UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

Meeting of the Panel on Transportation and Systems

Nuclear Waste Technical Review Board

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P A R T I C I P A N T S

Board Members Present:

Dennis L. Price, Member and chairman of the

Ellis D. Verink, Member

Staff Member Present:

Sherwood C. Chu, Professional Staff Member

Consultant:

Dr. Wolter Fabrycky

I N D E X

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P R O C E E D I N G S

(9:00 a.m.)

DR. PRICE: Good morning, and welcome to the second day of the Meeting of the Panel on Transportation and Systems of the Nuclear Waste Technical Review Board.

I am Dennis Price, chairman of the panel. With me today are Dr. Ellis Verink, the other member of the panel, immediately on my left; and Dr. Sherwood Chu, the board senior professional staff. This morning we are also joined by the panel's consultant, Dr. Wolter Fabrycky. Dr. Fabrycky is on the faculty of Virginia Tech and is a noted expert on systems engineering.

The focus of today's meeting will be on systems engineering issues. This will be a follow-up to a briefing the Board received on July 15th of this year on DOE's systems and engineering approach to the waste management program.

As preparation to today's meeting, we sent to the DOE a list of four questions which we wanted further elaboration. These questions are: Will the DOE conduct timely systems engineering trade-off studies, the goal of which is to optimize to the fullest extent reasonably achievable the spent fuel system viewed from the generation of spent fuel at the utility through final storage? If so, how? If not, why not?

The second question: Given the state of the system as it exists today, how will the DOE ensure the synchronization of decisions based upon a thorough understanding of needs, functions, and interfaces, particularly as these decisions involve the acquisition of major systems or system parts?

Third question: How does the DOE justify the bifurcation of functional analysis efforts, that is, the programmatic functions analysis, separate from physical function analysis? Will such bifurcation affect concurrence in the development of functional structures across programmatic, physical, and management areas?

The final question: Given the identification of approximately 6,000 requirements, does the DOE know that there is a feasible solution as the requirements and regulations are now stated? If so, how? If not, when will this be known?

Leading off the discussions for the DOE is Dwight Shelor. Mr. Shelor is the associate director for Systems and Compliance of the Office of Civilian Radioactive Waste Management at the DOE.

Dwight.

MR. SHELOR: Thank you, Dr. Price, and Dr. Verink, and the rest of the Board, and the guests that are here today.

One of the first things I would like to say this morning is unfortunately we are going to have to change our presenters today. Tom Woods is ill and was unable to make it and he was scheduled to make two presentations. For the presentation on the decisions methodologies, we have an excellent substitute, Bill Hoessel, also from Westinghouse. I will then substitute for Tom Woods on the other presentation, on requirements management.

So if you will bear with us, we will continue today on our presentations.

(New viewgraph)

Today we intend to present a brief overview of the systems engineering process, specifically responding to the Board's questions concerning the systems engineering program. I have taken the liberty of renumbering the questions, but I believe we have the questions verbatim, so if you will bear with us.

We have reordered the questions and put together a presentation that will follow that order. And we will, in this presentation, provide a status of our functional analysis effort, where we are, what we are doing now, and we will describe our requirements management process, which I think is a very important part and one of the bases of your questions.

We will describe the planned systems analysis effort and the plans to implement trade-off studies and systems optimization. Bill Bailey from TRW has a presentation on system study, system trades. We will describe how we are planning to approach a decision-making methodology and process and how it fits into the whole structure.

(New viewgraph)

I know many people have said, "What is this MSIS thing?" Well, for sure MSIS is not system engineering. MSIS is exactly what it says; it is a management system improvement strategy. Is it related to system engineering? It certainly is.

In our preparation of the MSIS, it was really aimed more as a program management analysis. We wanted to examine how we do business, we wanted to examine how we have done business in the past, and if there is a way to improve how we do business and how we manage the program. Now, systems engineering is certainly an important part of that, because the functional analysis, as we say, of the physical system and of the programmatic functions provide the basis for us to examine: (1) How well have we described what we want to do? and, (2) How are we going about bringing that system into being?

The rest of this, as you can see, is really aimed at managing the overall program with all of its component parts. Once you have defined the system that you want to build, then you can develop product-oriented work breakdown structures, which is a very handy tool for us to manage the program because from these work breakdown structures we can assign work to other people to have them bring this system into being, we can prepare system element strategies. And once we have decomposed what this system is into major functions, then we can come down and develop a strategy for that particular element of the system. This is a strategy on how that would be developed, which is part of the program management. Ultimately what we want to end up with is a fully integrated and consistent technical cost and schedule baseline.

In the Department of Energy we work to baselines. We establish a technical baseline, we work to it. That technical baseline has to have an accompanying cost and schedule. That is how the program is managed. And these programmatic functions, as we refer to them -- it may be a poor choice of words, but we were trying to separate these programmatic functions. These are program functions that somebody has to perform in order to bring this physical system on-line.

When we do that, once we have decomposed the programmatic functions, we can identify plans on how those functions will be performed, we can identify the roles and interfaces of the contractors and the various players in the program, and develop a document hierarchy that includes both the technical hierarchy and the program management hierarchy. You know, how are we managing the program?

Then, again, obviously we can look for a decision analysis process and integrate this into programwide system. That is what we are talking about when we are talking about MSIS. Some of our products or initiatives certainly are being conducted by systems engineering and we are using systems engineering approach.

(New viewgraph)

Using that as kind of an overall setting or stage, then let me, at this time, give you a brief answer -- I won't reread the question, but we will address a response to the questions. I think some of these are very good questions.

This comes back to what I was just alluding to. We separated the programmatic and physical system functions by definition and otherwise, because they have separate missions. When we do a top-down decomposition, the first thing we need to do is write a mission statement, and the mission statement then follows through a decomposition of functions. We define the programmatic functions as those that pertain to OCRWM activities that are required by people to perform to bring the nuclear waste management system into being.

Likewise, on a physical system functions, those are the elements, the physical elements, of the system which satisfy the waste management requirements and disposal mission. Our waste management mission is the disposing of waste. We have better definitions, and we will look at some of them as we go along, but basically this is the basis for the bifurcation and the approach. This one lets us analyze how we are doing business. The physical side addresses the system that is required to perform our mission.

(New viewgraph)

DR. FABRYCKY: May we ask for clarification as we go?

MR. SHELOR: Certainly.

DR. FABRYCKY: Could you put that slide back?

(New viewgraph)

DR. FABRYCKY: Under "programmatic Functions," programmatic functions are to bring the physical system into being, as indicated to the right there: "Pertains to OCRWM activities in order to bring the nuclear waste management system into being." The physical system?

MR. SHELOR: Yes.

DR. FABRYCKY: Okay. In terms of the schedule that is now set forth, when will that physical system be brought into being? Is there a line of demarcation between the acquisition thereof and the utilization thereof? When you speak of "bringing into being," would you clarify "bringing into being," not necessarily in time, when that will occur, but what that means in terms of ceasing that process out of "bringing into being"?

MR. SHELOR: Again you make a very good point: It may be a poor choice of words or it may be misleading. These are those programmatic functions that are required over the entire period until the repository is decommissioned, the markers are up, and the monitoring systems are in place. Now, somewhere out in time there will be a point where you walk away, where you no longer monitor. I think our definitions of when the repository is closed and you walk away from it are not very clear, but certainly our intent here is all the way through that time when we have required the management of that disposal.

DR. FABRYCKY: Thank you very much for that clarification, because the normal meaning of the phrase "bringing into being" is an end-of-acquisition phase activity. After that, we operate a system, we maintain it, we perhaps modify it, and then sometime in the future, we may then decommission.

MR. SHELOR: Clearly our scope here is that there will still be programmatic functions that are required all the way through the construction and placement, backfill, decommissioning, licensing.

DR. FABRYCKY: Good. I think I missed this point in an earlier meeting.

(New viewgraph)

MR. SHELOR: Again, I just put part of this strategy back on and it gives me an opportunity to go back and make a point I forgot earlier. One is that all of these activities -- we have an ongoing program. We have utilized existing policies, practices, and procedures that we have learned over the years in the program, or within DOE, that that is how we do business. So I want to point out that we are not stopping the program. We are implementing this activity so that when we come to a logical point when we can revise requirements documents or revise specifications or change our policies and procedures, then we will go through a change toward action, unfold the changes, and continue on with the program.

So we are not stopping. There probably won't be too many step functions, but this will be phased-in in terms of a way to improve how we do business.

(New viewgraph)

MR. SHELOR: Again, just to emphasize one other part of it, and it addresses the bifurcation, if you will. This graphic can be used to make several different points. For example, if we visualize that the physical system functions are on the Y axis and the programmatic functions are on the X axis, that is fine and dandy. And just to point out -- I don't know if you can see in the back or in the handout -- these functions are like "Provide Quality Assurance," "Evaluate Integrated System," "Identify and Characterize Sites," "Perform Systems Engineering." These are functions that are performed by people to basically design, construct, but not necessarily operate. Operate is a function of the physical system because people are required for that function, so they are part of the physical system by definition. That may be a question that you have later. To clarify that: that is true.

When you look at these, you can see that "Perform Systems Engineering" actually comes all the way down, but there will be a systems engineering component of transport waste, there will be another one to store waste, and so on. So what we can do is begin to identify these work activities, to identify what programmatic function has to be done.

An interesting thing that we approach here is that this process can be carried out, the functional analysis and decomposition, without regard to the organizational structure. We don't have turf fights, we don't have a lot of things. We are sitting out here off-line looking at what needs to be done. These are mission-driven functions that are necessary for this program to accomplish its mission of disposing waste.

After we have done this, then we can come back and look at our existing policies and procedures, how they are being performed and who is performing them, and at least make sure that these critical functions are assigned to someone. If nothing else results from this activity other than making sure that someone is assigned to do the function and they know what that function is, I feel that we will have accomplished one of our goals, to not overlook a critical function.

External relations: This a framework for us to come in and look, because external relations affects everything we do in this system. We need to look at this very carefully in how we do it.

One of the other things that is worthwhile pointing out is that we put an Z access in here. These are the classical management functions: plan, organize, acquire resources, direct and control each one of these work activities. That all has to be done. This is what we normally do when we manage an activity. And in almost any activity, any daily activity, either if it is a large activity, we write plans. Even if we don't write it down, we mentally go through these five steps: we plan it; we organize it; if we need other people, we get them; we acquire the resources, both personnel and hardware if necessary; and somebody directs and controls each one of these activities. So I would like to emphasize that it is the framework and should not be perceived as a rigid framework. This is the framework of those functions that are absolutely necessary to accomplish a mission.

