

UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD

Rosslyn Westpark Hotel
Arlington, Virginia

Thursday, January 17, 1991
9:05 a.m.

ANN RILEY & ASSOCIATES, LTD.
1612 K STREET, N.W. 202-293-3950 WASHINGTON, D.C.

BOARD MEMBERS PRESENT:

Dr. Don U. Deere, Chairman
Dr. Clarence R. Allen
Dr. Melvin W. Carter
Dr. Patrick A. Domenico
Dr. Donald Langmuir
Dr. D. Warner North
Dr. Dennis L. Price
Dr. Ellis D. Verink

ALSO PRESENT:

Dr. Roy E. Williams, Consultant
William D. Barnard, Acting Executive Director
Dennis G. Condie, Deputy Executive Director
Helen W. Einersen, Executive Assistant
Victoria Reich, Librarian

P R O C E E D I N G S

[9:05 a.m.]

DR. DEERE: Good morning, ladies and gentlemen. I wish to welcome all of you here. I am going to repeat the introductory remarks that I made yesterday, including the introduction of our panel members, for the simple reason that we have a lot of new audience today and a lot of new speakers here.

It's a pleasure to welcome you all again to the Nuclear Waste Technical Review Board's meeting, particularly the first meeting of 1991. Since it is the first meeting, I think I'd like to introduce you to the Board members, and we'll do it by introducing them as the panel chairmen.

Dr. Clarence Allen, who is the Chair of our Panel on Structural Geology and Geo-Engineering. I would ask each of the members to tell us his affiliation and his particular area of interest.

DR. ALLEN: Yes. I'm Professor of Geology and Geophysics at Cal Tech, Pasadena California. My primary interests are in seismology, geologic hazards, structural geology and related aspects of engineering geology.

DR. DEERE: There's a vacant chair on his left which is the one that will be occupied at various times during the day. This is the property of Dr. Mel Carter. He is the Chair of the Panel on Environment and Public Health. He will be in and out today.

In the third, I will introduce Dr. Pat Domenico who is co-Chair on the Panel on Hydrogeology and Geochemistry. Pat?

DR. DOMENICO: I'm a Professor of Geology at Texas A&M. My interest is hydrogeology.

DR. DEERE: To his left, Dr. Don Langmuir, who is also a co-Chair of the Panel on Hydrogeology and Geochemistry.

DR. LANGMUIR: I'm Professor of Geochemistry at the Colorado School of Mines. My interests have to do with water-rock interaction and geochemistry, generally.

DR. DEERE: To his left, Dr. D. Warner North, Chair of the Panel on Risks and Performance Analysis.

DR. NORTH: I'm a principal with Decision Focus, Incorporated in Los Altos, California. I'm a Consulting Professor with the Department of Engineering Economic Systems at Stanford University. My interests are decision analysis and risk assessment and performance assessment.

DR. DEERE: Dr. Dennis Price is Chair of the Panel on Transportation and Systems.

DR. PRICE: I'm Professor of Industrial and Systems Engineering at Virginia Tech and my interest, as you can tell, is in the area of transportation, special interest in human factors and systems safety.

DR. DEERE: Dr. Ellis Verink, the Chair of the Panel on Engineered Barrier Systems.

DR. VERINK: I'm distinguished Service Professor in the Department of Material Science at Engineering at University of Florida. My background is in metallurgy and my specialty is in corrosion.

DR. DEERE: The ninth member of our group, Dr. John Cantlon, was not able to be present at this meeting. He is the Chair of

the Panel on Quality Assurance. Also at the table we have our Executive Director, Bill Barnard. To his left, Dr. Roy Williams, who is a consultant to our Board in the area of hydrogeology. You might tell us your affiliation, Roy.

DR. WILLIAMS: I'm Professor of Hydrogeology and Director of Waste Management Studies in the College of Mines and Earth Resources at the University of Idaho in Moscow, Idaho.

DR. DEERE: Thank you. As most of you know, the Nuclear Waste Technical Review Board was created by Congress in 1987 to review the technical and scientific validity of the Department of Energy's program for managing high level radioactive waste disposal.

In the same law, Congress directed the DOE to characterize a site at Yucca Mountain, Nevada as the possible location for a geologic repository for the permanent disposal of high level radioactive waste. The Board's charge includes the evaluation of site characterization activities at Yucca Mountain, as well as activities involved in the packaging and transportation of the high level radioactive waste that could ultimately be stored there.

To date, the Board has nine members who are nominated by the National Academy of Sciences and appointed by the President. Our parent legislation provides for a total of eleven members to serve concurrently. We understand that there are two lists of candidate members in the fields of nuclear chemical engineering and in public policy that are in the process now of going through the appointment screening. We'll be pleased when we have our full compliment of eleven.

1990 was a very busy year for the Board. We had four full Board meetings, submitted two reports to the U.S. Congress and the Secretary of Energy, sponsored ten panel meetings and technical exchanges, and held three public hearings. Members of the Board met with representatives of the State of Nevada, the Western Shoshoni National Council, the Soil Conservation Service, the National Park Service, the Fish and Wildlife Service, the United States Geological Survey, and the utilities.

The Board members also met with nuclear waste disposal experts in Sweden and Germany during a week-long trip. The Board is currently considering its agenda for 1991. Possible areas of inquiries concerning the DOE's technical and scientific activities are numerous and challenging. The full list of issues before us requires that the Board and its seven panels establish priority early.

Therefore, we are especially pleased to have with us at this meeting representatives of groups reflecting a broad range of opinion on high level radioactive waste issues. This was the group of invited speakers that we had making presentations yesterday. I think it might be of interest to go over those so you can see that there truly was a broad range of interests and those of you who were able to attend would recall that there were considerable differences of opinions amongst the different speakers and a good dialogue developed with the Board members and the different presenters.

We had Dr. Colin Heath, currently from Remcor; Mr. Dan

Reicher from the Natural Resources Defense Council; Mr. Michael Martinez of the Southern States Energy Board; Mr. Louis Long, Southern Nuclear Operating Company. We had a slight change in the agenda because the next speaker, who was to have been Mr. Michael Wilson, was sick; also had been in an automobile accident. He would have spoken representing the Florida Public Service Commission.

So we moved up Ms. Susan Wiltshire for the morning session, a lengthy morning session, from J.K. Associates. Then in the afternoon we had Mr. David Leroy, the Nuclear Waste Negotiator who gave a presentation to the Board and answered question from the Board members and from members of the audience; and, a talk by Ron Callen, the National Association of Regulatory Utility Commissioners.

We also had a request from Commissioner McRay of Nye County who spoke to the group for a short period about the needs and concerns of Nye County and how they felt they could interact with the Board.

We continue our educational process for us by inviting John Bartlett and the DOE to present to the Board and to the audience the current views and activities, plans of the DOE. So we're very happy. We know that our educational process is going to continue today, as well as the one we had yesterday.

So I am, indeed, very pleased that John Bartlett, Director of the Department of Energy's Office of Civilian Radioactive Waste Management, was able to join us this morning, particularly after the very serious events of last night. Dr. Bartlett is responsible for the development of the nation's waste disposal system for spent nuclear fuel and high level radioactive waste.

Previously, Dr. Bartlett directed energy and environment work for the Analytical Sciences Corporation, which included extensive efforts on high level radioactive waste programs. Dr. Bartlett joined Task after working with Battelle Pacific Northwest Laboratories where he was Manager of System Studies in the Nuclear Waste Technical Program Office.

He also served on the faculty of the Chemical Engineering Department at the University of Rochester and as a design engineer at Knowles Atomic Power Laboratory. He was a Presidential Exchange Executive assigned to the Bureau of Standards and a Professor of Nuclear Engineering at Istanbul Technical University-Turkey.

We have asked Dr. Bartlett to share with us his analysis of the Office of Civilian Radioactive Waste Program, including priorities and strategies, budget allocation, program staffing and integration, and the effects of litigation on site evaluation activities at Yucca Mountain. We also understand that the DOE will complete an early assessment of the suitability of the site by the end of 1991 and that a management plan for this assessment was completed in December 1990.

We are interested in hearing more on this topic, as well. We look forward to your presentation, Dr. Bartlett, and we'd particularly like to welcome you and the staff members that you have with you today.

DR. BARTLETT: Thank you very much, Mr. Chairman. It's a

real pleasure to be here with you this morning and to have this opportunity to dialogue with you about the activities from a management perspective with respect to the Office of Civilian Radioactive Waste Management.

[Slide.]

DR. BARTLETT: The first slide indicates the topics which we intend to address this morning, or I will address. You will be hearing later in the detail from Mr. Dwight Shelor concerning our management systems improvement strategy and our interactions with the Board.

What I have done here is respond directly to the letter of invitation which you sent to us with respect to the topics you'd like to have covered. So we will address the Director's priorities, our program strategies in the major areas of storage and transportation, disposal and program management, our budget allocations, our program staffing and integration, the very important issue of access to Yucca Mountain, and then I've added a topic that I wanted to present to the Board as an initiative, if you will, open issues regarding management strategy.

These are long-range issues which I'd like to bring to your attention. Then there's an additional item which is not previously indicated on the agenda. I'd like to indicate to you briefly where we're going to go with the exploratory shaft facility design selection.

With that introduction, what I would like to do at this point is to introduce or ask to introduce themselves our management staff of the Office who are here with me this morning. We have all of our top management team present, and I'd like to start with Mr. Frank Peters.

MR. PETERS: Good morning. I'm Frank Peters. I'm the Deputy Director of the Program.

MR. HORTON: Good morning. I'm Donald Horton. I'm Acting Director of Office Quality Assurance.

MR. SHELOR: I'm Dwight Shelor. I'm the Associate Director for Systems and Compliance.

MR. GERTZ: I'm Carl Gertz. I'm the Associate Director for Geologic Disposal located in Las Vegas, Nevada. MR. MILLER: Good morning. I'm Ron Miller, Acting Associate Director for Storage and Transportation.

MR. ISAACS: I'm Tom Isaacs. I'm the Director of the Office of Strategic Planning and International Programs.

MR. SALTZMAN: I'm Jerry Saltzman, Director of the Office of External Relations.

MR. ROUSSO: I'm Sam Rouso, Associate Director for Program and Resource Management.

DR. BARTLETT: I might mention briefly that those who have indicated that their title is Acting has reference to the fact that we're still in the process of finalizing our reorganization. As soon as the paperwork is complete, that aspect of it disappears. These people are the ones who really make the program go and I'm just proud and delighted to be able to work with them.

[Slide.]

DR. BARTLETT: Let me turn now to the first topic, the Director's priorities. These are the ones I've selected to

identify to you this morning as our principal priorities, and I presume you all have hard copy in front of you on these in case you can't see some of these things.

The principal priority, of course, is to serve as the principal agent of fulfilling the Secretary's objectives for our mission, which has been, of course, as you know, assigned by Congress, which is in the Secretary's schedule to begin spent fuel receipt in 1998 and to begin disposal of high level waste in the year 2010.

These objectives for the program were established by the Secretary back in November of 1989 when he issued the so-called 60-day report in which he restructured the program and set the objectives. It is my responsibility to fulfill those major objectives for the program.

In the process of doing that, the Director's priorities to accomplish that mission are those indicated by the next few bullets; to assure, in fact, that we have quality and integrity in all program dimensions, a vitally important aspect of our activities; to assure a robust foundation for our decisions and actions and the management systems improvement strategy is a major feature of that; and, of course, to preserve flexibility as necessary and appropriate.

I'd like to take this opportunity to indicate to you as an element of our efforts to assure quality and integrity and a sound foundation, we have established for ourselves the OCRWM Credo. I'd like to show you that.

[Slide.]

DR. BARTLETT: At this time, I'll present to the Board a copy of this Credo. It's in that thing that's sitting next to you. This is vitally important to us. This is the basis under which we operate. I hope you will read it and heed it as carefully as we do, because these are the principals, the foundation for our operations and our sense of mission and the means through which we will fulfill our mission, basically.

I won't try to read all of that at this point. I'll give you the opportunity to look it over later. So those are the basic things. Then those priorities, the need for integrity and quality and a robust foundation, move into the operational aspects of the program and the specific program strategies associated with our major activities of storage, transportation and disposal. So let me move into those now and begin by discussing the strategies, the major strategies having to do with storage and transportation.

[Slide.]

DR. BARTLETT: One of the major features of this strategy is to integrate in detail the requirements for beginning spent fuel receipt in 1998. In other words, fulfilling the Secretary's objective to begin receipt at a decent level in the year 1998. The operative word here is to integrate in detail; to make sure that we have all the aspects of the transportation system and the storage system and the logistics, all arranged, ducks in a row, so that we will, in fact, be able to have an executable plan to begin receipt in 1998.

A key feature of that, of course, is timely siting and execution in terms of design, construction and operation of an

MRS, and I'll come back to that a little bit later. But fundamentally what we have done is to integrate -- let me emphasize again -- in detail the factors relevant to being able to meet this objective.

With respect to the MRS and its siting and timely implementation, we have, as you know, responsibility under the Memorandum of Understanding between the Department and the Office of the Negotiator, basically responsibility to respond to the Negotiator's requests for support in his activities leading to siting of an MRS facility.

So our next major strategy is, in fact, to respond effectively to the Negotiator's requests as we receive them. With respect to those activities of interfacing with the negotiator, we are also taking initiatives, as we can, in order not to have to sit around and wait for details, but we are doing whatever we can with respect to generics on the MRS design, the environmental impact issues and the licensing of a facility.

So we will be as ready as we can with respect to detailed response to the Negotiator's requests and we will be doing what we can to assure that the objective of 1998 beginning of receipt is met. In order to facilitate meeting that objective, another program strategy in this area is, in fact, to minimize the types and complexities of the technologies that would be used.

