that.

The big problem is that many of these requirements documents are not in electronic form now.

MR. WOODS: There are some people in the audience that would certainly agree.

DR. FABRYCKY: Is there any effort underway to do more things electronically, so that these benefits that you describe can be actually captured?

MR. WOODS: Thank you.

First of all, let me stress that DOE has not made the decision to go this way on requirement as yet. Okay? So, what you're hearing here is some of the insights we have gotten from this analysis, but yes, there are two points here.

Number one, the Weston folks have -- I don't know how many man-hours has been expended getting written regulations into electronic form so they can be incorporated in the database, and that isn't entirely finished but almost. Okay? But then comes the question about revisions, which is the second point.

Many of you are probably aware that there are electronic services available that provide the Code of Federal Regulations and other things in electronic form for purposes just of the sort that we're talking about here, and those are being looked at.

Again, I don't mean to suggest that decisions have been made on this yet, but again, when those -- when the text becomes electronic in form, then, as you say, there are standard commercial products that can compare one document versus another, point out differences.

Those things are all pretty routine and have been for years, and really, what I'm advocating is that we bring to bear some of those advantages on a difficult logistics problem in the program.

Did that answer your question?

DR. FABRYCKY: Yes.

MR. SHELOR: Excuse me, Tom.

This is Dwight Shelor.

I might add that we have already subscribed to the service for the Code of Federal Regulations.

It's a very important service, both to get it in electronic form and then to have -- I believe it's a weekly update on any changes that come to it, and I think it's the changes, keeping pace with the changes to all of the regulations and then be able to relate that through the relational database showing where those changes affect a function and a requirement, is the place where we will eventually be able to demonstrate the savings.

DR. PRICE: What are the boundaries of this system? When you are talking about the system, what are the boundaries that you have to place on it?

MR. WOODS: Thank you. And here, the system, of course, that we're talking about is the program, itself, that has to create the repository, the transportation system, MRS and so on. Therefore, the boundaries are all of the functions, whatever they may be, all of the functions that have to be performed under the authority of Dr. Bartlett, in OCRWM, DOE. All the functions that have to be performed to execute the NWPA. That's the boundary. Indeed, it's not a trivial intellectual exercise, to begin to break that into manageable pieces and examine what all those functions are. But all of them must be found and incorporated into a management -- or, I don't know, I grope for words sometimes -- a standard practice, a policy, a procedure, all of those things are meaningful. They have to be found and incorporated into those, or something that's essential to executing the NWPA will be overlooked. So, that really is the boundary.

DR. PRICE: Does your purview, as you're looking at this, involve anything inside the fence of the utilities? To me, if I were looking -- without being involved in the service of a particular entity, and looking at the system that involves nuclear waste, the nuclear waste system that we're contending with, would start with the generation of the nuclear waste.

[Slide.]

MR. WOODS: As a back-up, I believe, I can best answer your question with this graphic wherein, what I'm attempting to show is that, in order to execute the NWPA, a product or a system called the NWMS has to be produced.

I believe your question really is, is there some function down here that has a boundary that includes or excludes things inside the utility fence. Mike Duffy and Bill Lemeshewsky are the folks that did this functional analysis here, and looked at the requirements that dictate what that system must do. We were on this side, sir, and therefore, we wouldn't face that question directly, as a programmatic or a program kind of function.

DR. PRICE: From a programmatic standpoint, did you consider, for example -- and this relates something to what Dr. North said a little bit ago, about triple purpose cask -- did you relate anything in your program to minimizing handling?

MR. WOODS: No. In fact, our abstraction was a bit different than that. What we wanted to identify, relative to that, as close as I can get to it, is the design process that would investigate, for example, how little or how much are we handling the cask. So, what we were after was the design process. For example, being extremely explicit about the functions to be performed in conceptual design, as apart from preliminary design, as apart from definitive design; what are they? And in which of those, or all of them, do we address -- does the design process cause cask handling to be examined?

DR. PRICE: Now, to that extent, you would be looking at cask handling that might go inside the fence of the utilities; is that true?

MR. WOODS: The execution of the process we defined would look at that. Our analysis would not look at that. Again, if I can grab that chart I have already used very quickly, I hope it holds up in the example we're pursuing here.

[Slide.]

MR. WOODS: Again, our analysis was simply looking at the conceptual design process, which may include, in finding, let's say the technologies that drive the solutions or that may include, in a required sensitivity -- perform sensitivity analysis step in this -- may include looking at exactly that, Dr. Price.

But this analysis would not say go look at the utilities. This would say, in this program, a conceptual design process needs to consist of the following things.

DR. PRICE: Does it consist of minimizing handling?

MR. WOODS: No, sir. It would consist of sensitivity studies that would address that. But, our level of abstraction would identify the requirement to do sensitivity studies or trade studies or that sort of thing, that would try to identify that particular item that you're coming to.

DR. PRICE: At your level of abstraction, how do you deal with actual system acquisition, specifications and things like that?

MR. WOODS: If I understand your question correctly, I think you're --

DR. PRICE: Something in the programmatic side of it should drive specifications.

MR. WOODS: Yes, indeed. And this analysis would, when the document hierarchy or the information architecture, if you will, that goes with this is complete, you will find in it --

[Slide.]

MR. WOODS: -- you will find in it where the requirements that constrain the system functions, for example, where they would be documented, the kind of specifications that would be created to document those, or the kind of a database or the kind of statement of work or whatever it might be, would be specified in that kind of a document hierarchy.

I think what you're asking, Dr. Price, is a packaging question, for the information that would come out of performing the processes we're defining.

MR. SHELOR: The system boundary is probably one of the most important things that there are to define, because it really defines the work. But I will suggest, as an example, and we haven't yet -- but the question is, should we extend our system boundary to the point of trying to influence or provide requirements for the design of reactors that would produce a waste that's easier to handle. This now begins to extend the system boundaries significantly. We have not yet extended our boundary to that degree. But it certainly is an interesting concept, and maybe one that we should address, when time is available.

DR. CANTLON: John Cantlon.

An extension of that. This process of handling the waste streams is such a long emerging process, much longer than most ordinary engineering design jobs. The emergence of new technology, new discoveries and so on, is an absolute certainty in so many different areas. Is there anything explicit in the system that you've designed to actually take advantage of that and to keep the flexibility in and to, in a sense, drive the research processes very much of the way you were just mentioning.

MR. SHELOR: I think -- this is Dwight Shelor again. I think Tom can address that. I think Dr. Duffy will address that, too. We have explicitly included a whole area called new or developing technology, as part of this feedback loop, in the development of the system, and in the design and the requirements, to remind us to look at the design solutions, in terms of potential new technologies that should be implemented over the long haul.

[Slide.]

MR. WOODS: Yes, sir. As a matter of fact, this diagram, coming directly out of the analysis, if you'll notice, a common input into all of these design functions is the available technology, that is one of the principal inputs you find needed to perform all of those design functions. That's what that abbreviation stands for.

DR. CANTLON: Cantlon, again.

But, now, what is the drive that pushes you back up there, so you can put out RFPs in the research domains, the right kind of RFPs? Is there something --

MR. WOODS: That would not show in this particular function; but I totally support what you're saying.

DR. ALLEN: Any further questions?

[No response.]

DR. ALLEN: Thank you.

MR. WOODS: Let me pass the microphone now to Mr. Lemeshewsky, who will introduce the discussion of the physical system functional analysis.

Bill.

PHYSICAL SYSTEMS FUNCTIONAL ANALYSIS SCOPE/APPROACH/PARTICIPATION

[Slide.]

MR. LEMESHEWSKY: Can everyone hear me? I'm going to try it from the podium here.

My name is Bill Lemeshewsky. I'm the Branch Chief for Systems Engineering Branch.

I'd like to introduce the background behind the scope and approach for the physical system functional analysis efforts that Michael Duffy will talk about in detail, and cover an example related to the ESF that might answer some of the questions that have just been raised.

[Slide.]

MR. LEMESHEWSKY: Basically, I'm going to summarize a few facts that have already been brought up. The two source documents for the functional analysis effort; basically the Secretary's report, 1989, and the OCRWM Director's MSIS document, that called for systems engineering as well as a rigorous implementation of that, combined with functional analysis activities to tie in functions to the physical requirements.

The overall goal in that was to develop a revised set of technical baseline documents for the program.

[Slide.]

MR. LEMESHEWSKY: The approach that we used -- and I'll summarize it with a chart -- is first, to develop a management plan for the generation of six documents that I'll talk about in a minute. And that's in accordance with our quality assurance procedures.

Within that plan, we called for an approach to implement functional analysis in a series of meetings. These meetings were to be run by a facilitator, and to be supported by a core team of qualified and QA-qualified experts in order to frame the inputs we got from various experts and line personnel. This is a key area, and I'll bring it up several times in my presentation.

Also, this group, with the facilitator and the technical core team, were the preparers of these technical documents that I'll show you.

Separate from that, and you've already heard about it, is a separate regulatory requirements team that combed the 200 to 300 documents for applicable regulatory requirements. And I'll put a slant on that, as opposed to performance requirements that were taken elsewhere.

Finally, the key effort here is participation in these meetings by the line organization experts, national laboratory, contractor personnel, from which I wouldn't call it a consensus effort or brainstorming effort, but we took inputs, looked at functions requirements, and in effect, developed a consensus of people's opinion about where we're going on this program, and different ways to achieve it, without selecting a certain architecture that would lock in either a technology approach, or predetermined solution.

[Slide.]

MR. LEMESHEWSKY: The next chart, which you've already seen in Dwight Shelor's presentation, I just wanted to show you how it fits to the physical system functional analysis effort.

The initial management plan covered the six documents that we'll talk about in a minute, in terms of their general areas, that define that approach that we're going to use and the content, things like that.

The second box is where all the work was done, where the meetings were held, where we conducted the functional analysis effort, where we combined the requirements with those functions, interfaces, interface requirements.

The task team developed this draft requirements document. We went through an independent technical review in accordance with our QA procedures for that document. We're also going now just to completion for two documents, through our Change Control Board review of those documents.

Ultimate goal is a baseline and new set of improved technical requirements containing functions, requirements, interfaces, and requirements related to that.

[Slide.]

MR. LEMESHEWSKY: An organizational sequence diagram that reflects how this was done. This is a different cut at what Steve Gomberg presented to you, but I just want to show it from a visualization sense.

The regulatory group is on the right, combing the documents. They're coming out with the piecemeal regulations that apply in the center, and there's a similarity between the physical effort and the programmatic effort for the way the meetings were conducted, and the efforts were done.

The facilitator, with the central task team, also combined with the line organization and the program experts, decomposed the functions of the program.

Those functions created categories by which regulatory requirements and performance requirements could be assigned through a kind of an architectural approach of a standard specification format.

So in the rollup of these efforts, if you want to call it that, the regulatory inputs came in, the performance-related requirements came in, and with the group in the series of meetings that I mentioned, the requirements and functions were tied together, put in the document, with the identification of holes, functions, issues, other things that needed to be defined. The Central Task Team prepared that draft report, and locked in the numbers that track the functions and requirements for the sake of a draft document that we then proceeded to for tech. review.

[Slide.]

MR. LEMESHEWSKY: In summary, what do we obtain by this approach to date?

It started in August of 1990. We've completed four documents to date.