(New viewgraph)

MR. SHELOR: The next question has to do with the large number of requirements. One of the things that we want to point out is that obviously there are a large number of requirements. Most of those requirements fortunately are not on the physical system. A vast majority of them are requirements that need to be allocated to functions on the programmatic side, the requirements on the way people do or how the people function is performed.

Our approach to this is to go through a requirements research, functional allocation, and identify and allocate requirements to functions at the lowest possible level. One thing I want to point out is that in using this approach, it is entirely possible that the same requirement will be allocated to several different functions. But if it is necessary, we need to do that -- and that will be pointed out later in our presentation today -- because it will help us determine if there is a conflicting requirement, because we can then go down and look at it function by function. If the requirements are allocated where they are required on a function, then we can gather requirements and begin to look for conflicts.

The requirements analysis, system modeling, again, are used to identify conflicting requirements and determine if a feasible solution exists. The point here is that the first indication is that requirements research experts and domain experts can look by inspection, gather up all the requirements that are allocated to a function and in the inspection say, "Is there a conflict?" But that is not the final determination.

This process has to carry on all the way through, including starting with a conceptual design. If these requirements are allocated to a function of the physical system, when we sit down and begin our conceptual design and start looking for conceptual alternatives to satisfy this system requirements, we may find that our solution space is severely restricted by the requirements.

Well, then obviously the next question is: What do we do? We need to look at it. Can I reduce my overall cost if I can go back to the authority that originated the requirement and negotiate a larger solution space? It is a very important perspective and a very important activity. When we see this, we need to do that. This is why we have an iterative design process. In a conceptual design process you look at the alternatives, but you don't necessarily say you have to live with all of those alternatives. That is where systems people come in.

Another important aspect that we are doing now, we have a regulatory compliance group that is organized and will remain in effect to track new regulations or changes to regulations up front so that we can at least have a look at whether changes or changes to existing regulations or new regulations are going to cause us conflicts in regulations. But through this tracking activity, we need to be able to feed it back into our system and come back with recommendations or comments to those who are promulgating regulations. As you know, we provide comments on proposed rules and reg guides with respect to regulatory issues. We are going to have a lot of those.

The next question is: What happens if NRC gives us requirements that are just not doable? Through this feedback process we can go to the NRC and petition for a rulemaking to either clarify an ambiguous requirement or to change an existing requirement. The petitioning for a rulemaking is our best solution because the entire public is involved in a petition for the rulemaking, they have an opportunity to comment. The NRC staff then comes up with a final determination of a rulemaking, and we can use that in licensing. We will not have to revisit the results of a rulemaking during the process.

MR. VERINK: Just for amplification, could you give us an example of where that process has worked?

MR. SHELOR: Right now, yes. We have submitted to the NRC a petition for a rulemaking to clarify the ambiguities in the definition of the control boundary around the repository. It may be a subject of another meeting, but we are concerned that the definition of the controlled area, which requires expenditure of resources to build a security zone, radiation monitoring, health effects monitoring and the whole bit, we were concerned that that zone would come out and extend clear out to the boundary of the repository. So we have petitioned the NRC to clarify where the controlled zone is make a recommendation on what the controlled zone is, what the accident dose criteria would be within the controlled zone and outside of the controlled zone but still within the boundary of the repository.

MR. VERINK: How far away do you think the answer is?

MR. SHELOR: I would expect a year. Obviously we don't want to get into the position where we petition for a rulemaking and it takes longer and we submit the license application before we get the answer. I hope that doesn't happen.

MR. VERINK: I hope so too.

MR. SHELOR: But it is a vehicle that is available to us.

DR. PRICE: Dwight, if we turn around and look at this the other way, since some of the conceptual work has really yet to be done from a systemwide view of things, what about the situation where potentially viable concepts are not addressed or exercised because of the recognition of regulations which may or may not be valid but nevertheless exist that preclude, or at least are thought to preclude, addressing a concept?

MR. SHELOR: That is a good point. I don't think we could ever assure everybody that we have given all of them a fair share. I mean, there is the practicality of time and sequencing and the rest of it. I believe that it will be our -- or it certainly is my desire from a systems engineering perspective, to have the ability, again, to come off line and examine those conceptual alternatives that have been rejected in terms of the requirements.

What would happen if the requirements were modified or changed? And what affect would that have on the overall system? Now we are talking about the availability of resources both in people and dollars.

DR. PRICE: Another question I had goes to the issued that you mentioned, the tracking. How do you actually go about doing that?

MR. SHELOR: Well, we will get into it a little bit later, but I can give you part of the answer now. There are several services available now that actually track verbatim text on a computer disk of virtually all of the Code of Federal Regulations, and these are updated. There are promotional services, and the NRC publishes all the updates of their changes to their regulations.

We are not only concerned with NRC. There are many other major activities that we need to track; there is OSHA, MSHA, and the rest of them that we need to track. Our requirements research people will maintain an awareness of these changes. We will contact the authorities at MSHA and OSHA, which I believe are both under the Department of Labor. EPA, NRC and the rest of them that we identify that are using our requirements optimum, we will track those and update those and enter those changes into our relational data base.

I haven't talked about the relational data base yet, but the relational data base will be used in our approach to identify and link the requirement with the functions. So if we see a requirement has changed, we can immediately identify what functions in the total system have been affected and then trace that down through the design and evaluate.

(New viewgraph)

This question is a good one: Will we conduct timely systems engineering? I certainly hope so. The answer has to be -- I have to qualify the answer. We will do systems analysis, we will do trade-off studies, but right now we are playing catch-up a little bit. We are still building our tool box. We have to have tools to do system analysis and system trades. We are still building and improving that tool box. We will conduct trade-off studies at a time required when we are in the selection of alternatives. Quite frankly, we are a little behind the power curve on this and we are trying to catch up as quickly as possible. I really don't know how else to answer it except straight up.

DR. PRICE: Could I point out a couple of features of the question?

MR. SHELOR: Sure.

DR. PRICE: One feature is viewed from the generation of spent fuel. I know that your requirements start at pick-up at the gate, but when we are talking about trade-off studies in systems engineering aspect of it, we were somewhat deliberate in putting that "generation of the fuel."

MR. SHELOR: I recognize that, and I would maybe like to discuss that, because we have done studies in the past, particularly on the MRS and MRS system integration, where we have gone back and looked at the cost to the utilities that provided storage until the spent fuel was picked up and put in an MRS. This is part of a very extensive set of studies that were done for the MRS commission a couple of years ago. We went back and we looked into the utilities.

Looking into the utilities sometimes is very difficult. Now, we can do this off-line from a systems perspective to give us a little more insight, but you run into a lot of problems very quickly. One of the problems you run into is the whole issue of equity amongst the utilities. It is very clear that some of the utilities have already provided for lack of storage. They can store all of the spent fuel that will ever be generated by that plant. Other utilities unfortunately do not have sufficient storage currently available to store all of their spent fuel.

So now there is another interface with a whole utility industry. There is the other issues of not all nuclear utilities are alike; some are investor owned and some are not, and how their costs are treated is somewhat different. Now I certainly do agree, and our earlier analysis on this was from the viewpoint of the ratepayer. The one thing that is common in all of this is the ratepayer -- that these costs are passed to the ratepayer. If I want to examine the impacts of what I am doing, then I should examine that as than impact on the ratepayer. And we have done that. I expect we will do that a little bit in the future.

One of the things that I didn't point out earlier -- and this was debated amongst ourselves when we set it up

-- and that is this physical system function, which is a little fuzzy, called Accept Waste. Now, when we developed that there was a fairly strong argument: Well, why do I need to identify this function to simply transfer title to the spent fuel when it leaves the gate? Well, I argued also very strongly that we should put it there because there is an interface with the utility. We need to have some assurance, for example, that the utility performs their functions in preparing the spent fuel for our acceptance in transfer of title.

So it gets a little fuzzy, but we are trying to manage that definition and what Accept Waste really means. I think that it also allows us information to look back into the utility. As you probably are aware -- the acronym I remember is FICA -- DOE has conducted a study looking at each reactor capability, for example, for crane capacity, whether they can accept what size trucks, legal weight, overweight.

DR. PRICE: We were briefed on the latest status on that yesterday.

MR. SHELOR: I think all of that needs to come in to play. Obviously we need to analyze this and determine if we want to make recommendations to the Congress or other people as to whether the ratepayers' funds in the waste fund should be utilized to upgrade reactor transportation capabilities. That is a very important issue.

DR. PRICE: Your flow is accept, transport, store, dispose. But we wonder about where it starts. At accept, which is what you are addressing to us right now? We understand DOE's position at the gate, but from a systems engineering conceptual standpoint, trade-off study, optimization kind of a view, you can't start at accept.

MR. SHELOR: That's true. We need to know what it is we are accepting.

DR. FABRYCKY: The question that you are addressing -- of course I missed yesterday's meeting on transportation elements -- but really the fundamental issue here is we have a source to sink problem to solve, regardless of ratepayers, regardless of crane capacity. We are talking here about the flow component of nuclear waste disposal problem, only one of three major system components; operating components, structural components being the others. As Dr. Price just indicated, in order to do a proper systems engineering study with trade-offs, with optimization, we do need to work complete from source to sink.

I am glad to hear you say that although there may be some fuzziness -- without the gate or within the gate ratepayers mandate to Congress and so forth -- that you are looking at that fuzzy area to see really where this whole process should begin. Source to sink would be the overall, overriding principal that we really should try to apply.

MR. SHELOR: Exactly. Now, I don't want to complicate my life too much, but it is certainly an issue that I am aware of and one that certainly we won't totally ignore, even though we are not currently looking at it because it is not allowed by law. But one could argue: "Would it be worthwhile to utilize waste fund dollars to examine the design of a reactor and the reactor fuel assembly to make it easier to dispose of?"

DR. FABRYCKY: Very, very good point.

MR. SHELOR: Right now our answer is: "We are not allowed to do that."

DR. FABRYCKY: Regardless of what the law says, maybe where the opportunity presents itself, some pressure, gentle nudging and so on should be exerted to perhaps allow a more complete system study with a proper scope.