In other words, we are seeking to not mire ourselves in an R&D program which would carry high programmatic and management risks of success or the facilities or equipment being ready in time, but to take advantage of existing technologies and to put them to use in order to be able to meet the 1998 objective.

Another key part of meeting that objective is to work with the utilities to establish the spent fuel acceptance protocols. The important point here is that we are, in fact, working with the utilities to establish this as opposed to any other alternative wherein, for example, we might be attempting to instruct the utilities in our objectives.

We need a win-win game out of this. So we are working, I like to think, effectively, certainly diligently with the utilities to make sure that that aspect of the logistics will be in place along with everything else in 1998. Those are the principal program strategies for the storage and transportation aspect of the program. Let me now move on to the major strategies with respect to the disposal part of the program.

[Slide.]

DR. BARTLETT: Of course, our major mission here is to, as directed by Congress, evaluate whether or not the Yucca Mountain site is a suitable location for a repository. To accomplish that, there are many things we must do. One of them is essentially to be ready to proceed from our present situation where the State of Nevada has us blocked from expanding our activities with respect to site evaluation.

So we have a whole array of things we had to accomplish to be ready to proceed. What we have done as part of our strategy is to achieve readiness to proceed at Yucca Mountain. In the lexicon program management, the readiness words should be, in a sense, capitalized because this is a significant effort.

Many things have to be brought together. These things have been basically accomplished. The detailed milestone chart for proceeding with the evaluation of Yucca Mountain called for our office to be ready to proceed in order to achieve our downstream objectives on January 20, 1991; in other words, just a few days from now. That has been our objective, that has been our near-term goal, and we have, thanks to an excellent effort on the part of Mr. Gertz, accomplished that.

So we are ready as soon as everything that we need is in place to actually proceed with the evaluation of Yucca Mountain. Something that Dr. Deere mentioned; as a part of our strategy, we have adopted an objective of evaluation site suitability as soon as possible. This is, in fact, a change from the historic approach to the evaluation of the Yucca Mountain site.

Previously the basic objective was to make a large number of measurements of many types and, at the end of that process, assemble the information and see what the results were. We have, in response to comments principally from the State of Nevada and the electric utilities, reoriented the program to make this determination of site suitability just as soon as we can reliably and defensibly and, therefore, to expedite progress in the program and come up with some of the very important answers that must be obtained from and for our mission.

In doing that, we have prioritized the data acquisition strategy. The site characterization plan, of course, is an assemblage of the kinds of activities that are expected to be required for characterizing the Yucca Mountain site. What we have done is dipped into that encyclopedia, extract on a priority basis those activities which need to be done first in order to support this objective of evaluating site suitability as soon as possible.

As I think you know, once we reinitiate our activities to expand them at the site, we will be focusing on trenching in Midway Valley and deepening Trench 14 at other sites at which we are evaluating the calcite-silica deposits. Then we are working on developing study plans and the sequence of activities following from that as the program proceeds.

Fundamentally what we have done, as I say, is to prioritize the data acquisition program consistent with that early evaluation of site suitability objective. We do also plan to proceed iteratively with the data acquisition and the use of the data in the evaluation process. This has to do with flexibility and it has to do also with issues associated with the methodology for evaluating site suitability. I'll talk about that a little bit more in detail later.

That is a major interesting challenge for the program; how are we going to make the evaluation of whether or not the Yucca Mountain site is suitable.

[Slide.]

DR. BARTLETT: Let me move on now to a description of the program strategies with respect to program management. As I have already mentioned, a major feature of our management strategy is implementation of the management systems improvement strategy, which Mr. Shelor will address in some detail later, as our principal means to match actions and resources and the use of

resources with the requirements that are imposed on the program.

Some of the requirements I'm sure many of you are familiar with. The regulatory requirements, 10 CFR Part 60, 10 CFR Part 960, the siting guidelines, 40 CFR 191, the EPA's requirements for nuclide releases. In fact, there are over 2,500 requirements to which the program must respond. DOE orders are embodied in many things and what this effort is doing is systemizing on a systems engineering basis the application of those requirements to the activities within the program and to the functional requirements that must be met by the facilities and equipment within the program as it is actually implemented.

So the MSIS is the fundamental strategy for application of systems engineering, if you will, to relate all of these requirements to all of our activities and to identify the functional requirements, as I said, for the materials and equipment within the program and to identify the functional requirements for the management of the program.

So this is vitally important as an underpinning for our operations in the future and that's why we want to discuss it with you in some detail today. A very important aspect of our operation, of course, is quality assurance in conformance with requirements of the Nuclear Regulatory Commission, and looking ahead from Day 1, today and yesterday to eventually comply with the requirements of a licensing process.

In order to accomplish that, we have established an independent quality assurance office under Mr. Don Horton and he gives the guidance to the implementation of the QA requirements by the line organizations which actually implement the programs. We are in the process of evolving those programs as necessary to meet NRC requirements and we will be evolving them through a process which keeps pace with our program process, but it, in any case, assures that all of the quality assurance program, as necessary, is in place in order to proceed.

A key part of that was bringing in the QA program needed in place for readiness at Yucca Mountain, and this concept will be followed in the future. Another key part of our program management strategy is to obtain pre-decisional inputs from affected and interested parties. This is something the program has heard a lot about in the past and it's basically something that we are implementing.

We are in the process of completing a major effort of that type where we have had, with respect to what I call the strategic principals for the program, so far two workshops, the second of which was just completed yesterday, in which we had representatives of the affected and interested parties sit together with us and give us input on their views with respect to some major decisions that have to be made in the way of guiding the program.

I'll tell my story again. A lot of you are getting bored. But from my point of view, the Nuclear Waste Policy Act, as amended, provides, in fact, a very loose and flexible framework for this program. In fact, there are over 2,000 ways the mission assigned by the Nuclear Waste Policy Act, as amended, might be implemented using alternative technologies, locations for

activities and differences of activities, etcetera.

We need to shape and level and define the playing field. The means by which we are doing this is to adopt strategic principals which narrow that enormous range of options so that we have them as the foundation for major decisions in the future to guide the program activities and to guide the implementation with respect to technologies and activities that will actually implement high level waste management and disposal.

So we have had these workshops as a beginning effort to bring in the people who are affected and interested in this process to help us select these strategic principals. I say it's a beginning because we have received now in the two workshops to date their inputs. What will happen from here on is that we will now, our team here will go off anew what we have heard and convert that into what we anticipate will be the strategic principals we will adopt, and then we're going to feed it back to them; tell this group what we did with their inputs and get sort of a final feedback from them.

Then all of this will be built into the foundation for the mission plan amendment which will describe how we plan, in fact, to proceed on a strategic basis with the program in the future. We expect to issue the mission plan amendment in draft for comment sometime during the summer and the final by approximately the end of this calendar year.

The concept, however, of obtaining the pre-decisional inputs is vitally important and we have had good comments about the implementation of the concept. I might say, from my point of view, it has accomplished two things. One is to, in fact, give us, if you will, some confidence and guidance with respect to our own thinking about how the program will proceed.

I might say that the workshops that we've had with them did not produce anything new, and that's comforting because it means we haven't missed anything significant that was of concern to the parties. But it also gave us some guidance on which things were important and priorities to them, and it also gave them an opportunity to hear each other.

We hear on a bilateral basis from the various interests ranging from the environmentalists, if you will, to the utilities, but quite often they don't have an opportunity to hear each other or to hear what we hear. So by having these workshops, we had an opportunity for the full range of opinions to be aired to our benefit and to their benefit, and we will be working this, as I said, ultimately into the mission plan amendment for the program.

The next item is use external reviews to check and aid program progress. The Technical Review Board is, of course, part of that. I don't know how much sense you have of just how extensive that is, but our next viewgraph gives you an idea of the range of interested, affected, and interactive parties with whom the program deals.

[Slide.]

DR. BARTLETT: There better not be any more because we haven't got room for any more bubbles on the chart. Our interactions, our external interactions are, indeed, extensive. We try to address all of them with due diligence. They are

vitaly important to us because, just like the Technical Review Board, they give us good guidance, they give us credence, they serve as auxiliary means, if you will, to give confidence that we are proceeding effectively and responsibly with the program.

So we pay a lot of attention to all of these activities. The point, again, I would make is that they are, indeed, extensive. When you look at those bubbles and think about the attitudes and viewpoints that are represented by them, you can see, again, something of the range that the program has to deal with in making its decisions.

I'll go back now to the program strategies one.

[Slide.]

DR. BARTLETT: The next item says participate aggressively in regulatory framework development. What I mean by this, of course, is that to the extent possible, the Office will participate in efforts relating to development of the regulatory framework in this broadest sense, and that has to do with participating in developing regulations, as appropriate, and dealing in particular with developing the means for compliance with regulations.

I want to emphasize that with respect to development of regulations, our role is not to make up the rules for ourselves as we go along. However, as agencies, such as the EPA and the NRC, do establish regulations, either initially or through revisions such as the EPA is going through, there are opportunities for a variety of parties, including the Department, to participate in, through commentary and workshops, etcetera, the development of those regulations by those agencies.

We do that. In fact, with respect to the EPA regulation, Part 191 which is under remand and under revision as a result of a Court order, the Department, through another element of the Department, has all of its interests relevant to that regulation represented and participating in the process of revision of the regulation.

More specifically and of longer range importance to our operations, a major aspect of the program that has to be developed is the means for demonstration of compliance with the Part 191 and Part 60 regulations, whatever they turn out to be, and they may both be adjusted in time.

As I'm sure many of you are aware, the whole issue of the regulatory standards and requirements is under discussion, if you will, broadly within the community interested in this program, but specifically as times goes along and the regulations are, in fact, established, there will need to be means identified for how we will demonstrate compliance with the standards.

This is a major area of concern for us as the regulated and this is the area in which we can interact with the NRC as the implementing agency to help develop and define what are the appropriate means of demonstrating compliance, and this is the arena in which I intend that we act aggressively. We won't sit around and wait. We will identify areas where we think it is vitaly important that we have action and we will work effectively and interactively with the NRC and other parties to develop those means for demonstrating compliance.

Finally, as a launch pad toward the next subject, budget

allocation, I'd simply state that as a matter of program strategy in a management sense, we will be making, of course, our budget allocations which are consistent with the priorities and the strategies for the program. So these will, as you will see, reflect what I've already said about our major strategies and activities.

I'll move on to our budget allocations.

[Slide.]

DR. BARTLETT: Basically, as I've already set it up by my statements, we are funding storage, transportation and integration of those activities, all the activities, in order to, according to our best estimates at this time, be able to be ready to accept spent fuel from the utilities in 1998. In other words, we are funding these activities as necessary to meet the Secretary's objective.

So when we go through our budget exercises, we keep this in mind and we allocate our resources to these purposes consistent with that objective and consistent with the resources that are available to us.

With respect to the evaluation of the Yucca Mountain site and the disposal part of the program, the funding there is focused principally on the activities necessary for evaluation of the site. To explain what I mean by that, I'd go down to the last dash, if you will, where I say minimize effort on repository design and waste package.

In other words, there are many activities in addition to just discovery of the physical characteristics of the mountain that are related to the disposal program. We are, because of the focus on evaluation of whether or not the site is suitable and the strategy of making an evaluation of site suitability is possible, focusing the resources in the disposal part of the program on evaluation of the Yucca Mountain site.

As I've already indicated, our priority activities once we start to expand them will be focused on evaluation of faults and the characteristics of Midway Valley and the calcite-silica deposits. So our principal funding in those activities for the new activities will be in that arena.

We do still anticipate starting the exploratory shaft excavation in November 1992. This is, again, an intermediate or near-term milestone, if you will, leading to the longer term objectives with respect to disposal. As I said, later on I will talk more about how we're going to go through the process leading to that activity. Our planning, of course, reflects that anticipated start because as we interact with OMB and others in our budget planning, we look into the outyears.

So our budget planning reflects, again, that anticipated milestone and also the activities in the near-term precedent to that start of the excavation.

We are anticipating that in the not-too-distant future we will have under contract the new M&O integrating contractor. We will be funding them to support all of the program activities that we've been talking about, but principally, in the near-term, support to the program integration activities.

This, of course, is a major focus of the M&O contractor's

responsibilities. It will be a near-term and an ongoing focus for their activities. The point I'm making here is that their funding will be consistent with their assistance to their support of our activities in storage, transportation, regulatory compliance and disposal.

I guess my basic message with respect to budget allocations is that they fit our strategies, that they have been selected in order to apply our resources consistent with our objectives and our major milestones in the program, and, of course, we try to continue to do that. So we pace everything hopefully with good consistency.

[Slide.]

DR. BARTLETT: Within that framework, we have these major foundation activities that are supportive of and ancillary to the major activities relating to the storage, transportation and disposal, and these, again, we fund to pace our progress consistent with the resources available to us and consistent to the need for these activities with respect to what's going on in the mainline activities of storage, transportation and disposal.

So our implementation of the MSIS, for example, and regulatory compliance is essentially funded to keep pace with the progress and need within the program. We can't get too far ahead of the curve because we don't have the resources to do it.

In many cases; for example, in that regulatory framework arena; the activities are being paced by others. So we keep track of that. The external interactions, such as with the Technical Review Board and the NRC and the many other parties on that bubble chart, again, are funded and supported consistent with where the program is and its resources.

In other words, we try to have an integrated approach with respect to activities and allocation of budgets.

[Slide.]