Through this approach that we've documented in our plan, we've come up with a structured family of documents. We have a uniform approach, by the way. We conduct, generate, and review these documents.

We carried into these documents this functional analysis effort, where we kind of had a team-building exercise to begin with, pulled in the people to start with, had a core team to raise the issues, discuss the options, and basically develop a set of documents through a process that would add to traceability or other functions and requirements that aren't just necessary for a licensing approach, but are just good, common engineering sense, that you would want to do anyway.

Otherwise, the requirements that you've heard kind of get out of hand, and they need to be broken down to apply to the specific function of the different parts of the program, of the physical system.

A key thing that came out of this effort -- the next to the last bullet -- was a list of decisions, issues, gaps, studies that need to be done. Obviously, one would assume this is basically a rev. zero set of documents. And we proceeded on a schedule to try to create the best document we could in a time frame.

If there were certain issues that needed to be resolved through a study, we just identified it and left the level of detail there. In most cases, we went down to five to seven levels of breakdown for a particular area. But if we came to an issue where a decision has not been made on a program, or a study was still in progress, or a study has not yet been done, we just identified it, captured it, made it a part of that document, so that we could track and resolve these, so that when the study is done, we could in effect functionally decompose, come up with requirements, solutions, and document that, go back to our Change Control Board, and basically work a manageable process that we could keep track of -- and that's the last bullet -- so that this database and documents, as we generate these studies, as well as the regulations may change, too, we have an orderly way of going back in and modifying, evaluating, looking at impacts across the program.

[Slide.]

MR. LEMESHEWSKY: In summary, of the functional process that we went through, this shows the full physical system functions, top-level functions that are, I guess, obvious and intuitive to most people.

There could be a few more, or there could be subsets of that. This is what we started with and went five or six levels below here.

We have completed store waste and dispose of waste on the right. We have not started accept and transport.

The key point that Michael Duffy will talk about is we did dispose first, because that formed the basis in order to do the physical, functional analysis for the ESF that he will talk about with examples.

[Slide.]

MR. LEMESHEWSKY: Finally, the key participation that we received in this effort -- can't stress it enough as to how much it helps to put this early, in the front-end.

For the four documents, we utilized about 60 people in terms of major players.

There were more people involved that came to a one-day meeting, a one-time meeting to input their expertise in certain areas, but basically -- people have asked -- we've utilized about 20 man-year equivalents with these 60 people.

Additionally, as these documents have gone through independent review and the Change Control Board, probably about 15 additional people that have seen and inputted to these documents.

Finally, the 12 organizations at the bottom reflect the sum-total of, to the best of our knowledge, all the organizations that participated in one form or another, either as an expert in a meeting to give ideas, as a reviewer of tech documents, or as an expert participant in a chosen field that came up.

Without any further discussion, unless there are questions, Michael Duffy's presentation will cover ESF, as well as a broader look at the physical system functions and requirements and hopefully cover some of your ESF questions.

DR. NORTH: Would you like to take my question -- this Warner North -- regarding cost, specifically on your last slide?

MR. LEMESHEWSKY: Yes.

DR. NORTH: How does that set of numbers translate into dollars?

MR. LEMESHEWSKY: I understand the rule of thumb is about $150K a man-year, so $3 million since August of 1990.

DR. NORTH: Just for this piece of the program.

MR. LEMESHEWSKY: Four documents, correct. Combined in there, we had, ballpark, 25 meetings that ranged from two to five days each, and we basically had anywhere from two to five meetings per document.

Then we had a core group that went back and -- this is combining in with this regulatory research team that scanned the regs.

So, you know, it's a mixture of both physical systems side and the regulatory review group at Weston, where that basically resided for the research of the regs.

DR. NORTH: As you described that, I wonder, is $3 million way too low, considering all the other participation involved? Should it be double that number or something like that?

MR. LEMESHEWSKY: Well, we haven't completed all the documents, but in terms of the scope of the program -- and I would admit that there are holes in these documents that need to be completed with further studies -- I would submit that the studies to fill in those holes should and will, certainly, exceed the cost so far of these documents.

Otherwise, we will be unable to come up with the full set of not only regulatory but performance requirements for the program, which is critical.

Any other questions?

[No response.]

MR. LEMESHEWSKY: Michael Duffy from Battelle Energy Systems Group.

PHYSICAL SYSTEMS FUNCTIONAL ANALYSIS, IMPLEMENTATION/STATUS/SCHEDULE

[Slide.]

DR. DUFFY: As Bill mentioned, we have been working on this physical system functional analysis for about a year, and I can hardly give you all of the details of what we have done over that past year in the next hour.

I am going to try to focus in on a few things, and I think there's some key points I'd like you to try to walk away with.

First of all, regarding the requirements documents and the requirements that we have been looking at, there's basically three main points to make.

One is that requirements are necessary for the physical systems that are going to ultimately comprise this nuclear waste management system.

Second, as Tom Woods showed us, requirements are necessary for the program that's going to bring that system into being.

Third, something that you haven't, perhaps, seen yet in the presentations is that requirements are also needed for the test facilities that will be used to evaluate whether, indeed, those systems might ultimately comply with the requirements that are imposed upon them.

It's really that third aspect of it that I'm going to try to focus in on today. Since most of the morning session was devoted to the ESF, what I'd like to do is use the ESF as the example as we walk through this physical system functional analysis.

Regarding some of the main key points that I would hope you would pick up on is, one, the rigorous approach that has been applied to this.

Yes, 20 man-years of effort is a lot of time to be spending on this, but I hope that you will appreciate the rigor with which all of the participants that we have had over the past year have gone through this.

Another one is the flexibility that's being preserved with regard to the requirements, with regard to the ultimate design that may satisfy those requirements, and with regard to the testing program within the ESF.

A third key point is the consistency and the traceability that we're trying to maintain with this particular effort.

Fourth, I think that you will see that what we have as a framework for doing the kind of systems analysis studies that certain people were asking questions about just a few minutes ago, how might we build into the system some new technology, some changes, and some new ideas.

I hope that you will see that what we have got is a framework for being able to trace impacts of any of those sorts of changes throughout the system.

Finally, I hope you appreciate that we do have some concrete results. As Bill mentioned, we have basically completed four requirement documents to date. Three of those are being reviewed by the Change Control Board right now.

[Slide.]

DR. DUFFY: With regard to that, then, the, basically, two key objectives that I wanted to do here was, first of all, describe the functional analysis applied to the physical system and to do that by basically walking you through an example using the ESF.

[Slide.]

DR. DUFFY: Now, to the put the ESF into the proper context, Bill had showed you a function tree diagram down to the second level that had managed waste disposal at the top, and the next level down, where, as you can see, the four functions we have got here are accept waste, transport waste, store waste, and dispose of waste.

This basically was the effort that we started out on, and we had done the managed waste disposal, i.e. the overall system. Then we did the store waste function, the dispose of waste function, and at that point, we changed gears and got into the ESF.

If I can, I guess, digress for a moment, there were some questions regarding accept waste and how that related to, basically, the boundary of the system.

Accept waste we are considering to be a function of the nuclear waste management system. That is a function that needs to be satisfied by DOE/OCRWM.

Basically, as we have laid it out here, that's nothing more than a transfer of title from the utilities to the DOE.

There are a number of functions, sub-functions, if you will, that need to be accomplished within the boundaries, if you will, of that accept waste function that are primarily the responsibility of the utilities.

I'm not a licensing person -- I know, at least, there are a couple in the room here -- but I believe, also, that the utilities will be doing that with regard to the operating license that they have for that utility, regardless of what DOE is doing vis a vis 10 CFR 60 and the other requirements.

So, much of what the utilities are doing would be wrapped up here in the accept-waste function.

It is true, I think, that you will see here -- it's shown on this -- that DOE, for instance, is providing the empty cask and carriage to the utility that will pick up that waste.

Once it's loaded into the cask and carriage by the utilities, basically it becomes property of DOE, and DOE would be responsible, then, for transporting it either to an MRS or a repository.

To digress a little bit further, too -- this is not really what I wanted to get into, but I think it might answer some of the previous questions -- there was a question, I guess, on the triple-purpose cask, and I guess, by that, you mean a cask that could satisfy transportation, storage, and disposal.

If we look at the interfaces between these functions in terms of what we're showing there, the flow of the waste between those functions, that's precisely where we would want to, perhaps, establish this new requirement, this new DOE policy, perhaps, to minimize the handling of the waste.

What we could do then is propose requirements, do the appropriate trade studies between these functions, and see if it would result in a more optimal system.

That is what I am hoping you will appreciate, in terms of the framework, when I say we have a framework for investigating the kinds of system analysis studies that come up time and time again, and be able to put them in in a consistent fashion, to the overall system point of view.

DR. PRICE: Could I just ask, or make a comment. The appendage to it all sort of seems to be the storage onsite. That seems to be the appendage that can't get incorporated into the systems view, since you started "accept waste," which would be ahead of any dry storage onsite, that the utility themselves might have accomplished. Is there a way around that problem?

DR. DUFFY: I guess you're jumping ahead perhaps, and anticipating that when we say store waste there, the only means we have of satisfying that function is to use an MRS. It is true, and what you have done is exactly posed an alternative that can be looked at which could be at reactor storage. That's an alternative that could be investigated right there.

MR. SHELOR: Excuse me, Mike. I think, Dr. Price, the other part of the answer is the NWPI required DOE to establish a standard contract, which is 10 CFR 9601, and required the utilities to enter into a contractual arrangement with the Department for the acceptance of the waste. So, right now, our boundary of this system was established within the confines of the NWPI.

Now, certainly, I think there are, in my opinion, there should be trade-offs and analyses that do include a system larger than the NWPI, because, for example, when you're looking at trades, what is the cost the ratepayer pays to the utility and also pays through the nuclear waste fund, that is also passed to the ratepayer. So, I think there are some analyses that need to be looked at with a larger boundary.

For our purposes of the physical system, as defined by the NWPI, we started with transfer of title from the utility to DOE, when that cask leaves the fence at the reactor site.

DR. PRICE: Yes. That's my understanding. Thank you.

DR. DUFFY: Once again, in terms of flexibility that we're trying to preserve here, one of the things we keep in mind as we do go through this decomposition is, unless there's been a firm DOE decision made, we do not want to bring it down to such a level, that is, the functional decomposition to such a level that we would constrain the designers in any way to not being able to consider what would be a feasible set of alternatives.

Okay. That was kind of all of it -- a digression. Now, back to how this all fits into ESF. Again, basically, down here at "dispose of waste," although it's not shown on the diagram, that certainly is a lead that establishes the need for an ESF in terms of, again, the testing, testing facility that could be used to demonstrate compliance with the requirements.

[Slide.]

DR. DUFFY: Just to revert back for a moment to the classical systems engineering approach, I just wanted to emphasize that basically we've been concentrating over the last year on these two boxes here: The functional analysis and the functional allocation with, to a lesser extent, identification at least of trade studies, as Bill mentioned. We haven't gotten really into doing any of the trade studies, but we have compiled quite a list of trade studies that we think need to be done within the program now, to either support the establishment of performance requirements, to help make a choice between some alternative architectural solutions and for a number of other reasons.

Now, with regard to the ESF, we'll have to back up here and take a look at this mission need.

[Slide.]