MR. SHELOR: Yes. But as a systems engineer, that is the kind of thing that should not be neglected, because we are looking at the total system.

DR. FABRYCKY: To be professionally rigorous we have to speak to these issues, even if we have to do it off line and without pay.

DR. PRICE: The other features I was going to point out are "optimize" and "timely" as important words in the question. Viewing the entire system and then doing the kinds of robust rigorous studies that involve trade-offs to the extent that you are trying to optimize this complete system that we are just talking about, let me read you a question we asked John Bartlett. I asked John Bartlett on the July 16th board meeting and his answer --

MR. SHELOR: You will give me his answer too?

DR. PRICE: Yes.

MR. SHELOR: Thank you.

DR. PRICE: Yes, I will not leave you there without knowing what he said, nor ask you to answer that question, but really for a point of clarification.

I asked Dr. Bartlett, "To what extent in your perception is the cask procurement program, that you see a need for in order to get a fleet on line in 1998, going to be linked to and dictate the engineered barrier system alternatives?

Dr. Bartlett's response was, "That is a good question," which reassured me. Then he said, "This is the big system linkage in the trade-off studies where we really need this robust and effective and insightful system trade-off analysis. You will find this addressed at some length in the draft mission plan amendment." Then he went on to expand further his answer to the question.

Did I miss something in the draft mission plan amendment? Because I didn't see reference to these robust system trade-off analysis.

MR. SHELOR: He overstated what he thought would be in the draft mission plan amendment. I would certainly not suggest that the draft mission plan amendment would be the source to understand all that we are going to do. But let me, again, say --

DR. PRICE: Let me just ask you: Should that be in the draft mission plan amendment, just given your last statement?

MR. SHELOR: Only at a very high level, yes. I think that the mission plan amendment should only address the fact that it should be done and it should be done robustly, but certainly not the details of what will be done. But yes, to that extent. I am not sure it is in there.

DR. PRICE: Well, I interrupted you. You were about to say something.

MR. SHELOR: Yes. With respect to this question, and I think timeliness, the robustness and timeliness are both critical issue. As I said earlier, we are starting a little behind the power curve.

We are looking at two things. Number one, with respect to the repository, which is now driven by site characterization, we need basically to temporarily delink the repository from the MRS and transportation, only temporarily until we have time to catch up. There certainly are linkages that we need to address now between the repository conceptual design, the ESF underground facility design, and the site characterization surface based testing design. Those linkages need to be established now because our program is out in front of us a little bit. We need to ensure that those requirements of the repository, that the repository has to meet, are transferred and considered in the ESF design as well as the surface based test facility.

Maybe I don't have universal agreement, but my contention is that a drill hole is nothing more than a facility to take a test measurement. So I think the location of the drill hole and all of the roads, pads, and equipment to support drilling of the hole is a construction of the facility to take a test measurement. And to me this is not a novel idea because the NRC does have a requirement that to the extent practical we will not drill a bore hole that will end up in a drift in the repository.

So there is a need to coordinate the location of these bore holes with the geologic repository operation area underground layout and ESF. It is that kind of thing.

Getting down to a little bit of the detail, the other part of it is we don't have a volunteer for a host site on the MRS yet. The MRS is very important; it is high on our screen. The MRS cannot function without a transportation system, and transportation system is a key part of -- obviously the transportation and MRS may be an important component of the national energy strategy to maintain the optimum in this country. These things are certainly important.

Unfortunately we have just started and gotten through a little ways on our functional decomposition of the transportation element. We have gone through the system requirement, FRA decomposition for the MRS, and we are beginning to go work on the specs. But those are our focuses, certainly things that we want to get done as quickly as possible.

In the meantime, we are still building our tool box. By building the tool box, what I mean is that to conduct system trades and do systems analysis we need for this program a common data base, for openers. There needs to be a control data base so we know what our assumptions are, those assumptions are controlled, they are replaced with measured values when we obtain data, and that we control that process.

The data base has to become. We don't want to get in a situation where every time we do a study we go out and invent a new data base. We need the data base. We need to control the information on a source term count. What are all of these assemblies? What are their physical characteristics, burn up and the rest of it? We need that information.

We also need to develop algorithms, for example, and procedures for estimating costs of components. When we are in the conceptual design stage, it is really that; these are sketches. There are certainly techniques available that people use every day for estimating cost based on analogies: I need a tank; okay, I know what tanks have cost in the past. And the uncertainty in that cost estimate in the conceptual design stage is large: 25, 30 percent. But now, when I go to Title I, I have a few lines, I have layout lines and I can begin to make better estimates. Then when I go to Title II, I should be at a point where I can go get quotes from vendors and begin to determine some of the costs.

So the uncertainty of cost comes down. All of this needs to be considered in these studies as to where we are with these conceptual Title I, Title II designs. In addition, to pull all of that together, we need a consistent code of accounts. In the past I have been in situations where we have tried to compare cost estimates of the facilities prepared by other AEs. If they all use a different code of accounts, it is a problem. It is hard to make that comparison. So we need to standardize how we do cost estimates and to control that and to continually update it depending upon what stage of the design process we are in.

DR. PRICE: So you indicate really there is a need to get all of these tools, as you call them, into the tool box in order to be able to do an integrated look at things, and especially when you are trying to do trade-off studies at the conceptual level. Is that a fair statement of what you have been saying?

MR. SHELOR: Yes, if except to do a credible job we need our tool box. We are going to look at it anyway, and then we are going to improve how we like at it. We are going to take looks and we will use what we have available right now. But now we are going to have to use, obviously, some judgment as to how good a look that is, what our tools look like when we consider whether we want to make a major change or change direction. We need to know what the state of our tools are.

DR. PRICE: Part of your answer has been based around being able to approach a conceptual look at things in a proper way and make proper comparisons.

I would like to address the issue of the conceptual versus the program streaming along and marching to dates that are set and hopefully trying to make these dates realistic. Some of them may be required regardless of whether or not they are realistic and anyone believes you are going to get there.

We get trained in the program to march to a date that, when you get toward it, may shift. That has sort of maybe been the history in the past. You have to march toward this date and you have got to run, and this is a date you are working toward, and, therefore, you can't do this and you can't do that because this is the date you have got to meet. And as a result, some of the conceptual work, though the program has been in existence, simply has not been done. Isn't that a fair statement?

MR. SHELOR: Some of the conceptual work for the total system requirement, that is correct. And you are correct. Let me phrase the answer in two ways. First of all, if you don't set dates, what you find is that the job expands to fill the time and the dollars available. Now, that is a very fundamental thing, and we can demonstrate it. If I have dollars and time, I can fill it up. So there is a need to plan and schedule and establish dates. Some of our external controls are, in fact, dates that we have tried to deal with.

However, I would also submit that in going through the process, if we can have the proper considerations in our planning and scheduling so that we at least require ourselves to look at concepts and evaluate concepts and select them and record the basis of our decisions in selecting concepts to move forward with, and if you can't select from among all of the conceptual alternatives it is possible to carry two or more into the next phase if you have to, if there is information that was lacking, what we have to remember is that even once I go in to Title I and even though I am in Title II, that doesn't mean I can't change.

DR. PRICE: Well, in some ways, though, if you march along you do narrow your options down to the extent that if you had taken the original conceptual view without this march being involved, you may come up with an entirely, dramatically different system than the one that is dictated because of these schedules that have been set and then the demands that those schedules place.

I am not saying that you don't set schedules, but nevertheless, what is happening with the 1998 date that we are looking at using present state-of-the-art casks, which may then say something about what the MRS function is going to be and may indicate what cask maintenance functions will be. You then start building your plans rigidly in these directions and they become rigid after a little while because you now have these things into the system and these things must be dealt with.

If you were to step back and take a look at the total system and the alternatives and do the optimization studies, you may come up with something that would result in no MRS, or an MRS that functions entirely different, or receiving facilities at Yucca Mountain different, placement facilities quite different. But without doing the trade-off studies, you never have the opportunity to look at that because you are marching to this beat.

MR. SHELOR: Well, obviously you are absolutely correct, and I agree. But there is a trade off in the analysis. That is why we have program directors that have to evaluate how well we have done that and how we can meet mandated schedules. 1998 is a mandated schedule. Now, there are obviously two answers: You either compromise how you approach it by maybe not examining all of the alternatives, all of the possible alternatives and make a reasonable selection; or the other one is to go back to the originating authority, which in this case is the Congress, and say, Can I get relief on this mandated schedule? How do we handle this? That is the process that is available to us.

We have to make a determination whether or not the existing cask, the existing cask fleet, the existing technology for handling cask maintenance and the rest of it are constraints that are going to be in place. That determination is something we need to make. It may have been made unconsciously, or not deliberately, but in assuming that existing cask fleet, transportation and technologies certainly can be accommodated. And if something else comes along that is better at a later time, would that preclude us from upgrading to that system?

I haven't gotten to it yet, but I have another slide that is a very important one. I think that in our design process we have to keep an eye out and keep looking forward for new technologies that are becoming available. And maybe our design needs to be done deliberately to accommodate changes or upgrades.

DR. FABRYCKY: Can I ask, and I hope this is not too much detail, but your DOE RW-0295 P report, total system life cycle cost -- I have not had a chance to look at this -- but would it be worth asking for just a brief description of how that total system life cycle cost analysis was done? Was it done from a baseline concept? Were there some trade studies maybe considered in that total life cycle costing?

DR. PRICE: is this question too detailed at this point?

MR. SHELOR: That is an excellent question, but it also gives me an opportunity to give you a view to that, and it speaks directly to what I was referring to earlier. Within DOE, in the past, we have three things: We have a cost baseline, we have a total system life cycle cost analysis, and we have a fee adequacy analysis. Would you believe that all three of those use a different cost base and they were done differently by basically three different people?

DR. PRICE: Yes, we could believe it.

DR. FABRYCKY: We gather from that that you are not at all happy with that state of affairs.

MR. SHELOR: That is correct. We are taking steps and continue to take steps to correct that. That goes back to we will have a common cost data base with procedures and policies for developing the algorithm so that the projects will have the MRS transportation, repository, will have the responsibility for estimating a cost based on their technical baseline. Then we can roll up in them a total cost and have that available for systems engineering to use in system trades. It is absolutely mandatory.

Now, I would really rather not say anything else because I have not had direct responsibility for TSLCC, but that is one of my main concerns with TSLCC and the adequacy.