DR. BARTLETT: The next diagram gives you an idea of the Fiscal 1991 budget allocations. Where the budget assigned by Congress is \$242.8 million, the funding is distributed as indicated by the pie chart. There is one thing that's a little bit misleading. It indicates system integration one percent. That is the funding as designated by our budget line items. The funding that's actually going into that area, if you accumulate what's being applied in the other parts of the program, it's more on the order of six or seven percent of the program. In other words, it's not under-funded.

The funding that goes to disposal is, of course, funding or planned-for allocation to expansion of the activities at Yucca Mountain, but the point I want to make here is that there is an awful lot currently ongoing at Yucca Mountain.

As a result of prior activities, we have several hundred boreholes which are still being used to acquire data. We have existing trenches. We have a seismic network, etcetera. In other words, we have a comprehensive data acquisition source system out there which is operating now. So we have considerable funds going into these activities simply to sustain what's been done before and to develop on a continuing basis a data baseline which we will need.

These are precious data. If they're lost, they're lost forever. We can't go back and recover it. So we sustain all these activities and then our allocations are moving toward the anticipation of future activities at Yucca Mountain. That's the current year, as I said.

[Slide.]

DR. BARTLETT: If we go to the next chart, this is the expected anticipation based on the Fiscal 1992 budget request. We have no specifics on this yet, so I can't discuss specifics with you, except to indicate that based on what we requested, these are the way the funds would be allocated.

The only significant thing here is that you'll notice there is a slight diminishing of the total budget in terms of percentage going to disposal and an increase going to MRS and transportation, and that is consistent with anticipation that the Nuclear Waste Negotiator will have a basis for us to get going with more detailed and more investment of resources into activities relating to the MRS and our objective of beginning spent fuel receipt in 1998.

We will, however, be sustaining, as I said, our activities at Yucca Mountain with respect to disposal and are also anticipating in that timeframe -- if you think about it, November 1992, the expected date of start of excavation of the exploratory shaft, is actually in Fiscal 1993. So the costs associated with actually doing that excavation are not reflected in this budget chart.

The costs of preparing to do it which will be ongoing in this Fiscal Year and the next are, of course, reflected.

[Slide.]

DR. BARTLETT: Let me turn now to the subject of program staffing and integration. Integration of the activities is a very high priority for the program, as indicated by our emphasis on the MSIS as a tool for us and also as indicated by the fact it is a priority activity for the M&O contractor.

We're expecting the M&O contractor to play a key role in implementation and setting up the means for integration of the program activities. By integration in this case, I don't mean so much that we have all that many new things to do with respect to pulling program parts together and identifying them, it's a matter of establishing communication between parts as necessary.

Now that we're moving closer to a focus within the two major activities of pre-disposal and disposal, we have a need for tighter integration and communication of the various activities that are playing with respect to each. For example, the interface between the transportation system and the MRS and the technologies that would be used. You have to handle stuff, get it on and off the transportation vehicles conveyances and into the MRS, for example.

We have to have detailed integration of the activities relating to the progress with respect to evaluation of Yucca Mountain. So we will be looking to the M&O contractor and the function of integration itself to assure that we are doing those things well.

I've already mentioned that the MSIS provides the foundation for the integration. The integration is the implementation of the

products of MSIS, which Dwight will be telling you about later.

I make a statement here that the staff is of high quality, and, boy, are they ever. It's a real joy to work with these people. They are very effective, they're capable, they're dedicated, and I'll simply say that you already know that because you've interacted with a lot of our staff and the indications as I have them are that you have a direct means of being aware of the fact that we have excellent staff to implement the program at this stage.

We have staffing levels which are consistent with the budgets and the OMB allocations. What I mean there is that the OMB, in addition to assigning us our money, also assigns us the numbers of people we can have. I would also point out that in terms of maintaining staff and being able to hire staff, especially at senior levels, we do, in fact, compete with not only the external world and the difficulties of hiring people into the Federal Government with the competition of the private sector, but within the Department we have to compete with -- SES is our jargon for senior executive service personnel, the really key people who have the experience and the wisdom and the capability to move the program forward.

So there's a challenge here in many dimensions to obtain and sustain highly capable people for the program. One of the things that helps that is that the program is, in fact, exciting and challenging to work on and it attracts good people. This is one of the reasons that we have the quality of people that we do have at this stage of the game.

[Slide.]

DR. BARTLETT: The next viewgraph is our organization chart. The numbers in parentheses show you how our present-year 207 full-time equivalent staff, and I won't bore you with the details between what that means and the actual numbers of people, but that's the number that's assigned by the OMB, how these people are distributed among our offices. You heard earlier our staff who head those offices introduce themselves. They're all here. These are the people whom they direct within the Department.

Of course, we have within our contractors significant additional personnel and, of course, they're not identified here.

[Slide.]

DR. BARTLETT: Let me turn to the subject of access to Yucca Mountain. As I have already mentioned and as you are aware, we do have extensive ongoing data acquisition and analysis activities associated with the Yucca Mountain site. We also have ongoing activities in preparation for access to the mountain with respect to expanding those activities; drilling additional boreholes, trenching the exploratory shaft, etcetera.

Again, as I already mentioned, the program is, in fact, ready to proceed with expansion of the activities with a focus on Midway Valley and the calcite-silica deposits. We are, as I mentioned, I'll discuss in a little more detail later, ready to select and are preparing to select the exploratory shaft facility design configuration.

There is just one thing that stops us at this point, and I'm sure you all know what that is. The State of Nevada has refused

to grant us the permits we need to proceed to expand our activities. What this has done effectively, in my mind, is moved the path of program progress from where it should be, in terms of program management and technical activities and resolution of technical issues, etcetera, and making decisions on that basis, moving it from that path onto a path where it's controlled by the Courts and all other manner of variation from what really should be the path of program process and progress.

The key thing here, of course, is as we perceive it right now, and I have a compilation of three years of perfect track record of indication, including very recent, which indicates Nevada's past, present and promised relentless pursuit of obstruction of progress with respect to Yucca Mountain.

In my mind, this is totally inappropriate. They are taking advantage of what amounts to a loophole in the Nuclear Waste Policy Act, as amended, which allows them to do this and they are obstructing the will of Congress, they are obstructing my responsibility to move forward with the Secretary's mission.

So as a result, I believe that action is necessary. We're moving toward that, but let me give you a little bit of history and status with respect to where we stand.

[Slide.]

DR. BARTLETT: On the next viewgraph, I summarize very briefly the status of the Court actions. Let me give you an update as of today, if you will. First a brief history. The Ninth Circuit Court, back in September, heard the case, what we call the Veto Case, where the State of Nevada alleged that the Department had no right to proceed and be on Yucca Mountain because they had vetoed the action.

To make a long story short, one month later, the Ninth Circuit Court ruled that the state's allegations had no merit. They found very strongly in favor of the Department. On December 19, under the schedule established by the Court, the State of Nevada appealed that decision to the U.S. Supreme Court. We are presently awaiting action by the Supreme Court with respect to that case.

In parallel with that suit, which was a suit brought against the Department by the State of Nevada, the Department sued the State of Nevada to issue the permits that are required for us to proceed. That suit was filed in the District Court in Las Vegas.

The District Court Judge has stayed progress on that case pending the outcome of the Supreme Court case.

The Judge in the District Court had stayed that case until January 15 pending the progress with respect to the Supreme Court.

On January 15, the state had to file a brief with respect to the stay and the Department's request, through the Department of Justice -- this gets very complicated, sorry -- for summary judgment.

So the process with respect to the District Court case, the permits themselves, is essentially on hold at this point awaiting action by the Supreme Court on the appeal filed by the state with respect to their veto case.

When the Supreme Court acts, and we presume that they will act to what's called deny cert; in other words, not to hear the

case; or in other words, to sustain the finding of the Ninth Circuit Court; that should trigger the District Court and the state to take actions which would result in the issuance of the permits we need to proceed.

When that will occur remains to be seen. We're hopeful that the Supreme Court will, in fact, act in the not-too-distant future. Estimates range from a few weeks from now until perhaps the April or May timeframe. That's a rarefied atmosphere which very few of us are conversant with. We just take it as it comes from the Supreme Court.

But in any event, that will be the key trigger with respect to the ongoing case and with respect to any potential future action. If, in fact, the state reacts to a denial of cert by the Supreme Court and begins to process the existing applications on their merits as they have stated it, then there is a very good possibility that we could be back on Yucca Mountain and proceeding with expansion of site evaluation in the relatively near term.

If, in fact, the state continues, through whatever means, to continue to obstruct, then I believe it would be appropriate and necessary to take action that would remove the opportunity for the state to continue to do that. In making that statement, I am reflecting the attitude of the Secretary at this point, who has been very much conversant with this issue, and has taken a leadership role with respect to it.

As many of you may know, back in October, he wrote to Senator Bennett Johnston indicating his concern about this issue and stating that he anticipated needing legislation that would allow us to proceed with evaluation of Yucca Mountain, such that the State of Nevada could, not only in the near-term, but on a continuing basis, not have an opportunity to obstruct progress.

In essence, the situation now is we're waiting for the Supreme Court. After the Supreme Court acts, as I said, a number of things could happen. It is possible that we can enter into an arrangement, an agreement with the State of Nevada wherein all of this could be behind us and we could work effectively together in the future.

I see absolutely no signal of that. They haven't given us any indication that they might change their present posture. So we're ready on all fronts, is really what it comes down to. All I can tell you at this point is, as the viewgraph says, action for legislation to remove the potential is being considered.

We are, in parallel, considering actions that might facilitate an effective working arrangement by the state, but it just remains to be seen what the Court does and what the state does. We're taking contingency actions to cover all of the possibilities.

That's about all I can tell you about that at this stage. It's one of those things, like some others, whereas we have discussed it internally, the opportunities for progress are not within our control. There are two major features of this program where this is, in fact, the case.

One is, of course, the siting of the MRS, the responsibility for that siting. A key milestone in our progress toward beginning spent fuel receipt in 1998 is being essentially controlled by the

progress and effectiveness of the Negotiator.

We're responsive, we're doing everything we can to make sure there's no time lost, but we can only influence, we cannot control. We can only influence and assist. The same thing is true with respect to progress in getting back on the mountain. We can take care of progress once we're on the mountain, but we have to get back on it.

Here, again, the critical path for that is not in our hands.

It's in the hands of the Courts and others and all we can do, again, is influence and be ready for the consequences of that. We'll be doing the best we can on all of those fronts.

With those comments, let me turn to the last viewgraph you have, open issues regarding management strategy.

[Slide.]

DR. BARTLETT: These are some things I wanted to bring to your attention that we wrestle with on a long-term basis. These are not things which will be easily addressed or maybe not even explicitly addressed, but I want to make you aware of them because they're very, very significant to us. Maybe you can help us -- in fact, I'm sure you could help us with dialogue and consideration of these issues and how to address them.

The first one says how much should be invested and pre-decisional analysis of options. Just to draw the picture here, at one extreme, we can shoot from the hip and make a decision on something relatively quickly with very little effort, very little investment and study; say we're going to go this way and go do it.

At the other extreme, we could invest extensive time and money and expertise into providing an enormous basis for action. In large measure, that's essentially what we did now as basis for the exploratory shaft facility design. We have spent over a year and considerable investment of effort investigating 34 options for the exploratory shaft facility design.

It's a significant investment and it represents, if you will, the other end of the spectrum where a lot of investment is made before a decision is made. Somewhere in the spectrum between shooting from the hip and paralysis by analysis is the proper approach to investment, and it may very well, of course, depend on what the decision is.

Some decisions don't merit a lot of investment. Others may merit a lot of investment because they're of fundamental and far-reaching importance to the program. I just want to acquaint you to the fact that we are concerned about that, that we think about it, and that I don't believe personally that there's any hard and fast answer, but when some of these things come up, we will be thinking about that particular management issue, if you will, as a basis for how much investment we put into bases for decisions and actions.

Another thing that comes up closely related to that in many ways is when and how should pre-decisional use be made of external experts. By external, I mean external to the community; in other words, external to DOE personnel and external to contractor personnel.

How much should we bring in people like the Board, other experts who have a really focused capability to help us pre-

decisionally, but also might help us after the decision or after a preliminary indication of the decision to serve as genuinely an independent reviewer of what we have done.

So the choice is do we coop them in advance or do we take advantage of their expertise after we have taken internal action leading toward our anticipated decision or whatever. This, again, is a major management challenge as to how to address that. It, again, may depend on the situation and it's a policy and practice issue which we are sensitive to. Again, we might appreciate -- certainly would appreciate any thoughts you might have on this matter.

The other point I've mentioned here is what methodology should be used for tradeoff evaluations involving potential licensing process benefits. The key phrase here is "potential licensing process benefits." There are actions we might take which we see have the potential to, for example, shorten the licensing process at some time in the future, to aid the resolution of licensing process issues; in other words, to have long-range benefit which cannot be quantified in some sort of a cost-benefit tradeoff analysis very readily.

Highly uncertain. Will you really accomplish your goal. Would it be, in other words, a net benefit to the total program, to the program life-cycle costs, is it significant to the program life-cycle costs, to take actions now anticipating some benefit in the future which is potentially very fuzzy.

I might mention also that, in a sense, the details of the licensing process are, at present, kind of fuzzy. We have been investigating alternative licensing strategies. We have not discussed this in detail with the NRC yet, but there's a whole morass of options and considerations and possibilities out there where, in fact, the cash flow, the impacts, an investment now to get benefits in the future might be significant, but there's a significant programmatic risk assigned to that, too.

This is an area or a subject, concept which applies in many areas. I've indicated a couple of them here. One possibility, of course, is that we make a decision now as one of our strategic principles that we will go with robust disposal containers designed to provide defense in-depth with respect to the licensing application.