DR. DUFFY: We can go to, basically, the NWPA and create kind of a broad-brush mission statement that's listed on the viewgraph here. What I would like to do is just point out four aspects to that. There are only three lines of text here, but there are really four aspects.

Basically, it says that this exploration and testing is going to be done, one, for site suitability determination; two, assuming that the site does turn out to be suitable, the data collected will be used in license application; and we are going to do that, three, by protecting the environment; and four, by protecting the nuclear waste isolation capabilities of the site.

Some might think that that's a nice motherhood statement, but we have heard a lot this morning, too, about traceability of the ESF backup through all of the requirements documents and the requirements hierarchy -- of the document hierarchy ultimately up to the highest level requirements document for the overall system.

The question is, how does one actually go about developing that traceability between the ESF and the repository?

This traceability is important for two reasons: First of all, we have to collect the geoscientific data that is necessary to evaluate the ability of the site to comply with the geological repository requirements. Second is that we must not compromise the waste isolation capabilities of the site.

So, at least for those two reasons, two very good reasons, we want to make sure that we demonstrate traceability of the ESF functional analysis back to the results of the functional analysis that came from the dispose of waste effort.

[Slide.]

DR. DUFFY: What we developed then was a five-step process for basically doing an ESF mission analysis. Again, we began with the results of our "dispose of waste" or repository functional analysis, which basically led us to a set of geologic repository technical requirements.

What we did in the first step of the mission analysis then right here was, for each one of those requirements, to define a performance measure that would basically be the yardstick to determine how well, eventually, we would be complying with that particular requirement.

Now, the complete set of performance measures, you could see that some of them would require data with the performance measures that were based on non-ESF sorts of data. The remainder would need data that would be collected from the ESF, in order to estimate values for the performance measures and, hence, evaluate the compliance with the requirement. So, we did, basically, decompose the complete set of performance measures into those two categories.

We carried forth the performance measures that need or required data from the ESF. On the basis of those performance measures, we developed a methodology for estimating values for them. Once again, the performance measures would be the ultimate indicators for determining how well we're complying with the requirements.

The methodology basically took the form of logic diagrams, and I'll show you an example of one here in a few minutes. But given, then, the complete set of logic diagrams, which basically shows how we would go about the analyses that would be necessary to evaluate all requirements, we can use those to then specify what are the data needs, the complete set of data needs that are required from the ESF. I should say the complete set of data needs, much like the performance measures, had two categories.   Basically, the data needs required to justify the analyses in these logic diagrams can also be segregated into two groups: Those not depending on the ESF data needs, and those directly requiring ESF data needs. It is the latter there, again, the ESF data needs, that were used to identify and justify the complete set of tests that are planned to be conducted in the ESF.

Once we take these complete set of tests and define them a little better, a little more explicitly, we come up with a set of ESF test requirements which basically establish functional capabilities that are necessary at the ESF, and together with the requirements themselves, basically define much more explicitly what the real mission of the ESF is.

So, what we did was we started with a rather broad statement that could be extracted from the NWPA, worked through some rather rigorous analysis here, to come down to some explicit data needs and, hence, functional capabilities that would be required at an ESF.

[Slide.]

DR. DUFFY: The real work within that five-step process was developing a set of logic diagrams like this. I don't want to go through the complete logic here.

Not being a hydrologist, I might not be able to, anyways, but let me just point out what a couple of the keys are.

We have a requirement imposed upon the site which is the pre-emplacement groundwater travel time of 1000 years, greater than 1000 years. Basically in order to say something informed about how we're doing with regard to that particular requirement, we need estimates for two performance measures, that being the groundwater travel time itself in the unsaturated zone and the groundwater travel time in the saturated zone.

Now since we don't have groundwater travel time meters to put out at the ESF, we need computer models that will calculate estimated values for those performance measures.

In this case we show two, the unsaturated zone groundwater travel time model and the saturated zone.

Now at this side here, the saturated zone analyses are at this time anticipated to be beyond the scope of the ESF, so for the purposes of what we're doing here we basically cut that analysis off, saying that non-ESF data would be needed to do that, to basically drive that model.

On the other hand, for the unsaturated zone, in order to drive this model we basically need input data in terms of the flux, the effective porosity, and the flow distances. These three input parameters, if you will, trace down here, there are additional models that would be necessary to estimate values for them, additional data that might be interim calculations that would be needed to feed into them; the point being we eventually get down to a rectangular box like this that would basically show the primary site data needs and also an identification of the planned tests for collecting that information.

In a planning sense we are working from the top down. We are going from the requirement, this requirement coming from the set of geologic repository technical requirements, and you'll look at the complete set of all of these diagrams. All requirements for the repository that are related to the data that would be collected in the ESF would be covered.

Planning: We go from requirements down to data needs to the identification of the tests necessary to collect that data, and actual operation would be starting at the bottom, conducting the tests, gathering the data, doing the analyses and ultimately determining whether or not the site would comply with that particular requirement.

DR. NORTH: So what you really have here is a set of links from the requirements like groundwater travel time greater than 1000 years down to specific items in the site characterization plan or other descriptions of data that are going to be obtained.

DR. DUFFY: Right.

DR. NORTH: What you don't get into are questions of definitional ambiguity, such as groundwater travel time as we heard from Paul Kaplan at Sandia at the risk and performance analysis panel meeting in May, and you also don't get much assistance in terms of what are some of the data gaps that might come out of the performance assessment needs where you find out, for example, that there are other ways of getting information relating to the chloride 36 measurements that would perhaps indicate some additional tests besides what is currently on the SEP list.

I would like to ask you, how are you going to deal with these questions: (1) definitional issues; (2) data gaps as science evolves and more insight is developed on ways of getting useful information above and beyond what is already in the site characterization plan.

DR. DUFFY: Okay. Let me take those one at a time here, if I can.

First, what I'd like to say, I think your second question really smacks of how much data is enough. I don't have an answer to that and the requirements here are not going to --

DR. NORTH: But it is a very important management question, how much data is enough.

DR. DUFFY: Very important, right. The system studies, for instance, that Bill mentioned that we have compiled, that's the top one on our list for ESF -- it's basically to answer the question how much data is enough.

I think you'd agree that going through this kind of a process would be a first step towards getting hopefully into a position to be able to answer that. I can't answer it yet, but I think that you would agree that you need to understand the process that's going on here in order to be able to do that.

This is a first step at least in terms of establishing the requirements that should be imposed on the testing program.

DR. NORTH: Well, it's very useful to know which of the elements down there at the level of the SCP are contributing to groundwater travel time assessment, so you don't miss one.

What I am trying to get at is you have an approach that will give you an explicit view of what the linkages are.

DR. DUFFY: Right.

DR. NORTH: But in terms of definitional issues to resolve uncertainty and ambiguity on the requirements, it doesn't help much on that score, and it also doesn't help much in terms of how is science evolving and what may be some other areas for data gathering that aren't already on your list. Somebody has to bring that to you and put it into your system, and first and foremost you'll have to have communications so that at some point they have the opportunity to do that.

DR. DUFFY: Okay. With regard to the testing, once again, not to overemphasize the flexibility of what we are doing here but we do not want to impose on the tester here any constraints on how he goes about collecting the data, so from a headquarters' point of view, from an overall system requirement point of view, this kind of analysis could lead us to say that based on current understanding for how the performance assessments are going to be done, this is the kind of data that will be necessary out of the ESF.

How you get that data is better answered by the principal investigator at the site. We would not want to constrain him or tell him how he should do that.

How much data is enough is, I think, a valid question for headquarters to be facing up to, and I know that, Tom on the programmatic side, one of the subfunctions that they have been wrestling with is precisely this.

Now he is going to come up with the procedures, if you will, that one would go through to determine how you would come up with a quantitative estimate for how much is enough, but he is not actually going to do the quantitative estimating. There is still that void and that still needs to be done, no question.

DR. NORTH: It would be very instructive for you to look at the task force exercises that have been carried out and see how they bear on the question of how much data is enough and how that relates to your framework.

MR. WOODS: Dr. North, Tom Woods.

In fact, we did exactly that. The people working on that precise problem are the same people we have been working with to define the processes that will work for the program and the whole site characterization effort, and we have tried to keep the thinking moving together -- that is, not to constrain it one way or the other, but not to come with such widely differing views that then we can't handle the results. So we have made an attempt to keep together with the folks on that.

DR. NORTH: I think it would be very useful for you to illustrate that so that when I am looking at that bottom box there, I am not seeing just some numbers from the SCP, but I am seeing inputs from a month ago from Sandia that another issue has been determined with regard to groundwater flow pass in the unsaturated zone, and that is now added with another code as another set of data that clearly are going to be important, and you're in the process of bringing it in through additional documentation above and beyond the site characterization plan, which is now several years old.

MR. WOODS: Tom Woods.

I believe later on in your agenda, Dr. Younker is going to address these questions.

MR. SHELOR: This is Dwight Shelor.

Another thing I would point out is, just to re-emphasize what Mike indicated, we're using the information we have available today; we're documenting this. If those test methods change, I think it's important to go back and make the change in those documents so that we can trace and identify all of the other interfaces that are affected by that change.

DR. DUFFY: One more point on here. Although you are correct in noting that the numbers in the parentheses down here do refer to specific sections and activities within the SCP, the SCP was a starting point. And what we tried to do when we developed this kind of logic was get the people that were still in the program, that were responsible for the development of the logic in the SCP several years ago, but to update it with whatever new understanding has been developed over the last couple of years.

So at least to the extent that there was new understanding, new insights, in the last February-March time frame, I believe that that has been built into this kind of logic.

It has not taken explicit use of the information that Tom referred to, and I think that Jean

Younker will be presenting on Wednesday.

DR. DEERE: Don Deere here.

If I may, one other point on that. It's not just the information that's developed in the last two years, in thinking about it a little further. But this is an exploratory studies facility; and the very word "exploratory" means we are going to encounter things that were not anticipated. And there has to be the flexibility.

So I would agree with what Warner said. That bottom box shouldn't have a line across it.

DR. DUFFY: Oh. Okay.

DR. DEERE: It's sort of openended, isn't it?

DR. DUFFY: Yes.

DR. DEERE: New information as it develops.

DR. DUFFY: Yes. I think I have a later diagram that really shows how the results of information gathered would be used to feed back and have an impact on other things that are going on within the ESO. This was not intended to do that.

[Slide.]

DR. DUFFY: There are two more pages that basically just complete the logic diagram for the groundwater travel time requirement, if you will. And I don't think there's any need to perhaps dwell on those any more.

[Slide.]

DR. DUFFY: I would say that there are quite a number of tests that are necessary to collect all the information that will be required to basically just evaluate how well we're doing with regard to this single requirement.

[Slide.]

DR. DUFFY: Now, again, once we finish all those sorts of logic developments, we basically come up with the explicit information on the mission of the ESF. And at this point, then, we're ready to begin this, what I call three-step sequential functional requirements architecture approach, the so-called FRA approach.

Beginning with the mission, we would decompose the mission into what its higher level functions would be. That is, what is required in order to satisfy the mission.

These functions basically have requirements to be assigned to them that basically specify how well does each individual function need to be performed in order again to satisfy the mission. And finally, in terms of concept at least, what is the conceptual architecture that would be chosen to satisfy the requirements and the corresponding functions.