DR. FABRYCKY: Would you name again the three domains that are independently developed? One was the 295 P report. I see the other one here, the 291 P. What was the third one?

MR. SHELOR: Our cost baseline.

DR. FABRYCKY: That doesn't have a report number, it is simply entitled Program Baseline Document 1991.

MR. SHELOR: Yes. They are not necessarily consistent. There may be parts that are, but they are not necessarily consistent, and we need to correct that.

I still have one more question to cover here.

(New viewgraph)

This one we have talked about before, but as you can see with all of the feedbacks and the rest of it, from the mission need to the functional analysis, functional allocation of the requirements, both externally imposed and internally derived requirements, this design synthesis -- this is your conceptual design. You come up with the alternatives and you have some basis to make a selection and do the system integration and then the system definition. All of these need to feedback for evaluation/optimization with the trade studies, risk analysis, and support.

Down here is another tool box. This particular one doesn't have it, but the other thing that has to feed into this is another box down here that says potentially new technology that might be available in 10 or 15 years. That should be considered.

DR. PRICE: We certainly do agree with that.

(New viewgraph)

MR SHELOR: I suspect this is another complicated question where the answer is complicated. But, yes, we need to synchronize all of these decisions. Right now we are doing a little juggling in our synchronization because we are not far enough along to start from a top-down system trade. And as I said, we are going to have to separate the repository out here from the MRS and transportation until we have time to put it all together.

There are a lot of interesting things to look at in terms of the total system that we will try to get to as quickly as possible. But now, again, our program is schedule driven to a certain extent, and that is not to imply that it shouldn't be schedule driven, because I also believe that you need to show progress. You can't wait in making progress until we have exhausted all possibilities. You understand that.

It is important, as I have said before and will say again, in this functional analysis to identify and have the ability to trace the dependencies amongst functions, because if we have identified the dependencies and the obvious interfaces, then if we have a conflict in requirement or a change in a requirement of one function, then we should be able to identify all other functions that are dependent upon that function. It will help us in our analysis.

(New viewgraph)

Okay, after my 15-minute introduction, I just want to point out that Bill Lemeshewsky can give us where we are now in the physical system, functional analysis, preparation of requirements, and specification. Steve Gromberg will give us the same thing of where we are right now in this programmatic analysis. I will come back again and talk about requirements management, maybe not in as much detail as I just did, but at least the same amount. Then Bill Bailey, I think, can tell you what we have planned now in the near term, priorities, what we have selected and what we are going to be doing. Then Bill Hoessel will come back and sub for Thomas on decision-making.

MR. LEMESHEWSKY: I am going to give you a little brief background on the physical system functional analysis and a lead-in to a question related to trade studies.

(New viewgraph)

I have three slides on the background, and I want to focus on the link here. On this first slide is a background of what we have been doing for a year, the goal of trying to do a functional analysis and integrate the physical system functions with the requirements that are listed in many different documents.

Since August 1990 our goal is to revise the existing technical baseline for the program and create a series of documents that you may be familiar with, existing families called the WMSR family.

Third, we used a QA qualified team in order to conduct a functional analysis of each individual function, bringing in the program people in that area, whether it be the technical experts from the laboratories or the line personnel from the DOE people, from either headquarters or out in the field, to try to get the best focus on all the issues in one series of meetings. In general we have anywhere from four to six meetings on a particular function.

(New viewgraph)

The second slide is the FRA approach of the decomposition we did for the functions, requirements, and architecture. We did this for each major function in the program. It is an iterative stage, as you all may have remembered my earlier talk when I showed the two horizontal lines of the trade studies coming into the requirements and into the selection of architecture.

The bottom says that we prepared reports. Each of these reports -- and I have one with me -- is a system requirement type of document where it identifies the functions and the particular requirements that have been assigned to that function. We go down to maybe as many as 0 functions. Some functions don't have requirements yet because we have looked at regulations. Some of the requirements would affect how well you are going to do something, which would be a decision by the program to impose some kind of performance criteria.

(New viewgraph)

The next one is the current version of our top level functional flow diagram, showing those four major functions, the interfaces that we tried to evaluate to establish our major interface requirements. We have then decomposed each of those functions down to as many as seven levels under an individual box. And this is kind of our top level wiring diagram, our interfaces, our input, fuel sources, that type of stuff, leading into the status. We have not finished all of these.

(New viewgraph)

Where we stand to date on our document is shown on the next slide. Basically we have gone through our technical review and change control board review for the first and the last three documents. They have all gone through that board, wherein the comment resolution process of trying to resolve comments, where we just cannot clearly agree on what we should put in certain documents with the particular people who are on this board, so we go back to a full board meeting. We have done that by circulating paper and having one-on-one meetings. So the first one is a little bit further than the last three. They have all gone through this series of two reviews.

Currently we are doing, as Dwight Shelor has said, the transportation functional analysis. We have had three meetings on that. We are a little bit more than halfway through. We have not started accept waste, which should go out sometime next month.

(New viewgraph)

To lead in from there: How are we going to use these types of system requirements documents? This next chart is a pictoral. Along the top half is a functional analysis approach of taking requirements that we have grouped and trying to then allocate them and come out with a system spec against, if you want to call it, a facility. Part of that then is what you all know as a conceptual design process for designing these facilities where you have to look at alternatives. The tie for the trade study here is between the allocation of requirements from our documents into ultimate system specs and then the trade-off decisions between alternative approaches has already been discussed. So basically this shows the two horizontal paths. You need trade studies to be conducted to resolve issues.

I need to say -- and this is a lead-in to Bill Bailey's pitch, which should answer some of your questions on tools and approaches -- when we did our functional analysis, we went through the FRA approach and we just could not get to the bottom of all activities of the decisions that had to be made in the program. There are issues that have not been closed. There are parts of the program that have been thought of, but not hardly designed in the concept yet. They are still achievable, but they are not scheduled in the near term.

We are basically focused on the regs that we have for the performance of the program, but we have not captured enough of the internally derived performance criteria and our documents have either reserved sections of PBDs -- one thing we will hear about from Bill Bailey is our throughput numbers. We can't write an individual store waste spec for the MRS without putting in ultimate throughput numbers, and that is the need for one of the trade studies that we will talk about. So our documents need more work.

(New viewgraph)

This slide just says trade studies will help in the allocation of requirements across the program as well as selecting between alternatives.

(New viewgraph)

In the trade study process, what we have tried to come up with is generic minimum criteria by which we will identify the objectives of these studies, identify configurations -- and you will hear some more about that from Bill as to what we are looking for -- identify potential solutions that would come up with some common way of evaluating them, then perform the decision analysis to try to pick a best mix solution. There are differences of opinions on how to do this. I don't want to put these down as a generic approach. Each study will have to be tailored a little bit to make sure it is done in the right sense.

(New viewgraph)

In these documents that we have put together, we ran straight down the left-hand side, the FRA approach. Where we did not have studies, decisions would try to document that and move on and compile a list of 100 or so issues and studies that should be looked at.

So the proper way -- and we are going to go back either in these documents or in the individual system specs -- is to feed back this extra data that we obtain in these trade studies for issues that will help to further define the program, further define the requirements for individual facilities, define how we are going to operate. So going from right to left, the trade studies, to assess alternatives, allocate requirements across various paths of the program that are still within, if you want -- decisions that have not been made for allocating requirements.

Obviously, as you have heard the different approaches and if you have a different schedule, you might look at things differently. I think there is still enough time in this program that there are various alternatives to look at in how facilities are going to be designed, let alone operated. We are trying to bring some measure into prioritization into those key studies that hit most of the system elements equally.

I think one of the key ones that we have raised and have constantly tried to focus on for several years in this program is throughput rate for the program; not just pick-up, but delivery, storage, processing, and placement rates. You can have a different number for all of those and create all kinds of suboptimization approaches. Bill will talk to you about the models and tools and some of the history of what has been done.

(New viewgraph)

In summary, what we have learned from functional analysis efforts and our goals is to make sure it is traceable all the way down to the seventh level of detail, and we know there are levels that can go beyond that in our documents. We want to capture the interfaces. It is a critical area for where we are in the program between ESF as well as MRS, to make sure we don't prematurely take away some of our options in this program. So we want to be very much concerned about our interfaces and the requirements for them.

We set up through the documents the flow-down of the ability not just only to monitor changes and requirements, but be able to process those changes. As the federal regulations changes, we want to be able see where in the program it affects that function and be aware of it and not be unduly impacted, because these regs are changing as well as new regs coming out, and there are a lot of other things that are not just in our control, but EPA related stuff that will affect the way we operate these facilities. So we want to keep on top of that. We want a living system type of thing.

So the last two -- if I can just stress the fifth bullet down there -- to bring in these people to help put out these documents from all the different perspectives, from the technical folks, from waste packaging to the processing people to the geologist. We need help to bring them in and try to capture the issues and the thoughts, because there are different parts of the program that are going to be designed soon and others that won't be locked in for maybe ten years. Just state-of-the-art may be different, let alone the approach that may be thought of.

Obviously we need a full set of comprehensive documents from licensing to trace all of the requirements from these top-level documents down to the individual facility, procurement specs and operating approaches, so we can go back and show people that we have not missed any requirements and that we are sure that the requirements have been properly allocated to those functions at a particular facility, that they were done properly, I guess.

Are there any questions?

DR. FABRYCKY: You do have a slide here on synchronization of decisions for the system functional analysis, physical system functional analysis. Could you speak further to the timing back in an earlier slide on physical system -- I am referring to this one. What have you done thus far to bring the time dimension to your physical system functional analysis as to precedence relationships and so on?

MR. LEMESHEWSKY: We have focused on the requirements that have to be in place when the system is operating. If there are a certain deciding type of requirements, if there are certain design requirements that are in Part 60, certain exposure rates, we are trying to tie them all in and look at the system at the operating -- we want to have all of the requirements in this document that have to be met at the time of operation, which may be some of the obvious sitings for the repository.

If there are key rejection criteria for the siting, even though you have picked the site and started construction, we still want to have that requirement. They do not reference to 960, but still reference to a facility requirement or to a construction area. So if in the construction you find gold or groundwater or something like that, you reassess your load, but you don't go back to 960 and say forget the site for that.

If under all the data that is obtained -- you want to put all the requirements in there and keep them in until they are not necessary. We at one time had talked about having requirements for different phases in the documents, but we wanted to focus on the most critical set of requirements, which are those that have to be met when the facility is processing waste. So that seemed to be the critical time. If you could meet those, you would hope you could meet all of the earlier phases.