I might emphasize defense in-depth, not to compensate for any deficiencies that might be found in the geologic barrier, but simply to aid the resolution of issues with respect to the licensing process and demonstration of performance of a repository.

Well, if you're going to go with robust containers, fine. You may have gained that advantage. That issue may be small in the swim of issues concerned with the licensing process and, in fact, as has been pointed out in our pre-decisional workshops we've been having on strategic principles, robust containers cost more.

Is it worth it? Somehow we have to balance the apples and oranges. Alternative licensing procedure strategies, another possibility. As I said, we are looking at potential alternatives -- due process, if you will. Different ways of getting through

the process of closing issues on licensing.

Some of them might have all kinds of advantage in closing issues up front or attempting to. How would they, in fact, be beneficial? If we can, in fact, identify specific alternative procedures, what anticipation that is realistic might be made of those benefits now, and the licensing process won't kick in for another decade or more.

These are significant issues to the investment and process and progress of the program. As I said, I simply want to indicate to you that I think they're significant. In the spirit of trying to establish a foundation for the program for the future, we're trying to address them.

Let me simply say, again, if you care to help us, we'd be glad to receive your assistance with respect to those items. There are other examples of this. I'm sure you can think of some.

That's why I just have other dashes there. There are many other examples. I just wanted to cite a couple there which illustrate what's involved in this thinking.

Now, if I may, I'd like to move on to the item which wasn't on the agenda indicated. Last Monday I received from the Office of Geologic Disposal a copy of the report of findings with respect to this major effort of evaluation and characterization of alternative ESF designs.

That essentially triggered a process we will implement leading to my selection of the design which we expect to use. If I can have the next viewgraph.

[Slide.]

DR. BARTLETT: This is hot off the press, and I'm sorry you didn't have it in advance, but it didn't exist until about a day ago. As a result of the findings report and the meetings we have had to date, what I have tried to outline for you here are the factors involved in our approach to the ESF design selection and the utilization of that design.

There's a lot of stuff on this chart, but it's very important to this and I'd like to mention it to you. First of all, there's a lot of background and the Board itself played a vital role in that background. Some years ago, culminating in a site characterization plan being issued at the end of 1998, the basis for and then the initial selection of the ESF design was established.

Basically all of that was codified in the site characterization plan which identified the allocation of data, the surface-base testing -- that's what SBT is -- and the exploratory shaft facility itself, and then it's led into a process under which we are now preparing the study plans associated with those activities allocated to each of those.

So after the SEP was published, it was published, of course, for public comment and we received a lot, including comments from the Nuclear Regulatory Commission and this Board. Some of those comments were directed, of course, at the ESF design as it was presented there, two vertical shafts in a specific location.

That design was produced under the quality assurance system as it existed back in 1998, and as a result of those comments by the Board, this Board and the NRC and others, we took a second

look at the ESF design and how well it fulfilled or showed promise to fulfill its responsibilities assigned to it for data acquisition.

As a result of that, we have implemented over more than the past year the design option studies which looked at 34 alternative designs. I mentioned that that's two families of 17. Basically the distinction is in the first group, you don't go into the Calico Hills formation and, in the second group of 17, you do.

The options were considering essentially the details of layout and the means of access; shafts and ramps and the means of excavation, etcetera. So a field of 34 alternatives has been investigated and a report of findings of that investigation is actually what came to me on Monday in a meeting where the presentation was made and we had some initial discussions which led to this diagram of how we expect to proceed.

So out of that has come, in fact, in the findings some top rank design concepts which are, in fact, significantly different from the original two vertical shafts. That leaves me to say at this point that we have some preferred design concepts which are significantly different from the original.

We have also many other factors that are coming to bear now on a decision as a result of experience and learning over the time period since the SEP was issued and since the original design was under consideration and as a result of this evaluation of those alternatives.

I wanted to identify these for you carefully because these will be part of the selection process. We have now, of course, a new QA system and an upgraded and more expanded QA system that has been established through Don Horton's office and is being implemented by the line with application to this effort.

We have some additional data since the SEP was originally written. We have now the management systems improvement strategy and its implementation which is drawing on the requirements and the data responsibilities of the ESF and is essentially providing the traceable functional description of what the ESF must accomplish for its role.

We have a site suitability evaluation strategy which calls for a determination of whether or not the site is suitable as soon as possible and has led to the prioritization of the activities with respect to both surface-based testing and the exploratory shaft. We have a phased implementation strategy for the ESF.

What this reflects is essentially a decision on my part that we will -- it's not new, it's just affirmation, I think, is a way to put it -- that we will phase the implementation of the ESF. I'd like to point out the origin of a lot of these activities because they reflect our learning and response to things we've heard.

First of all, the fact that we did the design option studies is due, in large measure, to the suggestions and input from this Board, as well as from the NRC comments. The QA system, of course, we have to have consistent with NRC requirements. The MSIS implementation is essentially an outgrowth of the Secretary's finding that the program needed to be restructured and have a more solid foundation.

The site suitability evaluation strategy to focus on determination of whether or not the site is suitable as soon as possible is directly the result of the commentary from the state and the utilities that we should adopt this focused approach.

The phased ESF implementation strategy is really an outgrowth of the National Academy of Sciences' report urging flexibility in the program. The phased approach will give us the opportunity to learn as we go. That's what is reflected in this line that runs across the bottom in the other direction, the fact that by taking a phased approach we will be able to, after implementing Phase 1, learn from it and thereby refine the design and implementation of Phase 2 and succeeding phases of the ESF facility -- that's redundant -- the exploratory shaft facility.

I cannot tell you at this point what direction we're going to go. I have not made the decision. I am still getting inputs. We're doing a number of things, but the key thing will be to assure that we have, if I can go to this block here, revised ESF design foundation, that we have a comprehensive traceable and solid foundation for the decision when it is made in detail.

This will be in response to the principal focus of the NRC's comments on the SEP which said that we did not have at that time sufficient design control. The NRC had some concerns about interfaces of the exploratory shaft design, for example, with the repository design and with its potential to compromise waste isolation.

The NRC does not tell us how to design this thing. It's just that we need be careful and thoughtful in our consideration of their concerns. We are most surely taking them into account as we proceed. We expect to proceed with flexibility, with phasing, with learning as a basis for our progress.

In the not-too-distant future, in order to sustain the progress in that schedule I mentioned of getting all the things done before we can actually start the shaft in November of 1992, our key staff on this subject are working diligently to detail this thing as a basis for the decision and then how we will proceed.

I thank you for this opportunity to have presented these things to you this morning. I hope it's been useful to you. I'll be very glad to discuss any of the things I've discussed with you at this point.

DR. DEERE: Thank you very much, John. I think this is an appropriate time for us to take about a 20-minute break. We do this on purpose so we can keep you around a little longer and we can talk with you at the coffee break, and then we'll come back and have another 15-20 minutes of questions, if this is okay.

DR. BARTLETT: Sounds fine.

DR. DEERE: Then we will proceed to Dwight. Appreciate it very much and we'll see you very shortly.

[Brief recess.]

DR. DEERE: We will be ready to start our questions, first from the panel members. Dr. Bartlett, if it's all right, we'd like to also open it up to some of the audience.

DR. BARTLETT: Be glad to.

DR. DEERE: I would like to make a correction in my

introduction, the end of my introduction of Dr. Bartlett. I stated that the management plan for the assessment, early assessment of suitability of the site was completed in December 1990. It's not. It's in the final stages. So it should read it is in progress.

I will ask Board members now if they have questions for Dr. Bartlett. Ellis Verink.

DR. VERINK: I have a couple of questions related to the viewgraph about minimizing effort on waste package and some of the other comments later. The Board believes that the use of a more robust long-lived canister or engineered barrier system is a very important means of reducing overall system uncertainty and that the development of such an engineered barrier system can largely proceed in parallel with other activities without interfering with them.

In this regard, we are strongly recommending that DOE, perhaps in conjunction with us or otherwise, would proceed with a workshop on engineered barriers to help develop these opportunities and wonder what your view is. Would you support such a thing?

DR. BARTLETT: I would welcome such an opportunity. I think that's a very good idea.

DR. VERINK: You would encourage it at the earliest feasible time.

DR. BARTLETT: Yes. I would simply supplement my previous remarks by saying that the current lack of emphasis, if you will, on engineered barriers has to do with two things; first of all, the magnitude of our current budgets and the focus of the program with respect to emphasizing the evaluation of the Yucca Mountain site. It certainly hasn't gone away as an issue and a target of our efforts, but within those constraints it's one that, from our point of view at present, and especially considering the fact that the design will in some measure depend on what's found out about the site, if it's found to be suitable, for example, it is one that we can, in a constrained resource environment, relatively address at a lower level.

I'd be delighted to have such an interaction.

DR. VERINK: All right. It's our feeling that the engineered barrier system, of course, as you know, comprises more than just a canister.

DR. BARTLETT: Absolutely.

DR. VERINK: And there are some real opportunities there which can harness the power of thermodynamics, let's say, in this picture, which would be very helpful in adjusting the source term of some of these.

DR. BARTLETT: I think about what I call the thermodynamic repository where we take advantage of the low free energy, for example, as a means of minimizing the potential for degradation through corrosion or whatever means.

DR. VERINK: Right.

DR. BARTLETT: In order to enhance the stability of the system over time.

DR. VERINK: The other question I have is you mentioned that a more robust canister would cost more money. I wonder if, in

those cost calculations, allowance has been made for the time value of the money implicit in the saving of making a decision sooner rather than later.

DR. BARTLETT: Those are part of the tradeoffs I was trying to illustrate. Frankly, I don't know what the costs are at this point. I was reflecting, in fact, a comment that was made at the workshops we've been having with respect to the strategic principles where that observation was made by parties vitally interested in how we spend the money on the program.

It's not that we have made any tradeoff evaluations at this point because we haven't, but the point that was made is it is a factor to consider.

DR. VERINK: The point I guess I'm making is that if you're going to make something thicker, for example, then you've got additional metal cost. But the fabrication aspects of it and all the other parts of the picture tend to be far more than a little bit of additional metal would be.

DR. BARTLETT: Absolutely.

DR. VERINK: And the saving in time and resources from getting these things decided earlier rather than later build up the compounding effect which greatly mitigates that and probably wipes it out completely.

DR. BARTLETT: You're very adeptly illustrating my point about the tradeoffs. That's a very good example.

DR. DEERE: To continue with that, Ellis, I think that when you have a statement that it costs more, certainly it will, but that can't really be a decision if the magnitude of the costs and the other tradeoffs haven't been studied.

So it appears to us that some effort, continuing effort to develop this has to be kept on the burner for it to be able to be given a fair look further down the road, and I don't think you disagree with that.

DR. BARTLETT: No. As a matter of fact, any one of these specific items engenders or is involving essentially a system-wide study, because whatever you select as the design effects your fabrication facility, capabilities and requirements and your QA requirements, etcetera, and everything has impact.

This system is connected from the state of existence of the spent fuel in the pools through the transfer technology, to the transportation technology, to the handling technology, to the preparation for disposal technology, to the design technology for the repository.

They're all connected and any one point has impact throughout that system on a very highly connected basis. That's one of our problems. The difficulty of isolating and doing meaningful studies recognizing that, in fact, this system is very highly connected.

DR. DEERE: Excuse me, Warner, just one second. Again, to continue with that, I was somewhat surprised in reading over the notes that Dr. Cantlon of our Board took when he went to the Airlie Conference. I think it was a two-day conference. In his notes, I found that a number of the speakers from a number of different organizations were endorsing a look at the more robust engineered barrier system.

It was quite surprising to me that it seemed to come out from a variety of different points of view and different organizations. Warner?

DR. NORTH: I'd like to pick up on a similar point here. You had on one of your viewgraphs obtain decisional inputs from affected and interested parties. At a rather high level, this means the design of that system as you were describing. The decisions on the design of that system are very critical to the future of this program.

Some of these decisions involve tradeoffs between the level of performance or how safe it's going to be and how much money we spend. It strikes me that a better basis for decision than DOE makes that decision unilaterally to meet the standard at minimum costs, rather open that decision up to the interested and affected parties and let them comment on their views of the tradeoff between more assurance of performance or higher levels of safety and the amount of money to be spent on the system.

DR. BARTLETT: That's exactly what we're trying to do with the efforts on the strategic principles, the broad guiding principles as an initiating effort of that type. So far we're not at that kind of detail. As we move closer, once we've got the principles established, for example, then we would be requiring, in fact, that there be a pretty significant level of expertise and knowledge to continue to provide inputs of that kind, but we would expect to keep doing that.

DR. NORTH: It would seem like a very good opportunity to demonstrate how one can assure a robust foundation for decisions and actions to take an issue like this and investigate the implications for performance assessment on one side and costs on the other and present that material in advance to the affected and interested parties and then allow them to participate in the decision. That takes you away from what DOE has been criticized for in the past, the decide-announce-defend syndrome, which I believe you said you were going to try to change. It seems like this is a fine opportunity to do it.

To continue, sort of in the same spirit of philosophy, the ESF alternative study seems to me, speaking from my position as an analyst, a very interesting and precedent-setting exercise in the use of formal decision analysis methodology to try to integrate many aspects of a very complicated problem so as to provide a robust foundation for decisions and actions.

We have seen this information only in very preliminary form at our November meeting when results were given to us literally hot off the computer less than 24 hours old. We have not seen the report that was delivered to you on Monday. We have some thoughts, some of which have been expressed in letters and which will be dealt with in further Board communications, regarding where this exercise might go from here.