Now, down here you'll notice that in terms of selecting the architecture, of course, the basis for that is indeed the DOE management. And that would be based on some criteria much like we heard this morning with regard to siting the shaft, optional shaft.

The basis for selecting this architecture should be the results of some analyses or trade studies that have been done, and there could very well be a number of feasible alternatives that are being evaluated.

If you remember back to the chart that Bill Lemeshewsky used, we are making use of the Regulatory Research Team to help us compile a lot of the regulations and requirements that are going to be imposed upon the ESF, as well as the other parts of the program. And we're making use of significant technical experts throughout the program to help us in the functional decomposition, as well as the assignment of requirements to those functions.

[Slide.]

DR. DUFFY: A few constraints that I think are somewhat obvious, and imposed upon us when we do this functional analysis of the ESF are, first of all, not to preclude the possibility of it ultimately becoming a part of a geologic repository operations area. I think we've heard a lot about that this morning.

We also don't want to adversely impact the nuclear waste isolation capabilities of the site.

And we don't want to interfere with the validity of any of the ESF tests that would be conducted, either through the construction and excavation, or from interference of one tests to another.

[Slide.]

DR. DUFFY: Here is another one of those very busy viewgraphs that probably shouldn't be used in a presentation like this, unless you want to use it to make a point that this is a very complex, complicated perhaps, facility, we're looking at here.

Now, what we've done here is, we've taken the ESF, which basically the ESF is meant to be that concept that will satisfy this function, conduct subsurface-based activities.

And what this chart does show is how, first of all, "conduct subsurface-based activities" fits within the context of the overall investigation program, it being just a subset of the geoscientific investigations, and also it requiring several other functions at the same level, so that we can complete everything that is required of these geoscientific investigations.

Now, looking down from "conduct subsurface-based activities," we can see that it's comprised of four primary sub-functions.

First is to construct the ESF, conduct the ESF tests, support the operations of both the testing and the construction and, should the site prove to be unsuitable, to close the ESF.

I also might mention, as a result of the mission analysis, we have identified 42 tests to be conducted in the ESF, there being 43 sub-functions here, the 43rd being reserved for the fact that if the State of Nevada or the NRC requires additional tests to be run, we will have the capability built in there for addressing those needs.

[Slide.]

DR. DUFFY: A little different look at the function hierarchy, then, would be if I take a slice through this level down below the "Conduct Geoscientific Investigations," we see that "Conduct Surface-Based Activities," the function of interest, does interact with these other three functions at that level and, in particular, it's interacting with the conduct of lab activities and the assessment of data by extracting samples from what will be the ESF, sending those samples to lab activities that will basically analyze them, and produce data.

That data, together with some primary data that will come directly from the ESF, will be assessed, and on the basis of those assessment results, additional data needs, sample needs, test constraints could be fed back into the conduct of additional tests at the ESF.

So, this is where we're building in the feedback; that is, collecting new information, and on the basis of that new information, act perhaps a little differently than what would have originally been planned.

[Slide.]

DR. DUFFY: Just for a little more detail, one level down then, below the "Conduct Subsurface Based Activities," again we see that we are constructing the ESF, conducting the ESF tests, support both of those operations, and then, down here, it's sort of an either/or.

If the site were to turn out to be unsuitable, we would have to close it. We happen to think that it's important to know that beforehand. It may influence the way you design or build the facility if you know that some day you may have to reclaim it.

Or, hopefully, if the site were to be determined suitable, then the characterized site goes for Presidential recommendation.

But again, I think you can notice, up in this area here, all of the feedbacks that go from the results of tests, feeding back on, perhaps, further excavation, the construction of the ESF, and for the conduct of both that test and perhaps other tests.

[Slide.]

DR. DUFFY: Now, if we look at the 42 tests themselves, each one of them basically has a flow diagram, somewhat like this, that has an input, the condition, if you will, of the pretest site; that is, the geology, if you will, immediately around the test, and there would be requirements specified on what the condition of that pretest site should be prior to the conduct of any particular test.

After the conduct of that test, there will also be requirements imposed upon what is the condition of the characterized site; that is, how much of an impact can you have or how much of an impact is allowed on the site as a result of conducting this test?

Samples will be extracted for most tests, and data will also be collected for most tests, and there will be requirements established for each of those outputs.

All of this, of course, is being done with the resources at our hand and subject to any non-interference constraints that might be imposed upon the test by other tests.

[Slide.]

DR. DUFFY: In the requirements specification step of this functional analysis, the ESF has basically resulted in requirements, regulatory requirements, being extracted from 15 different documents.

I think you may have heard that some 250 documents have been reviewed to date, and so far, we have decided that only 15 of them are directly applicable to the ESF.

[Slide.]

DR. DUFFY: Now, within the requirements document, just to give you a flavor for what those documents look like, I have extracted a so-called "Function Description Table" here.

This one happens to be for the function "Conduct Percolation Tests in the ESF," and every function in the function hierarchy for the ESF and, as well, for the other requirements documents that we have developed follows this similar format.

First, each function has a unique function identification. Each function has a unique title, at least a unique title within that particular report.

Each function has a brief definition or description, elaborates a bit more on what that function really means, and we get into interfaces. These interfaces are identified in terms of the inputs to and the outputs from the functions.

"The inputs to," further, we specify where that input comes from; that is, what particular function, what other function that input came from, and in terms of the outputs, we specify where that output goes to, what other function.

[Slide.]

DR. DUFFY: Now, getting into the actual requirements, then, that are imposed on that particular function, our requirements can be one of three forms, constraints, performance, and interface requirements, and what we mean by that is constraints are basically regulatory requirements that would be imposed on the conduct of that function, mandatory requirements, something that DOE must comply with, they don't have the ability to basically trade off, at least without getting special dispensation.

Performance requirements would be requirements established by the program itself.

Those, perhaps, would be the results of trade studies and recognize at least what the current program position is in terms of the requirement to be satisfied by that function, but they are changeable. They can be traded one for another in order to try to optimize the system.

The third set are interface requirements, which are basically requirements imposed upon the inputs and the outputs to the function, and depending on the origin of that particular requirement, they could be either a constraint or a regulatory requirement or they could be a DOE performance requirement.

So, again, a function description table like this is included in each document for each function. Some of them have very few performance requirements. Some of them have quite a few constraints or regulatory requirements imposed upon them.

DR. NORTH: Could you give us a little more idea how this is going to be used?

In particular, it says down here in item "c", under the interface, "Flexibility shall be provided for the principal investigator to locate the block," and yet, we have a number of constraints and requirements that perhaps interact with that flexibility.

For example, waste isolation: You certainly wouldn't want that block to include a borehole.

How is this going to be implemented so that you can, on the one hand, maximize flexibility to the principal investigator but, on the other hand, make sure that all the constraints are suitably dealt with?

Is somebody simply going to look at this, or is there going to be a review process at several levels of management to assure that those kind of issues are properly dealt with? Where does all this go as it's going to be used?

DR. DUFFY: I think that Frank Ridolphi, from the M&O, will talk more about the implementation of this, but I guess let me at least put my opinion on the table here, and that would be that there are going to be design reviews, and during these design reviews, these system requirements documents, if you will, that we're developing now for Headquarters, will basically be the yardstick that Headquarters uses to determine whether the designs that are being proposed in these design reviews are complying with the requirements that they have imposed upon them.

Many of these requirements, indeed, are perhaps somewhat vague, potentially conflicting, if not carefully administered.

DR. NORTH: Would it be accurate to paraphrase as this is going to be a checklist, and the system will force those involved to at least consider seriously all of the items you have just listed?

DR. DUFFY: That's more than a fair description. It's a very good description.

MR. SHELOR: This is Dwight Shelor.

I'd go one step further. "Seriously consider" is not enough. These are the program requirements. They have to be addressed and resolved, and they have to convince the review panel that they have been addressed adequately, and ultimately, of course, NRC, our regulator, will look at both these requirements, as we have interpreted them from the regulations, and they have to satisfy themselves that we have done an adequate job of addressing them.

MR. KALIA: This is Heme Kalia with Los Alamos. I coordinated the testing program for ESF.

Dr. North, the strategy of that requirement is that we conduct performance analyses for each of these tests with respect to waste isolation, test interference, and test construction interference.

So, in locating a test location, impact of a test would be assessed by analyses and then determining whether the location is a suitable location, both from this perspective and the impact of the site.

I hope that answers your concern.

Thank you.

DR. NORTH: I guess what still concerns me a bit is, whereas this looks like a very good checklist to start with, there may be some other issues that are also important.

Test-to-test interaction, for example, I don't see, glancing quickly at this list, and that might turn out to be very important in this.

So, can I be assured that the process won't stop here?

It's not just compliance with all these requirements, the items on this list, but anything else that good scientific common sense might indicate is also important will be also dealt with and perhaps this list expanded as the design review group goes through its process.

MR. KALIA: That's precisely the strategy that is being used. We are identifying all of the requirements and working with the performance analysts, which is a Sandia function. That will be accomplished and done and documented. The information coming out from them, as to the -- for an example, how far the test will be located from a certain site, will be identified and put into that as a constraint to the designer. The review process then will pick up that indeed that was done. That is how they implement the control.

DR. DUFFY: Let me elaborate on that a bit also. This is a relatively simple case, I think. But, if you'll notice, the last requirement we have down here on this output, which is basically a requirement on the characterized site that would come out of this test, is that the zone of hydraulic or geochemical influence shall not extend beyond the isolated test block. I say that's relatively simple there, because we know we have a block that's been basically cut out, and we don't want any adverse impacts to go beyond that block that might interfere with some other test.

As Heme was saying, with regard to some of the other tests, where you don't cut out a block, performance assessment results are necessary, in order to take a qualitative statement such as this, and transfer it into -- okay, in terms of feet and inches, how far can I have a thermal pulse of such and such a delta temperature extend out beyond this point. Again, those are a lot of the kinds of studies that we're identifying that need to be done.

I suppose that a lot of folks could have stumbled across those kinds of things needing to be done without going through a full-blown functional analysis like this. But I would like to think that what we've got as a framework, that basically puts all of those into the proper context.

MR. SHELOR: Just to build on that. I think -- this is, again, probably an appropriate level for the system requirements to be driven down to. As you'll hear in a few moments, the next level coming down then will be a system specification, which begins to take some of these and translate them through analysis and studies into more specific requirements that can be reviewed, in terms of meeting the upper level system requirements and developed in conjunction with the conceptual design studies and preliminary designs for the system specs, and the design spec will ultimately be completed when the Title II design -- final design is completed. All the system specs will also be completed with all the appropriate studies. We will see that in a few moments.

[Slide.]

DR. DUFFY: The third step in the FRA process is, of course, to identify at least the conceptual architecture that has been selected to satisfy the requirements corresponding to the functions. At least, in a conceptual sense, this is what we're identifying for the ESF.

Again, one of the overriding concerns we had as we did this was we did not want to preclude any options that might be available to the designer, except for those where DOE may have already made a decision on how they want to go about having something done.

[Slide.]

DR. DUFFY: With regard to the status and the schedule, I think, as we've seen, in somewhat of a different forum, each one of the documents that's being prepared for these functions here is subjected to a five-step process, the first basically being the functional analysis and preparation of the draft report; the second being a management review by the DOE management that we're doing this work for; third, is a technical peer review; fourth, is to submit the document to the Change Control Board; and finally, the fifth step would be to baseline that.