Now, there are some requirements in earlier phases that just don't exist, as I said, when you are operating. But we wanted to put together a full set of those documents. To date, the program is working to an existing set of technical baseline documents that is incomplete. It does not have a second tier document for the transport waste. So what we are trying to do in this, if you want to call it midstream approach, revise this baseline before we significantly jump into the design efforts, so that the design efforts will feed these documents and fill in the balance of requirements that will come out of either AE studies or the trade studies that we are doing in parallel.

So we have an architecture in these documents, and we want to build upon that if the original existing architecture is a little bit too light for us to completely trace requirements all the way down to field level facility documents. Especially for licensing we want to make sure we can roll this up and down properly to explain to licensing people where these requirements were met and what approach was used.

DR. FABRYCKY: It is a little more complex answer than I was expecting. Could you put the functional flow chart up, physical system, manage waste disposal? It is clear from this chart that one must accept waste before transport can take place. There seems to be a natural timing at the very top level here. To what extent have you done timing analysis at lower levels?

MR. LEMESHEWSKY: In terms of operating

requirements or what the process flow?

DR. FABRYCKY: Yes.

MR. LEMESHEWSKY: We have some tools that will attempt to do that, but I don't think we have -- because of design concepts still being in the air, it would be fruitless, I think, to start focusing on what we do first internally.

DR. FABRYCKY: Part of the basis for this questions come from these reports that I have been asked to look at, the life cycle costing. In order to do life cycle costing one needs to see what activities and what functions ought to be performed when, so I guess I will need to look into it in more detail to see in these life cycle costing reports --

MR. LEMESHEWSKY: In another answer to the one that Dwight gave, the TSLCC approach assumes a very detailed approach of each facility's operation, which may be only one of many solutions in order to price, at a very excruciating level of detail, the cost of the system. It by no means is an attempt to lock us in, but in order to make a decision of how many guards are needed to escort a cask on a highway, somebody has made that number, how much they are paid on an hourly basis and how many hours they have worked for each cask shipment.

DR. FABRYCKY: Is that level of detail in this life cycle costing?

MR. LEMESHEWSKY: Yes, in many cases.

DR. FABRYCKY: I will have some interesting reading.

MR. LEMESHEWSKY: You will need more paper, but it is in that, down to the hourly pay of the number of guards and what kind of vehicle they drive and what the maintenance cost of the vehicle is.

DR. FABRYCKY: If we are at the conceptual level, is that level of detail appropriate, or are we locking in too soon?

MR. LEMESHEWSKY: Their point is that in order to be able to get a cost figure, they needed a number. When you get into it, where do the numbers stop? Fortunately, they have gone beyond the level of detail of knowledge of the program to come up with -- it is an assumption set, in order to base a cost estimate.

DR. FABRYCKY: Wouldn't parametric studies be more appropriate?

MR. LEMESHEWSKY: In my opinion, yes. But as Dwight mentioned, we need to tie these together. In order to come up with a significant figure number for the cost of the programs, someone has to estimate the cost of fabricating, the cost of transport, the cost to fix it.

MR. SHELOR: And those are all based on assumptions

DR. FABRYCKY: I guess not now, but maybe later we need to ask the talent behind this: Is it traditional accounting, or is more engineering-economist type, or micro-economist?

MR. LEMESHEWSKY: Accounting with the source of

data that may not always be current, but if somebody needs the cost of a waste package, they have a number in there for it, whether it is close, whether we know what that cost is.

DR. FABRYCKY: There is a second concern there, that this level of detail that we are describing here now can act as an inhibitor to creativity.

MR. LEMESHEWSKY: Yes.

MR. SHELOR: Particularly in the TSLCC. There is another point I would like to make, and I am sure it is one that you are making, or at least alluding to, and that is that it is a fact that can be demonstrated by going back and looking at other major programs and projects that in reality 70 to 80 percent of the cost of this program will be established in the conceptual design phase. The other interesting part to look at that we already know about on this program is that 60 to 70, or maybe even higher percent, of the repository costs are operational costs.

So it is critical, in my opinion, that we analyze the operational requirements of this facility as early and quickly as we can to help guide our selections both in the conceptual and the preliminary design phase to control costs and to know where we are going.

DR. FABRYCKY: That is an astute observation, Dwight. The cost committment that is very high early on in a program, regrettably we know so little early on. So we need to accelerate our look-ahead capability and our knowledge of what we are doing so we can decelerate the commitment curve. Then the accounting people, of course, will accumulate cost as they occur, and there is not much we can do about those and that is not very useful in decision-making except in a historical sense.

MR. LEMESHEWSKY: I had a point in there that TSLCC has to report costs of the program to Congress on a quarterly basis. They have to come up with a number that has to be based on assumptions. If we had the waste package design today, they would be asking for costs. They were asking for that cost four years ago. They come around and say, "What is the update on the latest waste package cost?" People give them a round number and they say, "That is fine. How much to make it? How much to ship it?"

At some point you say, gee, is all this necessary? But in order to come up with a total as to where you are looking at, everything being transported around where there are raw materials or the cask on highway, we need a number.

DR. FABRYCKY: I am getting even more worried about this whole area because of the mindset that this level of detail is creating on the system concept of flexibility of trade studies, creativity, new technologies that need to come to it. I am concerned about that.

MR. LEMESHEWSKY: We have not let the assumptions in that document stand on thinking, but they have no objective. They have to put out a cost report on a quarterly basis, whether it will be the ultimate cost of the waste package. They are doing the best they can with the information that is available.

MR. PRICE: The assumptions are made out of a sense of immediacy, and then the assumptions become part of the permanent acceptance and they become the system sometimes. I am concerned that we run into a number of things that seem to lead toward sacrificing the permanent on the altar of the immediate.

MR. LEMESHEWSKY: I notice he is focusing, is proper and correct. I cannot do anything other than agree. You will hear some of our trade studies and the tools that we have developed and we will look at those from Bill Bailey later.

Any other questions?

(No response)

Thank you.

DR. PRICE: We did originally have another speaker scheduled, but I think we can go ahead and take a break. You speakers take so long. We will take a 15-minute break. Let's come back straight up on the hour.

(Brief recess)

DR. PRICE: I believe our next speaker is Steve Gromberg.

MR. GROMBERG: Good morning. My name is Steve Gromberg. I am going to talk about the implementation and the status of the programmatic functional analysis. Basically the two things I want to try to cover is to give you a very brief summary of what I presented on July 15th at a previous TRB meeting and then describe how the programmatic functions and requirements are planned to be integrated into the ongoing program, and hopefully through that I will show you how we will bifurcate, if you will.

(New viewgraph)

The first couple of slides are the summary. OCRWM is committed to systems engineering. We have issued a Management System Improvement Strategy, and it has identified physical systems and programmatic functions. The programmatic functions are required to bring the physical system into being, as we have talked, and we have committed to conduct a functional analysis to identify programmatic functions, their interfaces, dependencies, and subfunctions.

DR. FABRYCKY: Quick question. Does the Management System Improvement Strategy have contained within it a systems engineering management plan?

MR. GROMBERG: No -- well, it does?

DR. FABRYCKY: Known as SEMP, S-E-M-P. I've heard there is something in draft form.

MR. SHELOR: The answer is clearly, yes. There is a program function referred to that provides systems engineering, and that will lead you directly to a systems engineering management plan.

DR. FABRYCKY: Does a draft exist?

MR. SHELOR: Yes. There is a baseline document that has been in existing for about two years. It is under revision at the current time. I would expect that we will issue that possibly in two phases: an interim revision and then another revision in the next few months.

Let me explain. Our current hierarchy really consists of, if you will, the NWPA, the mission plan, and then what we call the program management system. The program management system manual basically contains the technical and management document hierarchy and outline of the documents and responsibility matrix, or who prepares the documents, who reviews it, who approves it, and outlines basically all of our management document requirements that are in existence today.

DR. FABRYCKY: I want to be clear now. I am asking specifically for this commitment to systems engineering. Does a systems engineering management plan exist within the PMS framework?

MR. SHELOR: Yes, it does. And the systems engineering management plan is a separate document. It is referred to in the PMS; it is called for and referred to.

MR. GROMBERG: I misunderstood your question. I thought you asked if it was contained within the MSIS. But we do have a control document called systems engineering management plan that is, as Dwight said, in the revision process and that will be issued and it will include the things that are derived from MSIS.

DR. PRICE: When is this going to be?

MR. SHELOR: We can send you a copy of the current SEMP as soon as they get back.

DR. FABRYCKY: TRB was not able to provide a copy for me, TRB staff members.

MR. SHELOR: Well, we certainly can.

DR. PRICE: But you will send us one. The revision is due when?

MR. SHELOR: There may be an interim revision in about a month. And then our M&O contractor is working on a substantive revision to both PMS and the SEMP. And we will be happy to send copies when they are out. But I will send you the current PMS and SEMP.

DR. FABRYCKY: I have a copy of PMS.

DR. PRICE: SEMP is what you need.

DR. FABRYCKY: Right.

MR. GROMBERG: And let me just say, those are in draft form so they could be changed between the time you see them and the time they actually become controlled by program.

(New viewgraph)

The Management System Improvement Strategy in identifying programmatic and physical functions provides a hierarchy of the 16 major programmatic functions. Those are listed here. We've put them in hierarchical form for the purpose of conducting the programmatic functional analysis to group them by their common functions, so you can see system configuration, system implementation, external interactions, and management support functions.

(New viewgraph)

Now, of those functions, we have conducted seven analyses workshops and have some documentation in preliminary form going this fiscal year. You can see those primarily fall into the system configuration and program control areas and external interactions through regulatory compliance.

(New viewgraph)

I want to change the focus of the presentation from functions to requirements. In doing so, what I want to show you is somewhat of an evolution from the current baseline to how we plan to evolve the physical system and programmatic analysis. The current program technical baseline is called the Waste Management System Requirements, or the WMSR, as Bill alluded to, and the hierarchy is presented here.

There is an overall system and a complimentary system description document. There is a lower level transportation MRS and MGDS set of requirements. The transportation system is not issued at this time.

What the WMSRs do is they allocate requirements to very general level functions. They provide very broad requirements text, and by that I mean examples, to really emphasize the point, you shall comply with 10 CFR 1022, something along that line. Most importantly there is no distinction among the requirements, physical system and programmatic requirements; there is no distinction between those.