I wonder if you could expand somewhat on the flowchart you gave us with some idea as to the timing and as to the extent where we're going to have an opportunity to see the documentation, understand further data acquisition and evaluation steps in the process leading to a decision on the final choice of alternatives.

DR. BARTLETT: In view of other activities, we haven't this

week done the next step quite yet, but we will, which is to transmit to a variety of interested and affected parties, such as yourselves, that document and a memo dealing with essentially this diagram, describing how we intend to proceed, and quite possibly including in that some preliminary indications of where we think we're going to be going with this thing.

The key step next is to determine what our -- and specifically our process will be to implement this diagram -- the process leading toward the actual decision, if you will. That has to do with the fact that as a result of the fact that the design concepts which appear to be preferred are, in fact, significantly different from the original one, that, as a result, I want to make sure we've got everything lined up with respect to making sure the foundation is solid.

So we review what we had, add to the foundation as necessary, and then get all of that together. I'm hoping we'll be able to complete that, and my colleagues can help me, within a few weeks so that we can then have all of the basis for the decision actually complete.

So there's a process here that we have to identify and we're in process of identify the process, if you will, at present. Just as soon as that is complete, we will be indicating to others how we're going to do that.

DR. NORTH: A concern we have expressed in the past is mentioned in the second bullet of your open issues regarding management strategy viewgraph, the use of external experts. This would seem a situation where perhaps more of that on this study would be appropriate.

We understand you did have some outside people, not part of or contractors, involved in the expert inputs to the decision analysis exercise, but our sense is there is even more of that that you might do in the process of refining the designs and the evaluation of the alternatives.

DR. BARTLETT: It's certainly a possibility. Definitely. One of the things that we will be doing is comparing my decision criteria with the evaluation of the criteria that we're using in that study. We want to make sure that they're complete and also, as a matter of valuing the criteria, where experts might have input also.

We're going to be forming essentially an ad hoc decision support committee of experts, independent of what was done to produce the findings report, to support this decision.

DR. NORTH: The impression that we had from what we saw in November was the most sensitive factors in the ranking of the alternatives were the issue of program viability, which was an input from a management team, and the question of the value of the test where the effectiveness of the test depends on the alternatives. In both of those areas it would appear that further investigation would be well worthwhile and I wonder if you have any specific plans at this time for doing that.

DR. BARTLETT: I don't have any specific plans at this point, but I have a strategy which is embedded in the concept of proceeding iteratively and in phases with the activity, because there are so many opportunities and needs to learn as we progress

with this thing.

I have, for example, in the past few months visited the existing facilities and test programs in Canada, Switzerland and Sweden and I believe all of you have done that, too, and learned that none of these experiments goes as planned, which is something that Dr. Deere knows very well, too.

We have to acknowledge that. We're probably not going to be the first ones where they do go as planned and we want to take advantage of contingencies and learning opportunities as we proceed with that. So I envision that as being a long ongoing part of the basic strategy for utilization of the facility.

DR. DEERE: Dr. Price.

DR. PRICE: Yesterday, Colin Heath made an observation and asked him a question. The observation was that it appeared to me that the NRC comes up with regulations which they are ultimately laid upon DOE. When DOE receives those regulations, they fashion from those regulations issues, and out of those issues they respond with their organization and program.

I think the SEP Paragraph 8.1.1 sort of states this as a process, as compared with a systems engineering approach in which you have a mission which would be clearly identified and from that mission requirements flowing from those overall system requirements, subsystem requirements, ultimately getting to specifications and so forth.

The organization certainly is designed to support that kind of an approach. That observation I made and asked the question of whether or not it appeared to be the way things were and I think he stated that this was a weakness in the program in the past. That is going in response to NRC without basically depending upon a systems engineering approach.

If that is his assessment, that may or may not be your assessment of the past, but, nevertheless, have things changed or what has changed or how have things changed with regard to that particular thing, if it's a weakness in the program?

DR. BARTLETT: Well, I like to think that, at present, it's not a weakness. The potential for the need of a reconciliation, if you will, of those two things has been recognized and is essentially being implemented through the management systems improvement strategy, because basically it starts, as essentially that diagram indicated, with the requirements, such as the regs, and embeds them into the organization and the functional requirements for the system elements.

You're going to be hearing from Dwight Shelor in detail about how that is being done. So I don't see, if this is accomplished successfully, and it will be, that there is any disconnect between the two. It's possible and necessary that, in fact, the regulatory requirements, along with all the others, be allocated, distributed and recognized in the functioning of the program management and of the system that results from that management. That's exactly what we're driving at with the MSIS.

DR. PRICE: It's all the others that create concern; that they are recognized appropriately. For example, in the organizational structure, quality assurance has quite a bit of prominence and that comes -- as an outsider looking at it, you'd

say, well, that comes because there are specific requirements that come from NRC regarding quality assurance, and so that gets a special office.

At the same time, certainly these regulations have a lot to do with safety, but somehow organizationally there is not specifically a safety function, reliability, availability, maintainability, some of those kinds of things we don't -- I don't see them couched in the organizational thing and certainly some of them are related also to regulations, I'm sure, but they would fall out, I feel confident, with regard to the overall functional requirements and the analysis of those kinds of requirements, but they don't seem to have the same organizational prominence.

I do not see, for example, as important as safety is, an individual safety function within your organization.

DR. BARTLETT: I think it's fair to say that they are properly embedded and will be in terms of the implementation of the program activities toward design and operation of the facilities. They show up in the regulations, first of all, by reference in Part 60 to other NRC regulations, but more specifically and extensively in the DOE orders, issues such as maintainability, reliability, operational safety, OSHA requirements, IMSHA requirements, etcetera.

They are all there and you will hear more about that from Mr. Shelor and you'll see how they're being actually embedded in the program. So they'll be embedded in the operation and the program activities as a very integral part, along with the specific coast-closure requirements which are the ones which tend to be the focus of concern at the moment because we don't know how we're going to demonstrate compliance with them yet and we don't know what the requirements will be.

But they are implicitly and, I think, accurately and effectively incorporated in the implementation of the MSIS.

DR. PRICE: For example, I would expect them to show up then in specifications --

DR. BARTLETT: They will.

DR. PRICE: -- for individual end items, because it should naturally follow through. If it's really in the system, it should naturally follow through and fall out. And in the area of transportation, in the area of casks, for example, some of those things that we would expect to see in the area of systems safety analysis at the preliminary design review side did not seem to be surfacing, did not seem to be appearing.

The overall problems of human factors and human factors engineering did not seem to be appearing to be addressed in what we would regard to be an ordinary human engineering thing. So I do have a question and I'd be happy to explore that further with individuals and certainly wait with an interest on Mr. Shelor's thing. But it is an ongoing question as to whether or not it is there and is surfacing and manifesting itself the way it should be.

I'd like to ask another question. If the overall mission of this thing has to do with storing of things, and I think we have something to do with we've got to store this stuff somewhere, you indicated that the key in the area of transportation was the MRS.

Yesterday, Negotiator Leroy, when we asked him about his time schedule, he's aware of 1998.

Nevertheless, he did disavow himself as being directly -- as I understood it -- as being directly connected with some other time schedule because he couldn't operate on your time schedule. I'm sure he made that kind of a statement.

So given that, and I know you have the optimism of meeting the 1998 requirements, it appears that with the MRS, there are as many pitfalls, just as there are with the repository, including legal ones, and chances that the delays may be extensive and that given the overall mission that we've got to store this stuff, we may find it at this great variety of sites in dry storage.

Is that a fair assessment of the uncertainties that you have, even though the commitment is there for the 1998 date?

DR. BARTLETT: It certainly is, indeed.

DR. PRICE: Given that, what in the direction of standardization, if any, concerns are you going to exercise over 70 or more sites where this stuff might be located?

DR. BARTLETT: You have put your finger on another issue which I didn't bring up this morning, but one, again, which we're concerned about. To give a little bit of numerics to it, by about the year 1998, there will be about 20,000 metric tons of spent fuel discharged from the reactors on an integrated basis.

We will have established with the utilities the protocols for receipt; which ones will come first, etcetera. We'll be ready to go, but we will take only about on the order of -- our present expectation is about 400 metric tons per year. For a long period of time, material is going to be left in the storage at reactors, at the MRS, whatever.

Part of our strategic principles is how long, and this interface is then with the thermodynamic repository, if you will, and other things. There is no question that safety is associated with it. There is a question of proliferation of storage technologies; that each of these utilities may, as a result of taking action against the delay, or actual need in the near term to implement some sort of a supplemental storage to the pools; dry, wet, whatever they choose to do.

You wind up with a situation where, in a span of time, we have each utility going off and doing its own thing. So eventually then as the system proceeds and does, with measured pace, continue to take receipt from the reactors and transfer it to an MRS, meantime ongoing you have this potential of a whole variety of technologies for on-site storage at the reactors for which there has to be meshing acceptance technologies, maybe back into the pool or whatever.

This is a system progress and integration concern of ours. So it raises the question can and should the Department try and dictate what technologies might be used for a period of time of storage at the reactors in order to narrow the proliferation of technologies that might be needed just for the transfers.

DR. PRICE: We have kind of a general concern, and perhaps you can help me with this, that sort of touches on this. That is it appears as we come new on the Board, and now new is a couple years full, so I'm starting to get old, but in looking at what's

going in, there's a compartment over here or a box, as someone has described it, which is a utility's box.

There's another box which is a transportation box. There's another box which is the MRS box. There's another box which is the receiving facility box. There's another box which is the repository box. There are a lot of competing institutional issues and requirements that tend to separate these things and the integration of this whole thing -- then there's NRC and EPA and the integration of this thing into a system seems to be a major difficulty.

Have you any comment on that?

DR. BARTLETT: Yes. It is a major challenge, and that's why we have the M&O contractor coming on board with a major focus of system integration. Administratively, we show these allocations of functions, such as shown on the org chart. Operationally, it's absolutely essential, as I emphasize and you're emphasizing, that we pay attention to the interfaces in order to make it all come together.

We are looking for the M&O contractor to play a very significant role in helping us pay attention to that.

DR. PRICE: You said soon. I talked to TRW in June and they expected that month to sign the contract.

DR. BARTLETT: Let me ask Mr. Peters to address that question.

MR. PETERS: As you might expect, Dr. Price, with the complexity of this particular contract and the legal shroud that has surrounded the whole acquisition effort, it has taken some time to come to resolution in terms of the specifics of the negotiation. We are, at this point in time, for all intents and purposes, complete with negotiation with TRW.

Basically, we feel as though -- at least our procurement office is advising us that we could expect to be ready to sign a contract this month. The only hurdles that I am aware of at this point that we need to deal with will be to assure the Justice Department, who, in fact, was our agent associated with the litigation on this effort, that, in fact, we have conformed with the Court's directive, specific directive, and then, subsequently, Justice assuring the Court that we have done so.

We have been advised by our legal staff that that should not be an issue. So I am anticipating and crossing my fingers that we will have a contract this month.

DR. PRICE: This month.

MR. PETERS: Yes, sir.

DR. PRICE: What is the size of that contract?

MR. PETERS: It initially will be looking, for Fiscal 1991, at approximately \$30 million. We're phasing it in such a way that it will -- there are a number of what I would call off-ramps and checkpoints so that we will be moving the resource base of TRW up consistent with not only the resources we have available in the program, but also, I think more importantly, with the progress that we're making in the program.

The initial effort that that contractor will be producing on behalf of the Department is about the four-month point after award a transition plan. TRW's view of how they and the Department can

work together best, looking forward to where we are and where we need to be.

DR. PRICE: Thank you.

DR. DEERE: Ellis.

DR. VERINK: As kind of a followup on the same general sense, but referring also to some of my earlier comments. Looking again at the comment about the budget allocations, I hope that the word "minimize" isn't translatable as a de facto cancellation. If it gets too small, it's going to be a point where there's going to be real danger that beating the milestone of having any kind of an engineered barrier system to meet the foregoing schedule that you're building towards is going to be foreclosed.

DR. BARTLETT: It most certainly does not mean cancellation.

DR. DEERE: John?

DR. DOMENICO: I've got a hard question. I think I know the answer, but I'm more concerned with your logic in coming to this.

Based on what we saw for the allocation of the funds, apparently the site suitability aspects are controlling the budget and probably running the program for the next several years.

In terms of the site suitability criteria as opposed to licensability, I know you've had input from several groups. Basically, what was the basis of the decision to determine whether the site is suitable? Did you eliminate the whole concept of an engineered barrier or engineering aspects or is it strictly 100 percent geological?

DR. BARTLETT: We're still, in my mind, and the reason I say in my mind, developing the plan for the plan, if you will, is simply that in the last month or so I have not had an opportunity to interact with the core team that has the duty for figuring out how we're going to proceed.

In case the Board isn't familiar with it, let me outline for you briefly how we have proceeded so far. First of all, we've taken recognition of the fact that the need for a specific independent methodology for making a determination of whether or not a site, any site is suitable, is a program requirement. So we've dedicated effort to that purpose.

If we choose, for example, to do it in such a way, it might be a rulemaking. I want to set the stage for you of what the concept is, that there will be a firm basis for decision so that we cannot be and will not be accused of making up the rules as we go along, but that we have acknowledged that for program purposes it is essential that there be a specific methodology for making a decision.

We recognized this some time ago, so for a period of time, I had three groups working independently, almost, you might say, without guidance, except that that's the end objective, and certainly without interaction except for a database, for each of them to see how you would go about it, recognizing that the effort involves several key things; how you're going to acquire data and to what purpose, and how we're going to adapt the regulatory requirements to the purpose.