We have completed the first four steps for each of the first three documents: The overall system, store waste and the dispose of waste reports.

For the exploratory study facility, we are right now in the midst of step number three, which is the technical review. As a matter of fact, I think we're expecting all of the comments back from that review tomorrow, at which point we'll be responding to those comments and getting the report prepared to submit to the Change Control Board.

The "transport waste," it will be starting up very soon and by the end of the year we expect to have both it and the accept waste reports completed.

[Slide.]

DR. DUFFY: Finally, just to recap. This functional analysis approach we think is explicit, logical and orderly. We believe that it ensures consistency between documents, between the requirements and documents, and allows traceability up and down the document hierarchy. I believe that it provides a good framework for not only identifying but integrating the results of systems analyses that we believe need to be done to support further functional decomposition or further evaluation of alternative architectural solutions. We are preserving the flexibility for implementation as we implement this process. One of the most important points perhaps is with the wide number of multi-disciplinary people who have been involved in the program, we have been able to develop rather a wide programwide technical support in not only the process but in the requirements documents that are resulting from it. That is, those requirements documents that are coming out, I think, are comprehensive, in terms of requirements that they are basically recognizing.

Are there any further questions?

DR. ALLEN: Dr. Deere?

DR. DEERE: Yes, I have a question. I am not sure if it is for you or for perhaps Bob Craig. The example that you used of the test involved the large, isolated block. Is there only one test being proposed, and did you determine this and, in your assessment agree, or did you even ask the question, do we need two tests or three tests and not one?

DR. DUFFY: I would rather defer it to either Bob or Heme. Bob?

MR. CRAIG: This is Bob Craig, again, with the U.S. Geological Survey.

Actually, in our preliminary input, given the new configuration, the option 30, we are looking at other locations other than just the Topopah, into the Calico, and at more than one location, for instance, in the Topopah Springs.

From my involvement in this exercise, we were trying to keep it generic, in that we weren't looking at raft shafts, those sorts of things. But, to really answer your question, it's coming. It isn't in the official documentation yet, it will be as we get the formal design input process completed through our organization and through the system.

DR. DEERE: Don Deere again. Thank you.

I raise it for a purpose. Because we have a different audience here today, in general, than we had two weeks ago, when we were discussing in Denver the testing program. There we brought up the philosophy that many times you can take an expensive large or midsize test, but you're not really sure that the values you get from your tests really are applicable across the site. So, in large scale testing, for other major projects in rock, we have often gone to the philosophy of trying to pick out the average condition, then we pick out, for another test, something that is worse than average, and another one, something that's better than average. Then we get the results and see if we're right.

Quite often this helps extrapolate the information across the site. I think, on such an important test as this, we certainly want to look at, as Bob said, at several sites. I was very glad for his answer.

DR. ALLEN: Other questions or comments?

DR. NORTH: I think that point that Dr. Deere just made reinforces my concern. I think what you have here is a very good checklist or minimum set of requirements that will help ensure that the program meets its goals.

What you don't have is something that will eliminate the need for a lot of scientific peer participation and creativity to make sure that opportunities for getting better information are suitably taken advantage of.

DR. DUFFY: Well, I hope I didn't misrepresent what we had here and suggest that we were going to do the whole ball game with this. No, this is just the starting point. I think those of you that are familiar with the mil standard approach, I guess I would say is what we have got at this point, our system requirements, which ultimately are going to lead to A specs, B specs, and that's where you're going to get -- feed in the results of more of the kind of quantitative analyses that you're looking for.

MR. GERTZ: Excuse me, Mike, this is Carl Gertz. Let me help you a little bit along that.

What you say is a good statement and I don't intend, as a project manager, not to drive the requirements down so that when we actually specify and the architect engineer puts his drawings for his facility, test facility on paper, we won't have all the scientists agree, yes, that will give me what I want to get my test. But that's a couple of levels below this. This is the starting level in the hierarchy as the systems requirement. We'll be driving that down, as we go to detail design. So, this is just the first step of the process that's given to us.

DR. NORTH: The point on which I hope we agree is that just meeting all the requirements is not enough. That is essential. You have to meet the requirements. But you may need to go further, and the responsibility isn't discharged if you say, well, we've met all the requirements, therefore, I don't have to think.

On the plane out from San Francisco last night, I watched the movie "Class Action," which had some rather vivid scenes in a courtroom demonstrating that you can meet all of the Federal requirements in this case as a private party, and still be liable to a great deal of, let's call it monetary liability, as well as loss of reputation within the system, if you don't use common sense and the information that is clearly available.

So I hope that that will not be a problem, but my experience in the past has been too often people have relied on just meeting the requirements in complicated systems, and as a result, there have been some spectacular failures.

MR. SHELOR: This is Dwight Shelor, Dr. North.

I think it's an excellent point. It also gives me an opportunity to make another point.

I think, as Mike said, these are the system requirements. These are at a level where it does not dictate the design solution. The design solution has to be developed, and at least has to meet these requirements that are imposed on it.

Philosophically, the other question always has to be answered. When you do come down to a system-level requirement and are driving this down through the design solution to the design specifications, should program managers, as DOE hopefully is a program manager, should they insist that the design not be overdesigned, that it only meet the requirements?

What are the constraints in the philosophy with respect to cost and schedule control on the program? Because one could certainly argue, in many programs, that once you've established the requirements, if they are both necessary and sufficient, then you would penalize a contractor who exceeded the requirements, because now he is possibly driving their cost up.

I think that is a balance that we have to have in this program. I think it's one of the things that we have to consider in these programmatic functions that we're using to bring this system into being.

MR. KALIA: This is Heme Kalia again.

Dr. North, the project, as Carl indicated, I think we have plans and procedures in place to be iterative as we grow with the characterization program.

What you are looking at is a suite that was identified in the site characterization plan. It is being modified. And the project has issued a site characterization baseline document, which is subject to changes, and will continue to change now onward.

And as the analysis and other data comes home, the procedures are in place to allow for iteration to continue, and modify the testing program as we go over that. So it is not binding. The flexibility is a key parameter that is requested from the designer to provide the PIs to be able to change their testing program.

So I want to indicate to you, and I think Carl will support me, that the project has a plan in place to be able to change the testing program, conduct more tests if required, delete the tests which were no longer required in the project. And DOE is supposed to provide that capability.

I hope it answers some of your concerns. But thank you.

DR. NORTH: I just wanted to put the concern on the record. And, having done so, I think it probably is time to go on to other issues.

My overall comment on the system is that I think in terms of dealing with the necessary part, the system should be very useful.

What I am worried about is the sufficient condition, that meeting these conditions is sufficient. Because it seems to me that if the system is assumed to take on that function, we may be asking far too much of it; and the important flexibility we're going to need is to make sure that people down in the low levels of the program and in the particular areas of science are asked for their input at that time, rather than going on an old set of requirements.

We saw in the Challenger disaster a very graphic and tragic indication that there was information available about a failure mode that would occur at a low temperature. And it appeared that people knew about that, but that information never got up to the level at which decisions were made.

So you want to try to avoid having that. And if your system is seen as clearly addressing what is necessary as opposed to what is sufficient, that may go a long way.

DR. ALLEN: Okay. Thank you, Dr. Duffy.

I think, since we started an hour early after lunch, let's take a break now, and then we'll come back for Dr. Ridolphi after the break.

Thank you.

[Recess.]

DR. ALLEN: Before we recommence, I would like to compliment the people at the table up here for their restraint. Never before have I been at a meeting where anyone at a microphone has the ability to turn anyone else off.

[Laughter.]

DR. ALLEN: I hope this doesn't get contentious.

[Laughter.]

DR. ALLEN: So, Dr. Ridolphi, you're on.

INTEGRATION AND IMPLEMENTATION OF FUNCTIONAL ANALYSIS

[Slide.]

MR. RIDOLPHI: Thank you.

I am Frank Ridolphi. I'm the Systems Engineering Manager for the M&O. I'm an employee of TRW, and I'm going to discuss today what the M&O's role is, or how we see our role and participation in the Management System Improvement Strategy.

[Slide.]

MR. RIDOLPHI: The first bullet just summarizes our role. It's our responsibility to assist OCRWM in completing the development of the dozen or so MSIS initiatives that Dwight described earlier on one of his charts, and to assume the responsibility across the program of implementing those plans, procedures, systems, structures, et cetera, that are developed in completing those initiatives. And the scope of that role is shown in these two bullets, and the two bullets on the next chart:

To define the structure of the Nuclear Waste Management System program management system, including the systems engineering management process;

To produce the necessary program level plans and specifications that are required to implement that management structure.

[Slide.]

MR. RIDOLPHI: To support the other participants in the program -- the project offices, contractors, laboratories, et cetera -- in producing their documentation which flows down and is complementary to the system-level documentation, so that the program flows downward from the top, and the documentation at the lower level is consistent with the strategies and so forth developed at the top;

And finally, once we develop this set of documentation plans, procedures, requirements, et cetera, to ensure that all these are accomplished across the program.

[Slide.]

MR. RIDOLPHI: This is an M&O chart. And it's a little busy. I'm not going to try to brief the whole chart.

But the point of the chart is that we see the MSIS, and the completion and implementation of MSIS, as developing the program management system that's the backdrop of the entire program, not only for DOE and OCRWM and its offices, for ourselves, the management and operating contractor, as well as the rest of the program.

And if you look in this part of the diagram which describes or characterizes the program, you'll see all of the various functions described in both physical system and programmatic systems, either as part of a specific construction or hardware project, or as part of more of a general management backdrop that overlays and interconnects all of the specific projects.

[Slide.]

MR. RIDOLPHI: I've called this the M&O view of MSIS. You'll recognize it as being very similar to a chart that Dwight showed.

All we've done is add a few boxes here and there, a few lines here and there, to connect some things up. But the main message for this chart is to lead into my next two charts.

We see the basic initiatives as falling into two categories: systems engineering-type initiatives, and this is currently the functional analysis that's going on, physical functional analysis that Mike Duffy has described, and the preparation of physical system requirements documents currently in progress, and the parallel programmatic functional analysis and eventual production of programmatic documents that Tom Woods described. We sort of view those as the systems engineering part of the activities, and the program integration part of the activities.

[Slide.]

MR. RIDOLPHI: We are going to address those two specific elements in terms of both objectives and products.

The objective of the program integration aspect or part of the MSIS is to provide the integrated program management system and a disciplined engineering process against which to run the program, and the various products of those activities are the program management system manual, which you've heard talked about before, which includes description of organization and functions, program control procedures and requirements, the document hierarchy, which Tom discussed a little bit, as well as a systems engineering management plan, which includes definition of how requirements are specified and so forth, and definition of things like how design review and change control is accomplished both at the system level and the requirements that flow down to the project levels and how those functions and activities are accomplished.

Then, of course, there are a number of subordinate plans, procedures, and specifications that are identified and defined during the process that are also developed as part of program integration.

[Slide.]

MR. RIDOLPHI: The objective of the systems engineering activities is to provide an appropriate basis for system development which can be used to technically review and manage the projects. That's sort of two objectives there.