(New viewgraph)

Through MSIS there was a need to identify different functions, and these were based primarily on the different missions between the program and the physical nuclear waste management system. Very quickly, physical system functions are those that pertain to the physical elements of the nuclear waste management system which satisfy the waste management and disposal mission. Programmatic functions are those that pertain to OCRWN activities conducted by staff, resources, in order to bring the nuclear waste management system into being.

(New viewgraph)

The function requirements, architecture approach: From functions you can allocate requirements. We have a process of requirements, research process, which does an initial allocation of requirements. How they determined that is somewhat the subject of this bifurcation. Physical system requirements are those requirements that pertain to the operation and decommissioning of an item, structure, component, or their interfaces used in the management of nuclear wastes. I apologize for the typos.

Programmatic requirements are those requirements on the activities performed by OCRWM to develop, acquire, coordinate, or construct the physical system elements.

DR. FABRYCKY: Just a small point: The word "physical" needs to be interpreted, I gather, quite broadly here to include people, information?

MR. GROMBERG: That's right.

DR. FABRYCKY: Good.

MR. GROMBERG: Those things that directly impact on the physical elements, so that would include operating personnel and specifications that they use to operate the equipment in that form of information that you are looking at.

(New viewgraph)

Where we are leading to: The next step in the evolution, in order to work with the ongoing program, is to develop an updated set of program level requirements documents. There would be lower level requirements or specifications that derive from these upper level documents, but the basic shape or framework of these requirements is similar to the WMSRs. We have an overall system component. We have separated, because of the allocation of requirements, a physical system requirements document, a programmatic requirements document. And you can see that those are contained at each level of the hierarchy.

(New viewgraph)

The purpose of the programmatic requirements documents is primarily to allow transition from the current technical baseline to the system requirements baseline, the one that I just showed on the last slide. The programmatic requirements documents complement the physical system requirements, and so the two taken together provide the full set of requirements that are applicable to OCRWM or the physical system.

We have allocated programmatic requirements to the top 16 level programmatic functions. We haven't completed the lower level allocations yet. And we also identify specific requirements text applicable to the OCRWM programmatic functions.

(New viewgraph)

The status of the programmatic requirements documents is that they have been issued for technical document review in accordance with our quality assurance procedures, and that was issued for review on August 26th. Now, we have identified over 5,000 programmatic requirements from over 200 source documents. So you can see, as Dwight said, the majority of the requirements are on the people performing the work, not on the physical system. In many cases those are procedures that are required on us from DOE orders or regulations, and it is obvious when you look through the document.

These are consistent with the physical system functions, as I said before. There is an overall system volume, accept waste, transport waste, store waste, and dispose waste. The one difference you would notice in the chart is that there is no ESF or exploratory studies facility programmatic requirements document. The ESF is covered as a programmatic requirement that derives from the disposed waste requirements through the characterizing of the site.

(New viewgraph)

I am going to shift again a little bit. We have done seven of the functional analysis workshops for the programmatic functions. We have about nine more to do. What I am trying to show with this slide here is what the general shape of the functional hierarchy looks like.

The example I have used is Ensure Regulatory Compliance. It tends to fit in with the general discussion that we have touched on here, and Dwight will cover it a little bit when he talks about requirements management, and you will see some of the points in the lower level functions he will touch on as important functions that need to be formed.

Examples would be compile and maintain candidate requirements; evaluate the requirements; resolve rejections, conflicts, and ambiguities; establish bounding values for the measures. All those things are incorporated, so that is why I wanted to use this as an example.

Now, in addition to the hierarchy -- and let me point out that this is roughly a third level hierarchy; it goes down quite a bit lower, but I wanted you to be able to read it. If I put it all on one page you wouldn't be able to read it. In addition to the hierarchies, we have identified these functional flow block diagrams. Bill put one up which was a series of blocks and showed all the interactions, the constraints, the information flows between the functions.

(New viewgraph)

We will have this available ultimately for all 16 programmatic functions, and then what we would do is evaluate these. The keys are to integrate these process flows using dynamic modeling. An example would be: there are data needs from the design and testing activities that come into putting together a permit for a regulatory compliance activity; there are strategies and plans that need to be available and developed by other functions in order to support the work done in other areas. And so those interfaces through the forms, primarily of information flows, are very important.

You look like you are going to ask a question, Dr. Price.

DR. PRICE: Yes, thank you.

If we could go back to that previous slide. If you go to Develop Compliance Approach and go down to the third bullet underneath that, Identify and Reconcile Compliance Alternatives, is there part of that -- and I am assuming from what was said before, some part of that change regulation -- is there in this thing, Ensure Regulatory Compliance, any way to go up that feedback loop to change the regulation?

MR. GROMBERG: Yes, there is, but those are treated in the form of alternative options in order to comply with the requirement. In other words, you have different alternative methods to comply with the requirement if one of those alternatives could be to petition the agency that established that requirement for rulemaking. Like I said, the detail is in the lower level functions; it doesn't necessarily show up here. But presumably under the area where you have that particular function, has lower level functions that come out of the functional decomposition that would allow from that. We are certainly not precluding that possibility.

(New viewgraph)

We would integrate the process flows. We would compare the processes to the existing program processes, and then we would make any document improvements. Any documents that we prepare that are technical are reviewed under quality assurance procedures, and any documents that are ultimately going to be controlled by the program would be approved by the Program Change Control Board and those procedures that apply to that.

(New viewgraph)

Once we complete all the functional analysis we will be able to refine the allocation of requirements to the lower level functions, which is a thing we haven't been able to completely finish yet. We will be able to refine the allocation between physical system and programmatic functions, and we will be able to look at these process flows to define the programmatic functions at all levels to establish these hierarchies, identify information flows and dependencies between the functions, which we will find is a very important part of this activity, and like I said, also allocate requirements to all of the functions. Some requirements that we allocate to functions may not be from external sources; they may be identified internally. Presumably every function needs some way to measure its performance.

(New viewgraph)

Ultimately the final step would be to take the programmatic functions and requirements and document them through OCRWM program policies, plans, and procedures. These plans, procedures, and policies would first be established or referenced at the highest level through the program management system manual. In addition, the PMS would identify organizational responsibilities, document preparation, and review responsibilities, and programmatic functional interfaces.

(New viewgraph)

Then finally, in summary, I wanted to show you what our plans are for FY '92, and that is to complete the functional analysis workshops for the remaining nine programmatic function; to complete the documentation of the integrated functional analysis, the analysis between functions; and then to incorporate the analysis results into program documents.

Can I answer any questions?

DR. FABRYCKY: Bullet number 2, "Complete Documentation of Integrated Functional Analysis," could you elaborate on that further? Is that physical system and programmatic? Or is that within each subset?

MR. GROMBERG: Right now there is a need to integrate the physical system and the functional analysis, but this refers to integrating the analyses that were done for each of the 16 programmatic functions. The way the analysis has been done is we take a function at a top level, like control regulatory compliance or provide program control, and we decompose those functions.

One of the things that we find is that there are information needs, and primarily it is in the form of information needs -- data, procedures or policy, whatever the case may be, strategies, plans -- that come from other areas. In order for the whole system to work, we need to integrate between all of those different functions to identify all the information flows.

The example I used would be if a person working in regulatory compliance needs to prepare a permit, they need to have design information, they need to have site information, and that depends on design and site people to provide that information to them so we can put a permit together. There are timing considerations, there are resource considerations, and a lot of other things, the goal being to integrate the programmatic functions to ensure that we can get the job done and to identify areas where there may be some bottlenecks.

DR. FABRYCKY: I guess I am beginning to understand better the original purpose and intent for the bifurcation of physical system functional analysis and programmatic functional analysis, but I think I hear you saying that there is going to be further delay in bringing these two domains together, and your second bullet on the chart before us now is not intended to speak to that, yet.

What other plans in this higher level of integration --

MR. GROMBERG: I think primarily the point is to make sure that we understand and can control the differences between what the physical system functions and requirements are as opposed to the programmatic. I don't want to give the impression that all throughout the process we are not integrating the work that is going on between the physical system and programmatic, but there does seem to be a check to make sure it is consistent, to make sure that requirements are not lost somewhere in a programmatic activity that really applied to a physical system.

Once you start getting the people component in there, there are possibilities for some gray areas, and we want to try to integrate throughout the process to try to close those out. Examples would be: there are requirements for people to comply with procedures in order to operate a system, but there are also requirements to hire a certain percentage of Hispanics or minorities. There are those kinds of examples of integration that we need to do to make sure we have captured as best we can a mutually exclusive set of functions and requirements.

DR. FABRYCKY: One last comment on this issue: in the last TRB meeting that I attended, I learned that there are two separate contractors for the two domains, and that separateness there, of course, was consistent with the idea of programmatic on the one hand and physical system on the other. Will the M&O contractor now be addressing the findings, the developments to date and functional analysis of these two domains that we have seen to be bifurcated?

MR. GROMBERG: Yes, that is our plan ultimately. We want to complete the functional analyses using the existing contractors that we have because of their expertise and, for lack of a better word, momentum that they have established in completing these efforts. They routinely work very closely together; Tom Woods and Mike Duffy are the two people who gave presentations last time.

Ultimately our goal is for the M&O to take these and put it in a form that people in the organization can use it. And so that function which we have previously called communications is something that we plan for the M&O to do, and that will allow for them to integrate or incorporate the understanding of the original contractors, to get involved early and participating in workshops, and then have the experience to be able to continue on and develop those communications or documentation procedures that we need to get this incorporated into the program as a whole.

DR. FABRYCKY: Are you assuring us, then, that the memory of the good work that has been done by these two contractors will be preserved and carried forward and integration would take place.

MR. GROMBERG: I like to hope that will be the case. I wouldn't want to assure you, but that is our intent.

DR. FABRYCKY: I know in the last meeting I did not see these two contractors as partner to the M&O contractor, on the list of partners, collaborators.

MR. SHELOR: That's correct. I think the memory and the continuity was by some involvement of the M&O now while it is being done, and then obviously to have documentation of these efforts.

DR. FABRYCKY: Documentation in paper form, electronic form?