And also recognizing that the evaluation of the suitability of the site, the geologic setting, potentially separates that aspect from the performance of a repository in that setting. But

the regulations are set for performance of a repository within a geologic setting; in other words, a meshing of the natural and the engineered barriers.

So there's some very heavy issues associated with this thing and we had a workshop to the purpose where we brought together the people who are involved in the technical aspects and the legal aspects of regulatory adaptation aspects, and we noodled this thing for a couple of days. Out of that came essentially a basis, a charge of responsibility to this core team to take into consideration what they heard and give us an idea of how to proceed.

I have no preconceived notions on this. I don't know right now what the answer is. We're certainly not in a situation where here's the answer, now go prove it. It's a very complicated thing having to do with the devotion of resources and a defensibility and a traceability and sensibility of the decision rulemaking.

What it comes down to are three factors under consideration; suitability, *per se*, licensability and what I call determinability. Your ability through acquisition of data to reduce the uncertainty enough even to be able to make the decision.

The relationship between suitability and licensability, recognizing this fact that, as I said, suitability addresses the geologic setting, licensability addresses the repository within the geologic setting.

What we have identified are the issues. Perhaps Mr. Gertz can give you a progress report on the core team because his office is leading that effort.

MR. GERTZ: John, you explained it well and certainly that's what we're trying to determine. The philosophy is if you use a total systems approach to determine suitability, you're very close to licensability then, total systems including the engineered barrier system and the repository system.

We're trying to strive for putting together a system that looks at currently using the 960 requirements, currently looking at new data that we have, and making a determination, emphasizing disqualifiers and some qualifying conditions. The best decision now based on the data in-hand is it's suitable to continue progress toward site characterization or, on the other hand, is there something out there that's unsuitable.

In parallel to that, we're doing what John pointed out, the prioritization. If we determine there's no reason to stop, if our decision is to continue, then what tests should we do first once we get on the mountain to verify that decision or to find it unsuitable.

DR. DOMENICO: Will these criteria be the subject matter of your forthcoming report that our Chairman referred to later in the year?

DR. BARTLETT: My present expectation, and Carl can straighten me out, is that we're going to produce essentially a description for review by this Board of how we expect to go about this and the preliminary indication of it about the April timeframe.

MR. GERTZ: Yes. I would think so. By the end of this month

or so, we'll have a management plan for the plan. In the April-May timeframe, the high level waste conference timeframe, we hope to have a methodology and a data need, so to speak, and say, gee, here's how we're going to make early suitability determinations focusing on disqualifiers and whatever else.

DR. BARTLETT: And I would call that an initial proposal.

MR. GERTZ: You're right, John. It's a proposal because it was meant to be -- the product is a proposal that would be shared with interested and affected parties to see if they have any input to that, and then we'd produce a final.

DR. DOMENICO: Does early, in your opinion, indicate post-exploratory shaft timeframe?

DR. BARTLETT: Yes.

DR. DOMENICO: Yes.

DR. BARTLETT: Yes.

DR. DOMENICO: So it's not that early.

DR. BARTLETT: We have to have that data, no question about it. I translate early as as soon as possible with initial focus on the disqualifiers. Carl made this point and it's very important. If we find that there are --we don't find any disqualifiers and you get into all sorts of interesting issues about false positives, false negatives, and this is all part of this evaluation, you get into a syndrome where you determine it's suitable to keep evaluating suitability.

This relates now to the determinability issue and the investment of resources; how long do you go along with this and how can you determine suitability in a situation where the data are quite complex, the site is quite complex, etcetera. So this is what we're wrestling with in this. We set an objective, as I said, but the specifics of it are being worked out by the people we've assigned this neat little challenge.

MR. GERTZ: Let me expand on that just a touch. We intend to assimilate data and about a year from now make preliminary early decisions, saying, gee, based on all the data we have, it looks okay to go ahead. Certainly that couldn't be the suitability determination that would go to the President as envisioned in the Act, but it would be a suitability determination, preliminary, based on the data we have.

Then, I think John points out correctly, we will probably periodically make suitability determinations in the hope that sometime after ESF data is collected we will then have the suitability determination as envisioned in the Act and leads you to licensability. That's a broad picture.

DR. DOMENICO: Thank you.

DR. DEERE: Yes, Dr. Langmuir.

DR. LANGMUIR: John, one of the difficulties in the program has been that of trying to validate model predictions of feature performance of the system and it's obvious to the geoscientists that the analogue approach is a nice way to at least attempt to persuade the public that there is some rationale to the long term statements in that performance.

How are we doing with an analogue program within DOE right now? What is the status of that?

DR. BARTLETT: It's an integral part of the program. We're

involved in the activities that are being operated internationally, which I'm sure you're well aware of; things like interval, etcetera. I consider them an absolutely vital part of the program.

They, like the engineered barrier things, are not expanding activities. We're in them as deeply and as effectively as we can be with the focus of effort being as I've described it with respect to evaluation of Yucca Mountain. They're longer range, I think I'd say at this point. But like the continuing acquisition of data, these are things we must continue to do at at least an acceptable level to be part of the process. We can't drop anything that we have ongoing right now.

We can change our priorities around, but we can and are continuing the analogue development in concert with other activities in the other nations' programs.

DR. LANGMUIR: What about support of American universities and contractors looking at U.S. analogues as opposed to just sitting in on foreign studies? There apparently are some good tough systems in the west, for example, that have uranium in them that might be pretty decent analogues.

DR. BARTLETT: Let me put it this way. We're in dialogue with some universities about a variety of programs. Frankly, I'm not personally aware that that's a subject of the agenda at this time, but I'll be glad to find out and get back to you on it.

MR. ISAACS: John, I might just add a point that could enhance on your comments a little bit. We have formed, as a result of recommendations that have been made both by this Board and the National Academy of Sciences, a natural analogue working group to at least focus our attention on what benefits there may be in the natural analogue area beyond those that we're experiencing right now.

I think one of the things we've already determined is that there are one or two opportunities. It's not simply looking over the shoulder, incidentally. We're participating with our principal scientists in activities as appropriate. There are one or two other activities where natural analogue studies in Alligator River, for example, in Australia and the Okla facility are enticing enough that we probably believe that the modest amounts of resources that it takes to participate in those is probably warranted, and I think you will probably see, as a result of this, more formalized review of what's available to us in the natural analogue area, some enhanced participation consistent with the priorities that John has laid out.

DR. VERINK: I would remind that natural analogues have more to do with it than just transport through the rock. The choice of materials and the immediate backfill environment about canisters is part of the engineered barrier system are also amenable to very useful use of analogues.

MR. ISAACS: If I could just follow on to that comment. There has been a real question about the relevance of natural analogues and you can find people who, on one extreme, say show me someplace in 10 CFR 60 where a natural analogue is going to help you license the facility, and if you can't answer in the affirmative, then why are you doing it. That's one extreme.

The other extreme, it seems to me, is to consider what possible benefits there are to the repository program of natural analogues, and they extend well beyond those kinds of things; in fact, even beyond the kind of thing you suggest. For example, as I think was mentioned when Professor Langmuir made his comment, there may even be some benefits here in terms of communicating with the external world.

It's very difficult to take a computer code and some kind of an analysis and say, now, let me explain to you why the repository is going to work for 10,000 or 100,000 years. It's something else to show a natural analogue, a real system where there have been some benefits and people can understand it and you can actually interpolate rather extrapolate.

Those are the kinds of things that we hope to look at here and come to some decisions. I think it would be most welcome for your advice.

MR. GERTZ: Let me just follow on. As you are well aware, project scientists are developing proposals for United States type analogues and, once again, they will be competing for the limited resources we have, so what does it make the most sense to do at this time with the funds we have.

Tom points out very well that natural analogues may have more than just scientific benefits. They may have a communication benefit. So we'll be looking at it with all that point of view.

DR. DEERE: Warner?

DR. NORTH: I'd like to ask a question on the subject of changing priorities, picking up the phrase from the last discussion. Very much in the context of the analogues and the engineered barrier issue.

That is to ask you what thinking you have done against the contingency that the legal problems with Nevada are not resolved and the impasse continues. Have you thought about that contingency and do you have some plans that you could share with us?

DR. BARTLETT: It's called cold iron. Yes. We have thought about the implications of that. Essentially, what it would mean is that the program goes into an R&D mode and the activities relating to meeting those objectives are put in what's called cold iron. They more or less shut down with respect to making progress toward the evaluation.

We have been as a contingency thinking about how the program activities would be restructured to that purpose.

DR. NORTH: I think some of the concern is that you not shut down some of the R&D activities that might be very valuable in terms of further progress toward eventually having a repository, leaving aside the question of whether it's Yucca Mountain or somewhere else.

DR. BARTLETT: That's right. It becomes an R&D program with a long-range focus. It's very different probably in detail and structure from a mission program or determining suitability of a specific site as soon as possible.

DR. LANGMUIR: A critical related question is how do you maintain the scientists and engineers, the quality people that have developed expertise over the years within where you need

them.

DR. NORTH: That is the critical question, yes. Maintenance and sustaining capabilities, personnel resources that you would need to get through a transition of any kind.

DR. DEERE: I think our time is getting away, but there is one topic that you mentioned and I think that we should respond a little bit. That is how can you best use expert opinions in evaluating your program or have review of your program?

I think there is a great deal to have input from an expert panel or expert consultant while the work is being done. It makes a positive move in the program. It often changes its direction slightly. It gives different insight. If it's after the program has been done and you say this is our twelve months of activity and what do you think of it, then they're in a little bit different position and you're in a little bit different position to be able to carry it out.

So I can see advantages actually in both. Both activities have value. But coming from a background of being on boards of consultants in various countries on major projects for probably the last 20 years, I find that it's because the board of consultants is an outside group and it's meeting every three months or four months as the program is being developed and as the program is being carried out and the project built and commissioned.

You have to have almost an input throughout various stages. I really think that in certain activities, and the one we're thinking about is excavation of shafts, let's say, you do get different approaches. You do get updated technologies that maybe could only be brought to you by a person who was working very actively in doing that someplace else at the moment.

We feel that in some of the panels that you've had in the decision analysis studies that went into the shaft studies, you had some outside experts which I feel have probably given the program a real good push in certain areas.

So I think it's the feeling really -- I can't speak for all the Board -- in the various conversations we've had that experts, external experts, not only your own, but external experts can bring something to the program as the program is developing and not just as a review panel at the end. This is what we've done, do you approve or what are your comments. These may be of value, as well.

But I think it's more direct if you can get inputs as one goes along and inputs from outside.

DR. BARTLETT: I couldn't agree more and I like to think what I was trying to indicate is, in essence, we need two pools of expert resources; one essentially to be part of the process of producing results and others to serve independently to review, evaluate, validate, check the key findings and results that have come out of the program.

They are really two different kinds of functions. In one sense, we could say that that external sort of final input is the responsibility ultimately of the NRC, but I want it also as we go and I also want the broadening of the inputs and the expertise as we go internally.

So I see a need for both kinds of functions.

DR. DEERE: I think you're right.

MR. GERTZ: Dr. Deere, I'd just like to add, based upon encouragement from you all when the Sandia findings report was first delivered to us, we did have Dr. Parker and Dr. Fairhurst from eminent panels and committees of the National Academy help us review albeit the Executive Summary, but they provided valuable input within our system from which we developed recommendations as to where we go next with the report.

So we thought that was value added from a panel of outside experts.

DR. DEERE: Yes. When you have a panel of outside experts, but even more so when you have external consultants being involved in the program, you have to have flexibility as well because they are going to be making some suggestions and many times these do require being -- if they're agreed to be valuable suggestions, to be implemented and it may well make a change that has to come about.

So the rigidity really is not a real great property, I think, in some of these times. I think the flexibility that you spoke of has to be available. The more external advice you get, probably the more flexibility you really need to take advantage of some of the good ideas that might be put forward.

Warner, last question.

DR. NORTH: If I could add a comment rather than a question on this, reenforcing the same point from academic research that's been carried out by a colleague of mine, Elizabeth Pate Cornell, and published I believe in the November 30, 1990 issue of Science, looking at off-shore oil platforms. She has also worked with NASA on the safety of the shuttle.

This issue of having outsiders check a mission-oriented program appears to be a very valuable principal for avoiding getting into a problem of group think and cutting corners with a mission group that talks to itself, but doesn't have the advantage of experienced expertise from the outside that can bring to it a fresh point of view.

It seems to me as a principal, it's something that's extremely important for this program to consider and a very important part of changing the culture, as I understand you're trying to do.

DR. BARTLETT: I read the article.

DR. LANGMUIR: It relates to public credibility of the program, too, quite directly.

DR. DEERE: I now would like to ask if there are any questions from the audience. We will take perhaps two, won't you, John?

DR. BARTLETT: Be glad to.

MR. CRAFT: Thank you, Dr. Deere. This is not in the order of a question, more a couple of statements of information. I am Steven Craft, Edison Electric Institute. Lou Long of Southern Company represented us here yesterday.

On the issue, Dr. Price, compatibility between the utility system and the DOE system. There are four fundamental parties involved in that; the utilities, the DOE, the NRC, and the public

utility commissions representing the ratepayers.

The suggestion that you make is a very good one and one that we have had many, many discussions with among all these four parties. What you have to keep in mind is that the four parties are linked by a very complex combination of laws, regulations and contracts. No one party has the ability to order another party to do anything. It has to be done by negotiation and tradeoff.

When the NRC began two or three years ago beating the drum of compatibility between the DOE system and the utility storage system which has very intuitive and very obvious benefits in terms of perhaps things like personnel exposure and spent fuel handling, our reactions were simple. When the DOE system becomes defined, then the utilities will look at it and say, okay, can I have a system on my site that makes it easier to make a spent fuel transfer.