One is to provide the basis from which the projects can proceed downward, and the projects do not have to be concerned as much with reaching all the way back up to a specific regulation and so forth, and then the second objective is to provide the basis against which the program level can review the projects and determine if they are performing satisfactorily.

The various products of the systems engineering functions are more specific, system requirements documents and specifications, technical management plan, such as the test and evaluation master plan, et cetera.

WBS sort of refers back to project control, but if you're interested in a product-oriented WBS -- in other words, a WBS that is focused on the outputs and the products of the project -- then it has to be developed based on the functional and requirements and specifications analyses that are done, and the overall result is an integrated technical baseline against which you can measure the progress of the project.

[Slide.]

MR. RIDOLPHI: Now, that's sort of an overview of what we intend to do in support of the program.

Our basic approach at this point in time is, first, to start with the current MSIS products and activities. You've heard quite a bit of activity and accomplishments, products, and so forth that are currently being generated.

We will start where we are today and build upon that to complete the development of the various initiatives.

We're placing priority on the near-term ESF specifications documentation.

As one of the primary reasons for this meeting points out, that is a very near-term, important milestone, near-milestone-driven activity, but concurrently, we are continuing, as I said, the integration and implementation of the overall MSIS initiative. So, it's sort of a two-pronged effort.

Now, because we are doing sort of something that in an ideal world might come later, after you've generated the overall program management system, as it were, and we may have to update the PMSM and the SEMP in an interim sense to cover what we're doing in the short term, we will eventually generate newer versions of the PMSM, Program Management System Manual, and Systems Engineering Management Plan to replace the interim editions of those documents.

Finally, since we are developing specifications now, before we've completed a new program management system or the program management system, after that is done, we'll go back and reiterate again in the requirements and specifications to make sure they all meet the overall requirements, overall plans and procedures.

[Slide.]

MR. RIDOLPHI: Because we are concentrating on the ESF specifications document, it was necessary to come up with an approach to the systems specifications. And I'm showing this chart again; Dwight showed it earlier.

The documents across the top are the system requirements documents which Mike and Bill Lemeshewsky have described in the two previous talks before mine, including the ESF system requirements document.

What the M&O is proposing to accomplish is to flow each of these documents into what we're calling a program element systems specification, one for each of the major program elements, including waste acceptance, and one for the ESF, and then, finally, as I show on the next chart, assist each project office in developing a design specification which again flows from the systems specification and to provide a traceable set of specifications.

[Slide.]

MR. RIDOLPHI: This chart adds a little bit to what I just said. The systems specifications were provided -- again, going back to an earlier chart -- the level of detail required to technically review and manage the project.

It should be the level of detail that's necessary, at the program level, to review the projects and determine how they're performing, as well as the correct level of detail at the program level for the projects to build downward from.

These documents will flow from the system requirements document that you've just heard about and that way will maintain traceability back up through the system element requirements documents, the overall system requirements document, and back to the regulations and so forth.

We will use the existing or to-be-existing system requirements documents, other requirements documents that exist at the projects, systems studies -- we've talked a lot about other things that need to be done to generate information needed to complete these documents -- and other kinds of sources to develop the documents, and the program elements system specs will be baselined at the program level.

Then, as I said, we will assist the project offices, to the degree that's appropriate, in developing the project-level design specs, and because they'll flow down from the system specs, they'll be traceable all the way back through the physical function analyses to the regulatory requirements, and these will be baselined at the project level.

[Slide.]

MR. RIDOLPHI: A little bit about what each of these three kinds of documents contains.

You've heard Mike and Bill describe the system requirements documents, which contain functional decomposition or decomposition of the functions and their interfaces, regulatory requirements, performance requirements, and because of the way these documents are put together, traceability of these requirements back to the regulations and laws, and that the system requirements documents are based on a top-level architecture.

Now, the specifications will sort of be -- the items, the bullets that I've shown here are kind of in addition to what you see here.

Because the system specs will contain the same functional decomposition, the same regulatory and performance requirements, the systems spec will be traceable back up to the regulations, but there will be some additional detail and additional information in the systems spec that's not in the functional system requirements documents.

The systems spec is based on a system description and a conceptual design. It's a document that normally is generated during a conceptual-design phase.

There will be a conformance matrix, which is a means of defining early on how each of the requirements that we're calling out that must be met, how each of those is to be verified, either through some kind of specific test, through an engineer going into the tunnel with a tape measure to measure to make sure it's the right size, some way of confirming each of the requirements that are called out.

It will be in a, more or less, engineering or construction industry standard format. It will contain some engineering analysis and interpretation of things like regulatory requirements.

It will contain some things -- Dr. North referred to common sense; I don't know if that's exactly the right word, but common standards, common construction standards and so forth, specialty engineering such as human engineering, availability, reliability, maintainability, those kinds of things that normally are included in a specification.

Now, the design specification is very similar to the systems spec except to more detail. It contains the same traceability, since it flows from that document.

It's based on a Title I or a Title II design, has the same kind of conformance matrix and format, but it's based on more specific design information, more specific design analyses, and starts to bring in the lower-level construction codes as well as higher-level standards.

That is a definition of the documents in that hierarchy.

[Slide.]

MR. RIDOLPHI: The system requirements documents that we've talked about are planned to be baseline by July 31st, as Bill pointed out, with an overall system document, the "dispose waste" document and the ESF system requirements documents.

What we are planning to do is to come along as fast as we can behind that with a system specification and we're planning to have a draft for review by July 31st, which is basically this same time.

We are, of course, novices in the DOE review and PCCB process, but we're hoping to have that specification baseline by October 1st, which is the nominal restart date for Title II design. So, that document would be in place at that point in time.

We are currently and will continue to assist the Project Office in developing the corresponding design spec for the ESF. We hope to have an initial draft prior to Title II design, and we will continue development of that document through Title II design.

[Slide.]

MR. RIDOLPHI: It occurs to me that this is not a diagram of everything that goes into development of the system requirements, system specification, design specification, but is a flowdown of the pedigree, if you will, of those documents, starting with overall systems, through disposed waste, including the site characterization plan and site characterization plan baseline, into the system requirements document; and then the system spec and design spec flowing down from that, the design spec being part of the Title II design activity.

We will iterate back and forth with the basis for design document, so that design studies and analyses that are done in this activity will feed back up through the chain.

Now I have sort have moved from the general to the specific. I want to go back now and sort of recapture our general management plan for how we're going to participate. [Slide.]

MR. RIDOLPHI: We are planning to do this sort of in three phases. The first phase is sort of a transition plan, where we are concentrating on getting these ESF documents out, while we begin the process of the overall program management system development.

Phase II is sort of a development phase, which integrates the overall top management initiatives in the MSIS to produce the management structure. The outputs or products of this Phase II will be a new baseline draft of a PMSM and an SEMP, which are the two documents which kind of drive the program management and systems engineering process, as well as a detailed implementation plan that says, once these documents are approved, how are we going to implement them? That includes things like training, assistance, development of the subordinate plans and procedures and so forth, as is shown here in Phase III, which is the implementation phase, implementing the mainline documents and completing the system specs and all the subordinate plans and procedures.

[Slide.]

MR. RIDOLPHI: My final chart is a very top-level schedule that says Phase I is going on now. We plan to have the ESF spec baseline by October 1. We will have a more detailed development plan in which to start the development of the program management major documents during this time frame, and around the end of the year, we will be ready to begin implementation of the overall system.

Any questions?

DR. CANTLON: Yes. John Cantlon.

Since you have the sort of overall coordination responsibility, I don't see any R&D component in here. Where does this management operation thing feed back into the R&D feed system?

MR. RIDOLPHI: Now, when you say the R&D feed, specifically --

DR. CANTLON: You're designing a system to manage something that isn't going to happen for 20 or 30 years.

MR. RIDOLPHI: Okay.

DR. CANTLON: There's an enormous flow of new discovery, new technology, new techniques and so on coming in. If you design this system we may end up with a World War I battleship.

MR. RIDOLPHI: Right.

DR. CANTLON: What do you have in your management system to guarantee that you're going to have the technology appropriate? How are you driving the investment, the national investment in the research system, so that it goes in the directions that will feed the needs -- the opportunities?

MR. RIDOLPHI: You're right. I did not show those on any of my charts. When we go after requirements, or to go into a requirement or specification, we look across the board, in our organization, across the board of the program, not just in the regulations, not just things that flow directly out of the mission requirements. But we go, for example, to an outreach organization and say what kind of requirements do you want in this system? They may say we want a visitors' gallery, a certain size, and so forth.

We also have an element in our organization, the M&O Organization, in fact, that reports to me, in the Systems Engineering. I don't have an organization chart with me. Robby may have one tomorrow when he speaks.

An element of my organization is called "technology assessment," and the objective of that particular part of our organization is to survey, analyze and assess the applicability of new technology across the world. That's how we are planning to get it implemented.

As new technology or appropriate technology is identified, we will fold it into the requirements process. That is, if it means we have to change a requirements document, we will go through the formal procedure of proposing a change, getting it evaluated through the Change Control Board and so forth; investigate the impacts of such a change.

DR. CANTLON: That's, in a sense, the reactive mode to it, that you're looking at what's emerging.

I guess the other side of that coin is to what extent can you, from understanding now of full systems approach, impact what the investment in the research is going to be yielding? In other words, it's a two-directional opportunity.

MR. RIDOLPHI: That's correct. We have, as both Bill and Mike, I think, pointed out, generated in this process and we're continuing to generate, a list of things we don't know. It's either requirements needs that we have or places where we don't have a good design solution.

In each of those areas, what we will do is perform analyses of the system, in order to determine the usefulness of new technology or other approaches, and then as we identify things that need to be done, as an outfall of our systems analysis activities, we will identify those things.

MR. SHELOR: Can I follow up just a little bit to complement maybe the answer?

In our programmatic analysis that we're going through, we'll end up with a process -- we will do risk assessment in the program. One of the reasons that you look at risk assessment across the board, obviously, is to establish whether technical solutions are currently available. If those technical solutions are not currently available, or there may be better alternatives, then the risk assessment will allow you, hopefully, ultimately, to balance the risk across the program. This may drive budget allocations to development of technologies to reduce risk. That's why it is extremely important to complete this programmatic analysis, so that you have that interface and that information feedback into the budgeting and budget allocation process that we have in the program.

DR. CANTLON: The other piece relates to Dennis Price's comment, that is, the utilities -- the feed to this system and the degree to which you can influence the development of the waste handling technologies in the utilities needs to be addressed because it makes your job a lot simpler, more predictable and so on.

MR. WOODS: Dr. Cantlon, it seems to me that before the break as well as now, I'm hearing things that indicate to me that maybe I didn't come across clearly, and maybe we're assuming something here and not explicitly putting it on a chart.

I think that I can say this for all of the speakers; when we speak of a function, here again, we're not talking about a plan to do work. We speak of something, an identification of a "what must be done," not a "how it needs to be done."

Furthermore, in identifying the functions or the "what must be done," we're saying, gee, what has everybody else told me I must comply with while I'm doing that? We're suggesting that it's very important to the program that all of those things that have been directed upon us, need to be not only identified but put in a place where the designer, the manager, the decisionmaker, knows what kind of latitude he has.