MR. SHELOR: The documentation is on paper. There will be a document that has the results of the programmatic functional analysis. Obviously not only is the M&O going to look at this for a lot of the things that M&O will be doing on behalf of or for OCRWM, but many of these will then have to go back to the other organizational elements within OCRWM and say, "Here is a balanced integrated functional flow that appears to work on paper. Now will you sit with us and just compare this with what you are currently doing?" Because the program is going on right now, people are doing things. This is a means to identify if we are currently overlooking something or if there is a better way to do it.

DR. FABRYCKY: Okay.

MR. GROMBERG: The point I am saying is that other areas of experience are the technical experts who prepared and developed and reviewed these functional analysis.

MR. SHELOR: This won't come as a big shock and surprise to them because Tom and his core team are utilizing people that are working in external relations or contract business management. These are staff people that are working in there that are participating in this functional analysis because this is not a totally separate, theoretical exercise: if I had a blank piece of paper, this is how I would do it. But we are utilizing the experience and knowledge of people who are doing it.

One of the interesting things, if you will allow me, is that our feedback from these workshop sessions, eliciting technical experts or domain experts in their areas, is that initially they are dead set against it, they are opposed. They say, "I know how to do my job. Why are you here trying to tell me how to do my job?"

DR. FABRYCKY: But those kind of people are talking about procedures probably more so than functions.

MR. SHELOR: That is right.

DR. FABRYCKY: Activity is one thing, function is something else.

MR. SHELOR: After three workshop sessions just with a little structure that is provided by the core team, they come back and say, "Gee, that is not a bad idea." So the buy in is really taking place from the bottom up. An understatement would be that the upper level management is bought into all of this because they want to see what is the answer, what are you going to do to me? But right now, this buy in and involvement of the people that are doing the work has led to great success, in my opinion.

MR. GROMBERG: Just to concur with what Dwight is saying, there has been evidence in the grassroots. The people involved have come out with whole new perspective on what we are doing.

MR. SHELOR: And this is true not just on the programmatic side; the same thing has happened on the physical systems side. The process itself has provided a great deal of insight to the people that have been doing this work for the last ten years. And many of them have been encouraged and extremely complimentary as to what this structure brings to them in terms of ideas and interfaces and dependencies.

DR. PRICE: Question in a different area: You have a program change control board?

MR. GROMBERG: Yes.

DR. PRICE: In the system, what other change control boards are there and how do they work together?

MR. SHELOR: Right now we have about four levels of change control boards. It used to be five; we have cut it back to four. By definition, the level zero change control is at the -- well, another acronym for you -- it is the ESAAB, Energy System Acquisition Advisory Board, which is chaired by the Undersecretary of Energy. And this is our level zero board. The threshold controls at the level zero are six months schedule change, $50 million in cost, and the ESAAB is not particularly concerned about the technical baseline unless you have a major change.

The ESAAB is the DOE departmental control that is placed over the program, chaired by the Undersecretary, and we are required to obtain ESAAB approval to start all of the major phases from conceptual design, Title I, Title II, and then obviously for construction. So their authorization is required at phases in the program and there are thresholds for changes.

The next lower level board is what we refer to as Program Change Control Board, and that is chaired by the director of OCRWM. The members of that Board, then, are the associate directors and office directors of OCRWM. We are in several stages now, but the threshold controls there are lower. Isn't it three months in schedule? I need a little help now because I will get confused. Rather than quoting actual threshold, they are lower as we go down.

The next lower level Board will be a Project Change Control Board, and as we expand our projects from site characterization to repository to MRS and transportation, once those projects are established, then they will have their own Change Control Board. And then at the Yucca Mountain Site Characterization Project they have a Field Change Control Board. So they can implement changes within their threshold limits in the field.

MR. GROMBERG: Let me just add, if you don't mind, Dwight, the AEs also would have, presumably, control boards. M&O would have an Internal Control Board too. So that is the major process for changing and controlling in a program.

DR. PRICE: The Change Control Boards can prove to be barriers to new technology and innovative thinking.

MR. SHELOR: That is true, but this has to be balanced with the very definite need for maintaining a controlled program and working to baselines. As you begin to ramp a program up and you apply more and more resources to it, and if you are not working to a technical baseline, your program is out of control, I guarantee you.

MR. GROMBERG: Okay. Thank you.

MR. SHELOR: You probably are going to get tired of hearing me, but I promise I won't be able to completely fill Tom's shoes, physically at least. In any case, I am sure that Tom is on the way to recovery and I will make an attempt to convey the information that he prepared for the review. I guess the only thing I have to point out here is I am not Tom Woods.

(New viewgraph)

I think the general subject that we have talked about in looking at the questions of how we are going to manage and control and actually use systems engineering in the program, that leads us very quickly to how we manage these requirements. The purpose here at this particular time is to kind of review how we are doing our requirements management and where are we going to be going in that direction.

I think very quickly in this presentation we will go through the identification of the requirements, the system functional definition of both functions and requirements definition, the allocation of requirements to functions, the analysis and the process that you need to go through in analyzing the requirements once they have been allocated. How do we deal with ambiguous and conflicting requirements? What is going to involve our initial technical baseline? We alluded to requirements maintenance earlier this morning; requirements maintenance is certainly a major function that we need to do. We will also go over requirements compliance and traceability, and then, of course, we will summarize it.

Before I go into this, there is another point that I think is important to emphasize. To make this a real process of systems engineering and structured systematic approach --

DR. FABRYCKY: Incorporating continuous improvement.

MR. SHELOR: Right. -- one thing we have to remember is I am going to be talking about the verbatim management of requirements. We have kind of imposed on ourselves a requirement to use verbatim text right out of the regulation. We were headed down a path where people were beginning to paraphrase regulations, the text in the regulation. The problem there is there is no traceability: Who made the paraphrase? What was the basis for it? How do you justify it? So what I am going to be talking about for the most part here is the verbatim management of requirements.

In order to make this system work, as you know, we have to get a license to operate. In order to get a license to operate, we are going to have to show and be able to demonstrate compliance with the regulations. So at least for those regulations that we are required to comply with for a license, then we need to also show how those regulations were interpreted and translated to design requirements and constraints on the system.

So this is the key important step and the one that people look for. How are the regulations interpreted and applied, and what is our compliance strategy to that regulation? That information has to be documented because obviously we have a program that will probably span my lifetime, or at least my involvement in the program. It has to be documented, available, for those who may want that information at the licensing hearing. So that is a key step. I just wanted to mention that so we wouldn't overlook it.

DR. FABRYCKY: Before you leave that slide, I notice now you have things in the RFA order instead of FRA. Is there any significance to that?

MR. SHELOR: No. I would have to read Tom's mind, but I don't believe there is.

(New viewgraph)

We haven't talked a lot today about architecture, and we talked a little bit about it in July. But the architecture is a whole lot like the requirements. Part of the architecture was externally imposed on this program. The Congress, in passing the act, made an architectural decision; they said deep geologic disposal. They didn't say put it on the sun or under the ocean or anything else, they said, "Your top level architectural decision will be deep geologic disposal."

There was a lot of work done in support of the Congress in making that decision, but it is an externally imposed, architecturally imposed decision. Now, from that point, and also in looking through the act, you have to begin to glean out whether there were other architectural decisions that were made and incorporate them into a program.

The same thing is true for requirements, and again I want to emphasize the verbatim text of federal, state, and local, legislation, regulations, and ordinance -- including DOE orders that are applicable to this program -- that constrain the selection of alternative methods to perform functions. Obviously as you begin to put these on, you may, in fact, reduce the solution space. In addition, you have the internally imposed requirements that really come in, again, physical, functional, and performance requirements, or constraints selected on the basis of people doing systems analysis, conceptual designs, design studies, and system trades.

Is this unique? Yes, it is fairly unique. It does embody our classic systems engineering specification development that has been and is utilized by the Department of Defense, but we have many additional sources of OCRWM requirements to observe, and most of them are externally imposed.

(New viewgraph)

The identification of these requirements, first of all, requires that we develop a criteria for determining what requirements are applicable to this program. There are a host of requirements out there in terms of the Code of Federal Regulations, there are books of them. So we have to have an applicability criteria. We do search the literature and then we make an initial allocation of these requirements to either the physical system, as broadly defined as we have, or to the programmatic functions.

Then, again, the internally imposed requirements are derived from results of technical reports analysis, some expert opinion, and allocation during the design, and feedback from site characterization.

This is a point I want to make as we go along. The higher level system requirements are not going to change very often unless we have a change in either the mission -- a change in the mission would have a drastic change -- or a major change in an architectural decision that has been made. What is going to happen, as we go through the conceptual design phase of a program element like transportation or MRS, and if we make the analysis and the trades and we select a conceptual configuration or architecture, then we will go down and we will begin to fill out the specifications for that architecture, and they will be revised at every phase through the conceptual, preliminary design, final design.

(New viewgraph)

Here again, this is a little bit of a repeat and we have gone through it earlier today. But just to emphasize: our functional analysis, in any case, is mission driven, and this comes back to a concept that we talked about when we were working on the management system improvement strategy. From the program management standpoint, what do you want to do?

I want to focus all of our resources on accomplishing the mission. Now, how do I do that? One of the best ways is to define the work. If you can define the work that is needed and driven by the mission requirements, then you can put bounds on what the focus of that work is and keep the focus of the program on the mission.

Clearly the other objective of a program management system is to ensure accountability. When you have many, many participants and a large program, the real challenge is how do we obtain and ensure and keep track of accountability. Well, the only way you will get accountability is to define the work and assign it to someone. Once that is done, then that person, unit, organization, whatever it is, then can be held accountable for that work. So I think all of this ties together in this framework that we were talking about earlier.

We have the nuclear waste management system. It is a top-down decomposition leading to functions hierarchy and descriptions of the functions; functional flow block diagrams, which we will talk about again later, and you have seen some of them of early; and then material information flows and definitions. That is where we are going to go.

Program functions is the same thing, only what you are looking for here at the bottom line is information flows and definitions.

(New viewgraph)

From these mission driven essential functions, then the next step obviously in requirements and allocation is for analysts and domain experts, as we talked about earlier, to search these requirements text and then to link the text subjects with functions. Now, the analysts and the domain experts may have to work together and they may have to work back and forth. A domain expert may be an expert in a particular technical discipline, but you may require this analyst in order to get that reasonably and logically allocated to a function.