But until that system is defined, until we know what it's going to look like, till it gets beyond the cartoon stage, it is very hard to do that. NRC has recognized that and in their regulation in Part 72 where they license the out-of-reactor pool storage systems, there is a requirement that you be as compatible as possible or something to that effect, which is probably the best way to do it.

So there is a pressure in the system to be compatible, but it is very hard to have a requirement because you don't know what the DOE system is. Once DOE defines the system, then we can talk and say, okay, what's it going to take to get utilities to be compatible.

The second point I want to make, and this is a point that I have not had the opportunity to talk to John about. I heard it for the first time here. As a principal going into contemplating the cold iron program, those of us responsible for paying the money are not going to be terribly tolerant of a long-term R&D program that has a lack of a mission.

I don't know precisely how the utilities are going to react specifically to a situation where John is unable to get on Yucca Mountain site. We haven't confronted that yet. Our goal is to help get on Yucca Mountain site. But based on history, from how the industry reacted to programs prior to the current one, long-term R&D programs without missions are ones that we will not pay for and we will certainly not continue paying \$525 million a year into the DOE program for it.

It may be something the government will continue to fund out of its general revenues and take the waste fund and set it aside against the day that we have a mission-oriented program. That's something that may occur. But the ratepayer monies must be protected for that mission of disposing of the waste.

Thank you very much.

DR. DEERE: Thank you very much. John, do you have a response that you'd like to make?

DR. BARTLETT: Not really at this point. I think we all should be aware of what Mr. Craft just said and it is very important as a practical matter. When I say that we have thought about the cold iron approach, that's part of what I consider prudent management to think of the alternatives in terms of what

the alternative futures might be.

I think we should all recognize Mr. Craft's comments as to what the implications would be if we got into that circumstance. It's also why I think it's vital that we proceed with our mission.

DR. DEERE: We'll take another question.

[No response.]

DR. DEERE: Mel, you didn't have a chance to listen to his talk, but would you have any question you'd like to make to John?

DR. CARTER: No. I apologize for my absence, but I have no questions or comments.

DR. DEERE: We had introduced ourselves. This is Dr. Carter, who is one of our members and also Chairman of the Panel on the Environment and Public Health. Perhaps you could just tell them what your affiliation is and your expert profession.

DR. CARTER: I spent 20 or so years with the U.S. Public Health Service, following the environmental public health and environmental, if you will, as related to the radioactivity and radiation. Then I spent approximately the same amount of time as a Professor at Georgia Tech and I'm now Professor at Meredith's in Nuclear Engineering and Health Physics from Georgia Tech.

I'm also pleased that we're the national champions in football.

[Laughter.]

DR. DEERE: I knew that was coming. We settled that yesterday.

DR. CARTER: Those are my areas of expertise and, like I say, I apologize for not being present during the morning session.

DR. DEERE: Thank you. We want to thank you very much, again, Dr. Bartlett, for taking this time. We certainly appreciate you bringing over all of the management team. We know quite a number of them and now we get to know the other two or three.

DR. BARTLETT: I want to thank you again for the opportunity and to tell you how much we appreciate and value and look forward to your contributions to our program progress.

DR. DEERE: Thank you very much. We will continue with input from DOE. We're glad to have Mr. Dwight Shelor with us today. He is currently an Acting Associate Director of the Office of Systems and Compliance for DOE's Office of Civilian Radioactive Waste Management. He's responsible for planning, managing and overseeing the development, integration, and evaluation of the civilian radioactive waste management system.

He has been with the program since 1984 and has held several positions within the Department. We've asked him if he might comment on the OCRWM systems integration and on plans for interaction with the Board during this coming year.

Mr. Shelor, we're very happy to have you.

MR. SHELOR: Thank you very much for the opportunity today, Dr. Deere and the rest of the Board and the other people that are here. This is a unique opportunity for me because of following the presentation by Dr. Bartlett. We've talked a lot about the MSIS and how it's going to solve all of our problems.

Well, I think I can be here today to bring this down a little bit to reality and tell you a little bit more of what we are doing

and what the strategy consists of. The MSIS is a strategy that, in fact, consists of several initiatives which, when implemented, we hope will provide improvements to the management of this system.

I will also describe our approach to systems engineering generically in the program, our approach to functional analysis that we are using, and give you a little bit of where we are right now in that process.

First, I would like to go through and describe for you the initiatives that do, in fact, comprise the management system improvement strategy. We have a very clever viewgraph here. As we mentioned this morning, the Secretary's initiatives that were announced in November of 1989 did indicate that the Department would evaluate their management structure and one of the things that was identified as a key component which has been completed was the nomination and the appointment of a permanent Director for OCRWM, which has been completed.

In identifying the initiatives that are underway, obviously there has been a great deal of work done on updating the mission plan strategy. Dr. Bartlett has now completed the reorganization of the OCRWM group. It has been implemented and is being finalized.

We have identified two other primary initiatives which have to do with the implementation of a systems approach to identifying those functions that the physical waste management system must perform to satisfy the mission requirements and to identify those programmatic functions that program personnel must perform to bring products into being to satisfy the physical system functions.

Through the process then that I will describe in a few moments, then we will prepare a physical system requirements document and, in a parallel fashion or a similar fashion, we will prepare programmatic function plans and strategies for development of specific products, if you will.

In addition, another separate initiative has been to reassess the roles and interfaces of the contractors, national laboratories and other Federal agencies in the OCRWM program, and I believe a lot of that is being -- hopefully will be finalized shortly with the selection and award of contract for the M&O operator.

We can see then as we get flow out of the OCRWM reorganization that it didn't take a great deal of thought to recognize that for a program that has the potentially long duration of this program through repository closure, that it will be necessary and desirable to develop personnel resources of people that can come along and replace those of us that are here now.

We need an initiative and we have started some work on an initiative to work with and contact universities to develop curricula leading to careers in some expertise in our program. In addition, the preparation and the functional analysis of the physical system then can lead to the preparation of a product-oriented work breakdown structure and dictionary which begins to help us define work packages that I will talk more about in a few moments.

The physical system requirements documents will also have to have strategies for the development of those systems and obviously then from a programmatic side we will have developed a structured document hierarchy for the program, and then we will package that document hierarchy into the program documents.

We have, over on the upper righthand side, a very important aspect of any program. Recently it's been mandated in Federal programs, in any event, but it is a very effective technique. Total quality management. And I believe that once we establish a fairly good framework for the program, have identified those management processes that we are using, then a continued effort in total quality management to improve those processes utilizing the expertise of the people who are doing the work would be a valuable asset to the overall program.

Certainly we want to get to a point where we have an integrated technical cost and schedule baseline that we can use to control the program and make adjustments as required. We've also identified an initiative to establish, try to establish a uniform decision analysis process that can be used throughout the program.

In virtually every case, in order to provide the traceability, you need documentation of decisions as they are made in the program. I don't believe we can claim that every decision we make will be the right decision, but if we document what we did do, we can always revisit and evaluate its impacts on the rest of the program.

Then the last effort then as we come down this system would be to integrate the program-wide technical management system procedures so that we don't have separate projects using different procedures. We would like essentially to standardize and have uniform management and appropriate technical procedures in most cases.

All of these initiatives -- as you notice, there is no time scale on this strategy which identifies these initiatives. We don't visualize a situation where the program would come to a complete stop until we have implemented all of these.

The purpose here is to improve the management of the program, not to change step functions or stop work until we complete all of the actions. So we will be phasing this into the program structure as specific initiatives are completed through our controlled baseline of the program.

DR. DEERE: While you have that one there, did you have a question now, Warner?

DR. NORTH: I was going to draw you out a little bit as to what you meant by establish uniform decision analysis process. I hope it's closely related to the line in Dr. Bartlett's presentation, assure a robust foundation for decisions and actions, and that you will be documenting not only what decision or action was taken, but what the basis was.

MR. SHELOR: Certainly. However, we are -- quite frankly, we haven't completed that and we will obviously want to discuss it with many people before we finalize it. But we are looking at a decision process that is simpler, much simpler than the multi-attribute utility analysis that can be used on a more routine basis as a means to document many very important decisions that

are made in the program that maybe are less complex than a decision on the configuration of a complete subsystem.

DR. NORTH: I would not want to say it has to be anything like the exercise you have gone through and will continue, presumably, on ESF, but rather a principle of writing down so that others can see what is the foundation for the decisions and actions so that that's clear. And as you said, if there are changes, you can come back and revisit it and see what the basis was.

It seems to me this is one of the great advantages of having a formalized process and I would commend you for going ahead with this as a part of the management systems improvement strategy, and I'm very interested to see the details as to how you propose to do it.

MR. SHELOR: Very good. I'd like for a moment just to describe generically the systems engineering process that is typically used within the Department of Energy. In the generic fashion, we are following it in most cases. As we say, in most cases, the first thing we need to do is define the mission, either a mission need or a project need or whatever the objectives are, try to collect all of the constraints and go into a functional analysis of those functions required for that system to meet the mission objectives and determine the required performance of those functions as they're decomposed down to lower and lower levels.

In a functional allocation, going down to subsystem and components, this allows you then to identify the interfaces of the system and to identify the dependencies of elements throughout the system. You can identify the support that is required and establish through iterations or systems analysis a system architecture that can be used with components that meet the functional requirements to satisfy the system requirements.

A system architecture is very important to establish and this shaded area is really the focus of my discussion today as to where we are in development of this. But I do want to point out that once the system requirements are determined, then you go through a synthesis and integration system definition. We sometimes refer to this as conceptual designs where we evaluate all of the alternatives and then make a selection of which alternative then best meets the needs and the requirements of the system.

Then you go on through a Title I preliminary design. You can then go to a final design, construction drawing, and then over to system build, test and demonstrate.

DR. NORTH: I'm a little surprised that your shading doesn't extend to the evaluation optimization box below. Dr. Bartlett had in his presentation proceed iteratively with data acquisition and use and evaluations and I would hope that would be an ongoing process rather than something that you're putting off into the future.

MR. SHELOR: That's true. I guess the shaded boxes -- what I am prepared to talk about today, I want to indicate that this is a generic process that we would implement across the board, and obviously you can draw arrows back and forth. This is an iterative process all the way down through the system definition that involves trade studies and effectiveness analysis, risk

assessment and analysis.

DR. NORTH: The point I'm making is I hope you're not going to put that off, but start in immediately exercising that as part of the system rather than waiting until you get all the way over onto the righthand side.

MR. SHELOR: That's absolutely correct, subject to our ability to develop the analytical capability on the system simulation models and have people trained to do system studies. We're not quite there yet, but we're working on it.

In this, going back to a functional analysis, it's been sometimes referred to as an FRI, which is -- it really speaks to decompose of functions and specify the requirements, and then select an architecture. And it's a repetitive process starting at the very highest level in defining the mission and then decomposing functions down that can be used to satisfy the mission requirements.

This legend is consistent throughout and you can choose whatever convention you want, but we use the inputs-outputs on the left and right, the resources and controls at the top and bottom.

And as you can see, the first and most important thing to do is define the mission. Once you define the mission, then you can begin to establish functions that are required to satisfy the mission.

You do that with technical experts and when you get done, you will have a function hierarchy that can be placed in a report and then go to what are the requirements. You use regulatory experts, other experts. You look at laws, standards, regulations, commitments, what have you, the whole nine yards of whatever the requirements or constraints that exist on a particular program, and you get a requirements hierarchy.

Then you go to looking at a system architecture and decide from alternative architectures, final decisions, could be proposed by technical experts or the program managers. The selection is usually made by a manager. You look at the alternative architectures. You may have to do tray studies to ultimately then select an architecture that can be used within the system.

We then will have a functional analysis report that will document all of these decisions and provide the function hierarchies, the requirement hierarchy and the system architecture, and then can be put into a requirements document. The process that we are using, I'd like to describe very quickly.

We have two core teams with people that have facilitators with a great deal of expertise in dealing with inputs from groups and focusing them into a functional decomposition from the top down.

We have two core teams. One for a physical system, which is the entire waste management system, and we have another core team for the programmatic functions. And here we are trying to include every single programmatic function that must be performed in order to bring these products in to satisfy the physical system requirements.

We start out then with a core group supported by experts to do a function tray in many cases. We are not able to establish an architecture because we only result in identification of a need for further analysis before we can bring our architecture on down.

Once the function tray then is established, then we pass it over to more experts. We develop what are the performance requirements and how -- again, our objective here is to place the performance requirement at the lowest possible level on the function tree, which helps us coordinate things. Those performance requirements are then hung on the tree, fed back to the core group, as well as those constraints and the constraints that are identified will then come back in and then we result in an identification of the functions, the requirements and an architecture for the system.

Then we have elected to use then an interactive database so that we can produce requirements reports in several different formats. This is a little graphic that is more pictorial to indicate -- if I start with those programmatic functions that would be required or conceivable for the system and compare that then with the physical system functions that we identify and we come out again -- this is the function -- this is an indented version of a function tree and with its -- with the architecture.

Then you have some components. When you go through and do a functional analysis and decomposition of the programmatic functions, then you establish a hierarchy of functions that must be performed by personnel. And this hierarchy of documents then defines the program structure and documents the functions and the management processes that need to be conducted to perform -- that describe how you conduct and perform that function.

From the physical system, you hopefully have done an exhaustive examination and compilation of all of the requirements that the system must meet and you have developed a product-oriented work breakdown structure, which then can lead to work plans, cost accounts, and ultimately, when you have completed this, you have defined the necessary and sufficient work to complete the mission.