And now comes the point that Dr. North, I think, was getting at and, to a large degree, you were getting at, that I've got it all in one place so that I know whether or not I can even consider new technology, so that I know what it is that I can go out and do. How I'm going to run that scientific test, which methods to use, whether with new technology instruments; all of those things then are the choices that remain to be made within the constraints of the requirements that somebody else has directed on me when they told me that a given function had to be done.

I think that that is an important basic here. The requirements do not complete the job. They just define the solution space that's left, in which we then have to go out and plan what work is going to be done.

DR. ALLEN: Okay, thank you very much. Strangely enough, we're within 60 seconds of being on schedule here.

DISCUSSION

DR. ALLEN: The final three quarters of an hour here on the agenda is called Discussion. I didn't plan this agenda and I don't know quite what people had in mind, but I assume it's quite an informal discussion. I'm not inclined to rearrange people at the table or anything like that at the moment, although I hope anybody and everybody will participate, even if you've not been a participant during the rest of the schedule.

In particular, I wonder if we might start off by asking if there are any people here who have not been on the program. who are with groups not represented on the program, such as the State of Nevada and EPRI and so forth, who have any particular comments or questions? We certainly want to get every kind of viewpoint or question out. Yes?

MR. CALLEN: My name is Ron Callen. I'm from the National Association of Regulatory Utility Commissioners. There's one item that has come strongly to the fore, and Dr. North pursued it and I just feel, unless I misunderstood the information, I have no answer to; and that is the cost of the MSIS. I wonder if you could pursue that a little bit more? We had a couple of cost numbers, but I thought they were only related to minor aspects of it.

MR. SHELOR: I guess I can address this. I think the number that Bill Lemeshewsky mentioned in his presentation was probably a reasonably accurate number of an estimate of what was required on three physical system functional analysis activities. That was 20 man-years and if you use 150K per man-year, you're going to come out with about $3 million.

That's certainly not the total cost. That does not, I believe, include the cost of the requirements research activities. It does not include the cost of the programmatic functional analysis that's being primarily conducted or led by Tom Woods and his people at Westinghouse-Hanford.

I think if you want to look at the total activities for the management system improvement strategy, just the implementation that we've gone through to date, I suspect the number is more like $18 million. I base that on our total budget allocation for my office, less the budget allocation for our regulatory compliance activities.

So, all of the systems engineering activities, not including the regulatory compliance, for the last 12 months is approximately $18 million.

MR. CALLEN: That's a portion of your total expected costs?

MR. SHELOR: For the complete implementation, that would be correct, Ron, because, as we indicated, it's going to be several months now before the other documents are completed. Now, it depends on when you cut it off. I believe that the development, the establishment of the document hierarchy is going to be included in this cost. If we have to rewrite management plans, that's not included.

If there is a significant change in the product-oriented work breakdown structure, there could be an add-on cost for making that change within the existing system. We may have contractors that are working to an existing work breakdown structure that will have to change. There will be a cost for doing that.

I think that if we do make the change, that this transition period where the M&O is going to be transitioning over the next 14-15 months, is the appropriate time to make that change, but there is a cost associated with that; you're right.

DR. ALLEN: Any other comments or questions?

[No response.]

DR. ALLEN: Let me ask the people at the front table.

DR. NORTH: I would like to pick up threads from earlier comments. I'm sort of surprised and fascinated that we got through the whole discussion of the MSIS without the phrase "contingency planning" being used.

I interpret Tom Woods' remarks just a few seconds ago to confirm my own hypothesis that that may be among the most important uses for this system; that it's clear that there are going to be changes in the overall requirements. Come to the session Wednesday to hear about part of that.

There are going to be unexpected results from the ESF tests. There are going to be technological changes of major importance to the program and new insights from performance assessment. The question is how is the program going to adapt and adjust to these new developments?

This system may provide a lot of ability to deal with a very, very complex set of requirements and program contexts, so that things are not forgotten as these new developments appear and have to be folded into the program. But it seems to me that if that really is a major value of the system, you need to build that in from the very outset and make it a keystone of your philosophy.

I'm concerned because I didn't hear it, except a little bit. I strongly urge that in the discussion of the MSIS that that be highlighted.

I would like to pick up a point from this morning's discussion, and use it as a specific example.

Again, it was something I didn't hear in this meeting regarding design, but I heard it, and I've expressed myself in some previous board meetings, and I've had even more reinforcement through the risk and performance analysis activities of the last several months.

This is the issue of organic material, and its impact on the mobility of actinides.

I think that a very important concern in the development of the underground facilities is the degree to which there are organics present that might interact with actinides in the waste, and facilitate migration.

I think it is not at all too early to bring that into the design considerations and ask the question, what could be done to minimize the extent of organics underground that might form humic, or anything like it, and facilitate plutonium migration?

I didn't hear it mentioned this morning, and I submit it's the kind of thing that ought to be into the system so that that isn't a new question when we get further down the line with designs locked in, and a great deal of money spent.

That's a very important issue as far as I'm concerned, coming out of what I've learned about performance assessment over the last year or so.

MR. PETRIE: This is Ted Petrie, Engineering & Development at DOE.

What you mention is, in fact, a real concern. If you look into the control requirements document, which places requirements on ESF, you'll find it's in there, and is one of the things which must be considered. Maybe the reason why you didn't hear it this morning is that it's one of approximately 10,000 requirements that are imposed by the design.

So I'm just saying yes, there should be no doubt in your mind that it is one of our considerations. But it just didn't happen to be one of the things that was addressed this morning.

DR. NORTH: I am reassured. I hope that the contractors and designers also know about this. And if the system facilitates making sure that that element and the 9999 others all are tracked so they aren't forgotten, that's exactly why this system will be valuable.

MR. PETRIE: During Dick's talk this morning, he showed you an example of how we trace the accomplishments of requirements within the design. Let me assure you that was only an example, one of many, many, many, many, many. That is how we will assure ourselves that all those requirements have been resolved.

MR. SHELOR: This is Dwight Shelor.

I'd like to follow up with regard to contingency planning. I don't want to presuppose Tom Woods too much, but I've been involved in it a little bit.

Let me expand on my earlier discussion, when I mentioned risk management. I think risk management is one of the functions that we're looking at on the programmatic side. And when you begin to decompose risk management, right away you see that you're going to have to have daughter functions, such as analyzed risk, and evaluated risk, and then you come over to mitigate risk. And then when you begin to mitigate risk, one of the sub-functions there will in fact be contingency plans: what if my original assumptions for the technology do not work or come to be, then what are the contingencies that I have in place to mitigate the risk of that not working?

So I believe that, obviously, and again, to make an excuse, in the short time that we have available this afternoon, we did not go through all of these functions. But your point is well taken, and very important.

I think the risk management really starts at a very high level in the program, because we have to look at what are our contingencies if we don't get access to the mountain; what if Yucca Mountain is not suitable? What is our contingency plan taking off from there

So we are starting at a very high level, and we work this down to mitigating risk, and using that analysis and mitigation strategies for budget allocation, which is the real driver to the program.

DR. ALLEN: Dennis?

DR. PRICE: A couple of things out of the day, comments I might like to make.

I noticed you generated 6,000 requirements. Isn't that correct, somewhere like that number? And then someone just said 10,000. So it's between 6,000 and 10,000, which is thousands of requirements. That's a lot of requirements, and obviously we need some kind of assistance to be able to track.

At one part, one of the presenters was indicating they identified the issues necessary to come up with the requirements for functional analysis, and did so by calling in those people who were experts in the area, and having a brainstorming session.

This kind of theme is repeated quite often where, at the very heart or the very root of whatever flows downstream, it comes from a brainstorming session. In general, this kind of bothers me, that we rely upon the artfulness of a brainstorming session, and I'd like to see somewhere some real consideration given to developing ways of refining this art, if it has to be an art, techniques for approaching the development of issues, or requirements, or whatever, that take you a little more than brainstorming; because that seems to me to be ultimately one that is without any check and balances. There's no way to get back and say yes, we did a complete job or an incomplete job. It's whatever happened in that brainstorming session.

Yes.

MR. WOODS: Tom Woods. Let me see if I can answer that for you.

Having sat in on some of Mike Duffy's sessions on the functional analysis of the physical system, I think I can speak both for that effort, as well as ours.

Virtually no brainstorming at all. The workshops that were conducted with the line organization expert people, sir, were done in a very rigorous process of elicitation, decomposing, function-by-function, those things which must be performed -- not how; we're not planning the program -- those functions that must be performed to enable the parent to be completely performed. And that is a pretty standard, very rigorous method that has been used for quite a number of years. There's nothing new there. But certainly no brainstorming going on.

There's a set of tests that the facilitator of the workshop employs, as the members of the workshop suggest different functions. There are tests to be applied as to whether or not those are necessary functions. And, having apparently reached a point of completion at a given level, there are tests that can be asked of the workshop members as to whether or not the assembled set is sufficient.

So there is very, very little brainstorm kind of activity with respect to the functional analysis, per se.

With respect to the requirements, let me take a shot at that, if I may.

I don't think that there is a problem with the 6,000 to 10,000 number disparity, only in how the one speaker and myself are referring to requirements. The only way in which I've used requirements today is those things that are in text today in regulations, in applicable directives, in DOE orders, state ordinances, whatever may be the case. If it is applicable to this program -- and there's a set of criteria to determine that, but it's very difficult -- but if it's applicable to this program, then the text applies and the job of the functional analysis is to link the specific paragraph or sentence to the function that it applies to, all the way through the regulation

So there's no brainstorming there. And every bit of every regulation and document can be accounted for with respect to the function that it applies to.

So I guess I would want to assure you, and put your concern a bit at ease, that, as I think Mike Duffy stressed in his presentation also, there is more rigor in this method than anything else I know of; and, in fact, if there's a vulnerability, it's the cost involved to provide that rigor so that there is traceability, so that there is repeatability, for those in even later generations that want to make sure we didn't miss something.

DR. PRICE: I am pleased with the response. The idea that every requirement is found in a document makes one think, though, that as you come up with the requirements, it's merely a search of the documents, not what was presented to us, which I found reassuring also, that you start with the mission with what needs to be done and regardless of whether or not it's found in a document it becomes -- it flows down through the requirements. And you're shaking your heads yes.

MR. WOODS: But with one additional qualifier, if I may. Remember my remarks a minute ago, identifying what needs to be done and the imposed requirements -- the way I'm using the words -- and imposed requirements that constrain how we're allowed to do it, that's only the beginning point. Then one must sit down and design a test or design a piece of equipment or so on. And then, there are people in the room who are attaching the word "requirements" to the results of that planning or to the results of that technical effort. And I only mean when I use the word "requirements" what has been imposed on the performance of the function on the outside.

DR. PRICE: If I may, I'd kind of like to switch over to something else that we discussed earlier, and that was the boundaries of the system.

Where I think the response was, there are some things which need to be studied or looked at or optimized that go beyond what the rules are for acquisition of the waste and what DOE gets. Yet, I'm still groping for how or what is the mechanism to release such studies to be done.

MR. SHELOR: I believe we have an excellent way to do that. I can't put the chart back up, but one of our programmatic functions that we're examining is external relations. We have an external interface with the utility industry. A lot of times it is represented by EEI. But in any event, the external relations will have an interface with the accept waste function.

External relations also will lead us to a process where we can maintain a dialogue with the Congress and the utility industry or the ratepayers for this activity. As I indicated earlier, areas where the analysis must go beyond our system boundary as we have defined it and that's where we would find that interface.