You have also then hopefully focused then your program efforts on accomplishing the mission, along with schedules, budgets, changed control procedures.

DR. NORTH: So what you've given us really is a design for a system that you are in the process of building, is that correct?

MR. SHELOR: Well, sir, if I were starting from scratch, this is the process that I would do. What we are in the process of doing now is kind of reverse system engineering because a lot of those system architectural decisions have already been made. The program is eight years old. We're going back and examining off-line, if you will, from a more structured documented approach, and then we will compare and evaluate impacts on the system as we complete this and implement it.

But it is an effort to improve our management systems by systematically evaluating.

DR. NORTH: And we told you in our first report to the Secretary and the Congress that we thought more use of systems engineering methodology would be very valuable. I'm delighted to see you doing it. But I'd like to give you a very strong admonition. Having watched the application of these principals in a number of different areas, there is the potential that they

become relatively rigid and hard to change as you build them into a big formal system.

The advantage is with a system like this, you are able to keep track of an enormous mass of detail so that when something changes, you can see its implications to the rest of the system. My plea is you set this up in such a way that it can be extremely flexible and that you can track changes in it very quickly.

For example, if you have this implemented in the form of a set of computer programs where you can see what the implication is of some change that results, for example, from acquiring additional information about the site, you can see its application and you can then make decisions to take advantage of that new information.

I'll use an example from Professor Cornell's paper in Science having to do with an off-shore platform where they were going about the design of the platform at the same time that they were trying to characterize the soil conditions of the ocean bottom on which this would rest.

They made a mistake. They were rigid and flexible and as new information came on about the bottom of the ocean, they didn't take into account the implications for the platform design. As a result, they had a severe problem. So you want this system set up in such a way that as you get more information, you can go through this process and come out with changes, for example, in specific work plans, revisions to the work statements for your contractors in this very big and complicated program, so that the implications of the learning get passed through the system and actions are taken as a consequence.

If you can do that, it's very valuable. If you can't do that, you ought to wonder whether or not this system is worthwhile at all or whether it's simply getting in the way.

MR. SHELOR: I agree and that was a major consideration in establishing this. We are using the computer-based system to assist us in the development of the functional analysis and all of the requirements, the function tree descriptions go into a computerized relational database that could be accessed, edited, modified, and changed.

Otherwise, it's simply too big to keep track of this on a paper-based system.

DR. NORTH: Agreed, and I hope you will test it by looking at how it deals with changes.

MR. SHELOR: Yes.

DR. NORTH: Run some exercises on it. Supposing we get information about Ghost Dance Fall of a certain kind. What does that imply? Practice contingency planning with it and I think you will find it an extremely effective tool.

MR. SHELOR: The thing again to remember -- to this point, in determining the requirements, those are system requirements. It's not involved in coming up with the design solution to those requirements. In many cases, there may be a modification or a change to a regulation that is translated into a system requirement.

But how we interface with the development of the design solution is that iteration step I showed on the previous viewgraph

that said there has to be feedback. And you may have new information. You may have to go back at some point and change that system architecture -- I'm sorry -- it was two slides back.

You may have to go back with new information and select a different architecture because you have new information at this point. Now, fortunately, in many cases, the requirements don't change very often. They may. They may be modified or they may be changed, but we need a way to trace any changes in the requirements.

The constraints, in fact, may change more often than the requirements. As another point, I'd point out or just to emphasize here is that you can go through the FRI approach, establish this framework, both on the physical system and the programmatic functions, that are essentially independent of the organizational assignments.

The trick then is to make sure that within the organization that you have selected that you have assigned all of the important functions.

DR. NORTH: The problem you're going to have is you have a situation where the criteria, as we were just discussing, they aren't fixed. They're going to evolve. You have enormous uncertainties that you are dealing with in terms of the geology of the site. As we learn, as criteria get refined and as we learn from site characterization activities more about the site itself, it's going to have a lot of implications all through the system.

MR. SHELOR: It's going to have major implications in the system and I might -- the other thing that you're pointing out is the fact that the FRI and the whole system approach usually works very well on engineered systems. The fact that we are trained to include -- use it in a total system that includes a natural barrier may be our most difficult challenge that we could make.

DR. NORTH: Right. And you don't want to repeat the problem of that oil platform described in Professor Cornell's article.

MR. SHELOR: Yes. And hopefully we can recognize that and, as I said earlier, the implementation of this may not solve all of our problems. I hope it doesn't give us bigger problems, but I am convinced that it will provide a documented traceable system that can be used to help us improve our management.

The other key to all of this is accountability. Unless you can, within some bounds, define the work and establish the requirements for it, you cannot achieve accountability in the program. I don't know of any other way to achieve accountability in a program of this magnitude.

Let's go back just for a moment and give you a couple of brief examples of how the FRI worked on the physical system down to level zero. We have gone selectively down to much lower levels, but there will be insufficient time to present a lot of detailed information at this point.

We chose -- and these are draft at this point. But if you take as our top level function, that's the manage waste disposal, and the inputs to that that are spent fuel commercial high level waste from purchasers of our contract and the producers of defense high level waste, if you will, and the Presidential memo that essentially stipulated that we would co-locate defense high level

waste with the civilian and spent fuel and commercial waste, the NWPA and its amendments has those controls. The Nuclear Waste Fund then is the resource that the program used.

And there is obviously an output that we want to look at that goes to the accessible environment. You take that down to level - - what we call or refer to as level zero. You can then begin to look at four primary functions that are all required in order to accomplish the overall mission, which is to manage waste or, conversely, to dispose of waste.

We have elected to go with accept waste, transport waste, and then I might indicate that this is multiple transportation steps, but it can be represented with similar inputs, outputs, constraints, store waste and then dispose waste. I won't belabor this. I think the charts are in your handouts. Again, you can see an example of the development of the controls, constraints and the requirements.

And then as we further decompose these functions, then we bring the requirements that are required right down with them. This then can be portrayed in a function tree or an indentured structure, either way, back and forth. Manage waste disposal, four primary functions, and then we begin to get down into this interface between OCRWM and either the producers or the holders of the contract.

We normally would not show a purchaser responsibility, but this is such an important interface that we have elected to take this down to the point to where it reminds us that we have to address that interface with the utilities and exercise some responsibility in this with multiple producers -- and transport waste.

This is very high level examples, but in the next viewgraph, there is again the system architecture. And a lot of these -- sometimes you say, well, gee, that only amounts to a name change or a change in verbs and words, but it is a convention that works, let's us keep our bookkeeping together, and let's us go into a computer-based system.

As you can see, in waste transportation system, then would be an architecture or these four systems then provide the architecture of this overall system. I might also point out that another good example of a selection of system architecture is one that the Congress did when they selected ecologic disposal versus other alternatives for us to work on, which then became the basis for our mission.

We did not have a responsibility then to make trade studies and evaluations and selection of the system architecture that led to ecologic disposal. Same philosophy and approach holds true as you come down.

For example, we come down -- there's a conscious decision on this architecture because it says dry. An alternative would have been wet, for example. So those architectural decisions either have to be made or the need for an analysis to make that decision is identified as we go through the process.

The traceability, defensibility and how do you approach this. Just as an example, if you come down -- again, this is just an indentured format of the function tree. You can select multiple

architectures for a given function, but when you put these together in a system and consider the interfaces or the interaction of that function with other functions in the system -- in other words, interfaces and their dependencies -- then you must come over and develop some screening or constraining requirements that you can begin to narrow down what are acceptable architectures based on these constraining requirements.

You have then the remaining individual architectures and then you want to make -- combine those into acceptable sets that meet the requirements. Then in most cases what you end up with is a defensible best set and maybe a backup alternative that you want to document for future consideration.

I want to come down to a methodology and it's a very important question, particularly in this program. Many times -- how do the ESF design and test requirements emerge. For example, as I would characterize it, the only need for an ESF is, in fact, to characterize the site. If I knew everything there was to know about the site, I wouldn't need an ESF.

However, if I need the ESF to characterize the site and it's also within the repository block, then there may be a requirement that certain portions of the ESF meet repository, future repository requirements. When you come down, first of all, let's look at the ESF test requirements. Down into dispose function is really where it comes, but in every case you look for the information and data needed to define the system and its performance.

Site characterization, that's the total set of data that you need both to make a site selection, a site suitability determination, and the data required to design a repository if the selection is made. Then you go into the geoscience or data acquisition planning and the test requirements for data acquisition, and you come down -- these are combined in many cases.

You can consolidate them for efficiency, if nothing else, identify what test requirements do you have and if you can allocate these to surface-based testing or underground testing and identify, for example, boreholes at the surface or something that you need in the ESF.

Now I have a need to satisfy data. Now I come down and I do another functional analysis and I determine what the physical functions are of the ESF in this case. The next viewgraph then shows the relationship, once you've gotten down here and you do this other functional analysis, then you go back and you'll pick up some or the appropriate controls and system requirements and regulations that are appropriate from the repository as they relate to the exploratory shaft.

DR. NORTH: Again, I'm a little worried about language and concepts. The presentation we just heard from Dr. Bartlett included a box that was labelled "learn." Flexibility is another key word. Iteration. What you want to get out of this is some robust strategies and I think to do that you're going to have to go around these loops many, many times and look not so much at requirements, but at tradeoffs, because within the many requirements you have of the program, some of which, maybe much of

which is set in law, you have many situations where, frankly, you can make a tradeoff between something like cost and something like time and something like performance.

This is traditional systems engineering. It applies virtually anytime you go through systems engineering. You have those kinds of tradeoffs to make. And if you set it up that you are going to have somebody formulate a set of requirements at the outset, you're going to go satisfy all those requirements, you wind up with a system that may be very, very sensitive to small changes. It is anything but robust. It may be incapable of standing up if the soil conditions turn out to be different from what you had assumed when you designed the off-shore platform.

It seems to me that what you need to be able to do on this is a great deal of sensitivity analysis to investigate the uncertainties and develop insights and learn from the analysis process until you have convinced yourself that you have a strategy which is really robust. That, I hope, is what you're going to do.

MR. SHELOR: Certainly. I think initially we want to do the best job we can in defining the system requirements and then when you begin to look at potential design solutions, you have to do the trades, the sensitivity analysis, and you may want to go back and reiterate and either try to change or modify the system requirements. There is no doubt about it.

DR. NORTH: Dr. Price just made a remark to me. I'd like to make sure it's on the record. That is robustness ought to be a requirement.

MR. SHELOR: It can be. Certainly. One of the things -- I guess in a way it's almost too abstract because there is no way to quantify it, but how do you get to this analytical or the evolution of the system architecture. What we're saying essentially is that there are some set of constraining requirements and then you begin to look at what are our technology limitations and where do they overlap, leaving us some space to work in, and then going back to programmatic considerations, cost and the rest of it.

These are the issues you were talking about.

DR. NORTH: Let's not consider it black and white, in or out. Let's consider it as we can change it at a cost.

MR. SHELOR: These can go -- these are undefined. But ultimately you end up down in an area where you have a region of acceptable alternatives. Now, it may well be then in the robustness maybe whether the selected set is, in fact, robust and not next to a boundary and fall off a cliff. But those are the analyses and approach that you do that.

DR. DEERE: Excuse me a moment. At 1:00, the Secretary of Energy will be doing a news conference on CNN and I think we want to hear that. What we would like to do is see, Dwight, if you could finish the four or five graphs that we have here and then the interactions we will leave for another date, if we may do that.

MR. SHELOR: Sure. Absolutely. As a matter of fact, my next one was the last one. Timing is very good. What we have done is selected an approach. We have identified initiatives that we will try to implement as the management system improvement strategy.

We're in the very early stages of that in terms of the functional analysis and establishment of the system requirements and architecture.

Right now we have the two core teams working. We're on track. The first attempts at these are very time-consuming and, in some cases, excruciating until people become familiar with the process and begin to buy into a little bit more.

But, in essence, what I believe we will end up with is a documented and traceable and defensible system development approach.

DR. DEERE: Thank you very much.

DR. PRICE: I have one pressing thing I would like to bring out here.

DR. DEERE: You have five seconds.

DR. PRICE: Five seconds. That has to do with the interfaces, that it's more than paying attention to interfaces, but it's optimizing across the boundaries so that you get across the various requirements. You've got a multiple objective optimization kind of a problem to bring out across all of the barriers, including utilities and their involvement in the front end of a lot of this stuff that you're doing and getting clear down across the boundaries to the -- I think of, for example, minimization of handling is one of those requirements that we see in industrial engineering which cuts across all of these boundaries and that affects everything, including maybe the design of the canister.

MR. SHELOR: Exactly. I think you are absolutely right, but I believe that this framework -- we can use this as a framework to introduce those requirements and all the other requirements that you would have in development of a system, including human factors, safety and the rest of them; come right in through the system.

We will be able there to cross system boundaries or subsystem boundaries in the optimization. We have to identify interfaces and control them from a system perspective.

DR. PRICE: The thing you haven't presented to us today that maybe we can get to some other time is system acquisition process and how it intermeshes with this.

MR. SHELOR: That's another subject entirely, but it does -- it's a very important one in terms of identifying the strategy for acquisition of the system.

DR. DEERE: Thank you very much.

DR. PRICE: And eight years into the program of just defining requirements indicates how topsy-turvy we are at this point.

MR. SHELOR: Yes.

DR. DEERE: We don't need an answer. Thank you very much, again. Appreciate this and we'll have an opportunity perhaps to see if you could join us at a later date, certainly not today. John, again, I want to thank you for coming over and bringing your management team.

DR. BARTLETT: Thank you.

DR. DEERE: The meeting is adjourned.

[Whereupon, at 12:35 p.m., the meeting was adjourned.]