DR. PRICE: I appreciate what you say, that there are areas that the analysis just simply has to go beyond those boundaries to really capture the impact of maybe design changes and so forth, life cycle costs to be able to really get to it.

Just one last comment and that's, I think, a good bit of the discussion that went on today touched on whether or not we're going to establish this systems engineering process that will deliver a set of requirements and be rigid. And there was a word used, "flexible."

I think the need is for a dynamic kind of a system with respect to both the requirements and the technology because some of the comments also that came out had to do with, well, technology changes. With a system of letting contracts, there may be a tendency for the requirements to be contractual in nature and lose some of that dynamic capability; and whether or not there is a way to really address that, I wonder.

Where you let a contract now, it's frozen in time as to requirements and maybe even technology, and maybe that also affects things downstream so that you get a cascading effect in the contractual type of world that you have to deal with where at the same time you need to maintain this flexibility, and I'm wondering what your thoughts are on that.

MR. SHELOR: Maybe there are some other people who would like to comment also. But I would like to reiterate that in the establishment of the system requirements -- and this is just the top-level system requirements, if you will -- when we identify the functions that the system must perform, we have not dictated the design solution. We have not even assumed, for the most part, what technology would be used in the design solution to satisfy that function.

When we go through, then, the rest of this systems engineering process, when we go through a conceptual design, as we have done, the conceptual designers would utilize the system requirements, evaluate or establish maybe several alternate conceptual designs that conceivably meet the requirements and do an evaluation in selecting one, hopefully, one or more of those conceptual designs to meet the requirements.

Then you begin to build the specifications for that conceptual design because now you're beginning to relate that to a technology for the design solution. Once you begin to do that, then you are locked into those risks that are associated with that technology meeting the requirements and working as an integrated system.

The real key and the point where you begin to look at your alternatives is in the conceptual design. Now, in the particular case that we have here now on the ESF, we had progressed through the conceptual design through Title I, through the two shafts.

We have gone back through the ESF alternative study, which is essentially now a conceptual design and an evaluation of several alternatives for the ESF and are developing that into a design study which is essentially going back and doing the conceptual design and the Title I design over again. So, all of that information has to be contained in this ESF design summary report, which will be used to update the Title I.

I think the point is if, in the future, there are better technical solutions to the requirements, then we will come back and evaluate those through the same process, real conceptual design, and developing into a preliminary and a detailed design. But until those better technical solutions are available we can't evaluate them now and we must move forward with some baseline design that will satisfy the requirements.

MR. WOODS: Tom Woods, once more, if I may.

The sense of your question, Dr. Price, is one of great importance. The NAS, in their report, talked about their fear of the program being too rigid, our inability to respond to unforeseen things. At very, very basic levels, there's a tension here that simply will not be ignored.

The tension is one of having a program sufficiently defined that it can be executed without chaos, which means that everybody needs to know what everybody else is doing so that they don't get in everybody else's way. That requires definition; there is no way to avoid it.

But we're confusing inflexibility with definition. It doesn't need to be there, where only a program that's defined can be executed successfully. So, how do we be flexible?

The only answer is in a changed management system that is extremely responsive, maybe responsive on a time scale of unprecedented nature. That's the only way flexibility can be built in, unless one wants to throw definition to the winds and we're just going to go out and everybody do their own thing. We all know what that leads to in terms of orderly progress.

So, there is that tension. There's no way to avoid it and it has to be reckoned with.

DR. DEERE: Perhaps another answer was given this morning by Carl Gertz when he said that they are thinking that the construction contract will be some type of cost reimbursible, which means that every time you make a change in tests or add an additional test, you don't have this great problem that the contractor says, well, this is outside the contract and it's going to cost me more, or my unit prices don't apply.

So there is flexibility in the construction type of contract that is being considered. There are different types of cost reimbursible contracts, and I'm sure that several types will probably be looked at, if I understood him correctly.

MR. GERTZ: That's fine. Let me just add to the real time. Excuse me; this is Carl Gertz with the Yucca Mountain Project.

In real time, last week we started work in a couple of areas at Yucca Mountain. We had our change board and we had five changes that we had to convene the first day we started out there. We got it convened, we made the changes to the specs and moved on with the activities. I'll talk more about that tomorrow, what we did.

It was very pertinent to this discussion, that we're out in the field using specs, making changes and moving on with the scientific investigation with the principal investigator, Duane Gibson, standing in Midway Valley with John Stuckless and Zell Peterman standing in Trench 14 and with Bruce Crowe standing out in Lathrop Wells.

So, there is flexibility in the system. The scientists, I think, are now pretty well convinced there is. It may not quite be as flexible as they like, but it is responsive to their needs.

MR. SHELOR: I'd like to add to the description of flexibility. Again, the requirements basically do not dictate the design solution. The designers come up with the design solution and they do an analysis of that design.

Most of the real flexibility you have for making field changes and for making very quick turnaround adjustments and allowances for the unknowns that we know are going to be there when we go underground, are in the design analysis. What are the boundaries and what are the constraints on the analysis?

I'm trying to think of a good example, but if I'm going to design the materials test area for a very specifically defined location, that's fine to specify that in a drawing or a construction drawing, but I hope that the analysis would allow me to shift that location back and forth and expand the location without going back and redoing the basic analysis.

So, it's the scope of the analysis that is in support of the design that provides you the flexibility to deviate during the construction process.

DR. ALLEN: Dr. Fabrycky, do you have any final comments?

DR. FABRYCKY: Wolt Fabrycky.

I'd like to go back, I think, to the beginning of this session that we began, and Tom, I think you brought forth the example of General Motors versus Pontiac. My question or concern is that I'd like some elaboration on the apparent separation of the functional analysis for the physical system; that is, bringing the physical system into being, and the programmatic functional analysis.

There seems to be some time spent on saying that these must be separately treated. I guess I'm uncertain about the real "why" for that and also the analogy of GM and Pontiac. Are you talking about Pontiac, the automobile, or Pontiac, the Division of GM?

MR. WOODS: The automobile. I think the instance there was that it's pretty handy for most any of us to conceive of an automobile, I don't care what type, as being a personal transportation system and being able to reason and see that that is a totally separate entity with many, many functions necessary to provide personal transportation, and yet that is a thing apart from the company that conceived and designed and manufactured and delivered the personal system itself.

Now, what the whole notion here is that it's not enough for us to face the personal transportation system, or if you will, the waste disposal system and understand what functions it must have, but we must also look at the processes necessary to bring that into being, as I think was Dwight's term; bring the waste disposal system, transportation, et cetera, into being. If those programmatic functions then are missing something, if they're not well tuned to one another, then there's going to be difficulty in executing the program.

There may be difficulty in bringing that personal transportation system or that Pontiac into being, in this case, the waste transportation system. So, the two play hand-in-hand.

Very interestingly, the DOD, I think now, in considering a revision to the cornerstone Mil Standard 499, is looking at, as are some other larger groups, the concept of concurrent engineering, which is really exactly this: it's not enough to understand the system or service to be produced to perform a mission, but it must be tuned and tailored to the processes that have to be in place, or the best idea in the world may not be able to be produced unless the processes are right to produce it.

So, that's the two sides of this analysis.

While 99 percent of the time, it's pretty clear which function falls on which side, there are areas where it gets fuzzy. It's hard to set a criterion down, an analogue, if you will, that works in all cases.

Mike and I have struggled a lot with this and we're both very well aware of the concepts. The way that we've left it is that we're going to have to resolve some areas when the two analyses come toward a close and we have overlaps between the two. We have yet to do that.

DR. FABRYCKY: That helps considerably. The operative words that were bothering me were "bringing the physical system into being." The life cycle completeness I guess I was concerned about. But you do not mean that simply bringing the physical system into being, and after that, the programmatic ends. The programmatic will continue to live with the physical system, maintain it, operate it, and so on?

MR. WOODS: Yes.

MR. SHELOR: I think even to the extent that we have to consider that those personnel who are involved in the operation of the system are a part of the physical system.

DR. FABRYCKY: That last phrase helps considerably.

MR. WOODS: But yet at the same time, if I may, there indeed may be program functions going on at the same time there are people operating the system.

Now, where does one stop and the other start? And there are fuzzy areas that are just plain hard.

DR. DUFFY: But you are assuring us, I believe, that the two will come together, appropriately, and the fuzziness will be addressed.

MR. WOODS: Yes.

MR. SHELOR: Yes.

DR. ALLEN: Other comments from members of the Board?

[No response.]

DR. ALLEN: How about the staff?

[No response.]

DR. ALLEN: Any other comments from members of the audience?

[No response.]

DR. ALLEN: Well, if not, let me personally thank the participants, both those on the schedule and those who volunteered opinions. And I'll turn the meeting back over to Dr. Deere.

DR. DEERE: Thank you, Clarence.

Again, I wish to add my thanks to those of Clarence to all of the participants and to their organizations, for allowing them to take the time to put the presentations together.

We think it was a very appropriate time for us to learn where the program is, to learn more about the program.

Certainly, I personally have a much better understanding, and I'm sure that I speak for the other Board Members, staff, and consultants. It has been very worthwhile.

As interesting as this has been today, I don't want you to go home now, but hope that you stay on for the meetings that we have for the rest of the week. Particularly I'll mention tomorrow's meetings, which start at 9:00 o'clock, rather than 8:30.

Our invited speaker is Dr. Bartlett, whom we have asked to address the program priorities and budget; and Carl Gertz, Director of the Office of Geologic Disposal, who will also speak on these same topics, and the status of the work that is going on at their Yucca Mountain office.

We have invited the General Accounting Office, Mr. Rezendes, to make a presentation of their analyses of the OCRWM program; and Mr. Todd LaPorte, who is a member of the new Advisory Board Task Force created by the Secretary of Energy. They have had, I believe, their first meeting, and will be making a presentation tomorrow.

Then, in the afternoon, will be a further overview, a larger overview M&O contract, by Robby Robertson, of the TRW Environmental Safety Systems, Incorporated. We think that will add very much to the information presented today.

Then, Tom Isaccs will present to us a briefing on their international activities by OCRWM; and the Board has considerable interest in these.

So we feel that tomorrow is an extremely interesting session. We certainly invite you to come back.

On the following day, we will be talking about many of the standards and regulations.

Melvin Carter, who is the Chair of our Panel on Environment and Public Health, on Wednesday morning will be introducing the subject, making preliminary and introductory remarks.

Mr. Clark of EPA will be talking about the EPA Standard, 40 CFR 19.

Mr. Fehringer of NRC, on NRC Regulation 10 CFR 60.

And Paul Gnirk will give a historic overview of the DOE site selection criteria, 10 CFR 960.

The final paper or presentation will be by Dr. Jean Younker from Science Applications International, on an update. This will be the third update that we have had -- I guess an introduction two meetings ago, and then two updates -- an update on the early site suitability evaluation study.

So we felt, in choosing these topics and these speakers, we will get a very good update on where the program is now, what has really been happening in this last six to 12 months, and we invite all of you to attend.

So again, thank you all.

[Whereupon, at 4:30 p.m., the meeting adjourned, to reconvene the following day, Tuesday, July 16, 1991, at 9:00 O'clock a.m.]