Once this is done and compiled by function, then you want to get that into the relational data base. This relational data base is becoming -- I hope it is not a buzz word because it is a tool, and it is a very important tool for us to identify and show traceability of these requirements, where we need to make changes, what the impact of changes are. It also allows us in a relational data base to print out many, many different reports. We can ask it to give us an indentured functional structure with the requirements. We can ask it to tell me if I have allocated all of the requirements from a particular document. You can cut it many ways once you go to a relation data base.

(New viewgraph)

DR. PRICE: Did you have a question, Mr. Fabrycky?

DR. FABRYCKY: Maybe so. Could you bring that slide back?

MR. SHELOR: Sure.

DR. FABRYCKY: Under that first check mark, Analysts & Domain Experts Search Requirements Text to Link Subjects and Functions, has there been an effort to seek out any commercial software packages, computer codes that would help to ease the work of these people?

MR. SHELOR: Well, the one that I can think of that we have available to us is really over here in the search and requirements. 10 CFR, the Code of Federal Regulations, can be purchased on a floppy disk. That saves you a lot of time translating those into WordPerfect, or whatever you are using.

DR. FABRYCKY: That is my question, translating into what? Into WordPerfect? Where else have you gone beyond WordPerfect?

MR. GROMBERG: There is ASCII. But from the ASCII text, you can load it -- actually Gretchen probably knows better than anybody.

MR. SHELOR: Let me back up. Right now we are working on a prototype relational data base. And prototype is underlined. What we are looking --

DR. FABRYCKY: Commercially available?

MR. SHELOR: Commercially available. It is called Ingres.

DR. FABRYCKY: That is the one you are choosing?

MR. SHELOR: That is the one we have chosen for the prototype. The M&O contractor is going to hopefully learn from this prototype experience and develop requirements for the full relational data base that we will be using. We are currently using WordPerfect as a text mode to get in to Ingres, and that is very cumbersome and you don't want to do that in a real system.

DR. FABRYCKY: I guess what I am trying to encourage here is a search in the commercial domain for packages under check mark 1, as you have done under check mark 3. Because they are out there, and they are amazing.

MR. SHELOR: Yes.

DR. FABRYCKY: I don't want to mention any. We have done some work in that area and come up with a favorite or two, but that is for you people to do, open your eyes to the commercial packages.

MR. SHELOR: Our approach here, quite frankly, is we need to establish our requirements: What do we want this to do? And then obviously search the commercial world.

DR. FABRYCKY: Underlying my questions are what Dr. Price was referring to earlier: The technology that will make possible the storage of waste is one thing. Is the technology also out there in the systems engineering domain? You need to be taking advantage of the latest electronic based tools.

MR. GROMBERG: What you are talking about is a Hypertext or Hyperlink software?

DR. FABRYCKY: Yes. Let me not speak to any of them specifically. Some of these packages run as much as 40 to $50,000, but they are not WordPerfect.

MR. SHELOR: Some run 6 to $700,000.

DR. FABRYCKY: They are much more perfect than WordPerfect for this purpose.

(New viewgraph)

MR. SHELOR: Here again I am using Tom's viewgraphs and didn't have time to sit down and do any more. But I think clearly the message here is that the compiled requirements establish composite constraints. If you have more than one requirement on a function or maybe a single requirements, it is obviously a constraint. But you want to get to composite constraints by function. You can look for dominant requirements on that function, or even on the entire system, and doing that enables a meaningful analysis of alternatives. I think it is a key point. If you don't do the first two, you are going to have trouble with the last one.

Then obviously if you are looking at functions, you don't want to forget the system behavior because you want to look at your most highly constrained functions in terms of the overall system. This involves not only the cost, but the operations and success of the system. All of these, then, become a major prerequisite to the synthesis process that we referred to, and Bill Bailey will give us a little more information, insight into the system trades and analysis. All of this comes in to play in selecting the approaches.

(New viewgraph)

This logic then extends very quickly to addressing both ambiguous and conflicting requirements. And, again, the compilation of the requirements by the function then gets you down and establishes the context for understanding the meaning. If you had the function and the function description and you have requirements that are allocated to that function, then that provides the context to understand the meaning of the requirement.

It goes on very quickly, and it is true that now in a program like this we want to have a centralized controlled interpretation of those requirements. Being responsible for licensing and interactions with our regulators, I need to know what these interpretations of the regulations are, and we need to communicate this with the regulator and get their agreement, essentially, in order to carry on and finish this job. Obviously we need to come to closure with the regulator on how we demonstrate compliance with these requirements. And that is not a separate field.

It is an integral part of this job, regulatory compliance.

Let me digress for a minute -- we are not going to be too late for lunch -- to tell you that this does feed directly into our approach on regulatory compliance. First of all, the NRC has produced a draft of what they call their Format and Content Guide for the License Application. They have sent that to us, we have reviewed it, we have commented on it, but that Format and Content Guide for the License Application is going to say, "Here is a format, and here is what we think needs to be in the license application." That is a target for us to shoot at.

Once that Format and Content Guide is worked with the NRC, then we are developing an annotated outline of the license application. This annotated outline of the license application says basically, here is all the information we need to put in the license application, and then we begin to see what issues, what holes, what gaps, what issues are going to be remaining to complete the license application. This is separate from site suitability, which is one of our first determinations. But once we have determined if a site is suitable, then we need to focus on the license application because that is the time and all of those things we need to focus on to get to a construction of a facility.

So, again, by identifying in the annotated outline what information is needed -- for example, in geohydrologic domain, there may be in existence today eight or ten different models. Now, we need to work with our regulators, our technical people, and narrow down the number of models. And there has to be some basis for selecting which model is best. We negotiate and come to closure on that with NRC and then go out, collect data, and use that model. Now, that closure may take years, but it gives us something to track and keep track of. A little digressing, but it is very important.

We may also find conflicting requirements -- or ambiguous requirements is what we are looking at. This helps us in coming to closure on bounding conditions: What are we talking about in terms of ambiguous requirements?

Conflicting requirements, it is a lot of the same process: centralized, controlled interpretations. We can have a conflict just by not controlling the interpretations of the regulation. Two different interpretations can be as bad as a conflicting regulation. This is important in effective institutional relationships, our relationship with our regulator, obviously.

(New viewgraph)

What is the composition of our technical baseline?

Well, it is certainly going to be based on defined functions, the functional flow block diagram, imposed architectural decisions, and also derived architectural decisions. Requirements will be compiled by the functions. The requirements interpretations and conflict resolutions will have been done or identified and placed under control. All of that technical baseline will be based on a verified functional analysis requirements, requirements analysis.

What do you do after that? Well, you may have to negotiate interpretations of regulations and resolve conflict with the originating authorities, whoever they are. And then obviously this would go into the trade-off analysis.

I would just like to add a couple of bullets down here and that is: Now it is time to do the engineering analysis and the engineering work that takes these requirements and translates them to design criteria. And that documentation must be maintained and tracked as well.

That is what you look at, what you review the design in terms of: Does this design meet the requirements? How were the requirements interpreted?

(New viewgraph)

Then as we indicated earlier that change control is a critical element of a program of this nature, part of configuration management, centralized monitoring of the requirements, wherever they are. We also need to have configuration management of our internal technical results and decisions and affected functions. All of these have to be identified and tracked. And you may have to revise the function description and interfaces depending upon changes. This is also necessary in preparation of change proposal and disposition.

Now we come down to another very interesting area, and that is: typically how is this information used? On a program like this we require all of our participants and everybody working on this program to work to a control document, and he should have the latest control version of that document. That is a lot of paper, and paper is important, hard copies are important. I am not disputing that at all. So we are looking at feasibility and possibilities of going to read-only data base for requirements of controlled documents. The read-only data base can be updated on schedule, pre-scheduled times, you can print out hard copies, it can be disseminated instantly, and there may be new advantages to that kind of operation.

(New viewgraph)

Again, it comes back to compliance and traceability. We need reference lists of source documents.

A lot of implementation is through standard practice and procedures. The verification is usually, as I said, done in design review. Then we have T&E, test and evaluation and audits.

This process of compiling these requirements by function enables us to demonstrate this linkage through the functions to the other program standard practices and procedures, the work breakdown structure, technical work plans, results, decisions. It allows us, we believe, to focus our standard practices and procedures to accomplish this mission.

(New viewgraph)

In summary, we certainly have a modern day regulatory environment. There are large numbers of requirements, there is no doubt about it. The requirements may be interdependent, conflicting, and complex. Sometimes these requirements may tend to obscure approaches. Obviously, as you know, one of the real challenges to a regulator is to not design your system when you are writing the regulations. And that is a real challenge on their part, and it is a real challenge on our part not to take implied designed solutions that may be buried in the regulations.

Systems engineering and specification development is very effective with internally imposed requirements. We need to do this with the externally imposed requirements and constraints as well. Improved methods of requirements management are needed. I think Tom is right: OCRWM is responding to these needs.

DR. PRICE: I was hoping this morning to provide a little time in case there were some pressing questions that people from the audience would like to address to any of the speakers this morning. But I think we are going to have to defer that to the very end of the day. We have a little discussion time allowed there. Are there any questions that any of the Board members or staff would like to bring?

DR. CHU: Yes. It might be premature right now, Dwight, but on the slide before the very last, the linkage to the work breakdown schedules and technical work plans and so on and so forth, have you gotten to the point now -- in other words, work has been going on and the work has been broken down, WBS down to seven digits and so on and so forth. Have you gotten to the point where the breakdown structure has been altered, or the task within the existing structure has been altered, or the plans have been altered?

MR. SHELOR: The answer to that is not yet.

DR. CHU: So I am being premature.

MR. SHELOR: No, it is a good question.

Right now, today, I can't tell you the work breakdown structure would be changed. What we are doing right now is a basis to evaluate what that work breakdown structure looks like today and whether we want to change it. We are anticipating and looking forward to a product-oriented work breakdown structure in the future, and there are definite advantages to keeping that product-oriented and handling the other things as part of that overall structure.

We may not change it at all; it will be a management decision to change it, but at least there will be some basis for it. And it is this examination -- because once we go through the programmatic functional analysis and begin to examine this indentured structure of functions and their interfaces and dependencies, we may want to change the work breakdown structure, we may want to change how we do our technical work plans. But I can't answer that today.

DR. PRICE: If not, if there are no other questions from the members of the Board, I think we can go ahead and break for lunch. Actually, then, instead of running late, we are five minutes early. If any of you would like to sort of dwell in the room for five minutes and leave at 12:15 as the schedule dictates, you are welcome to do so. But other than that, we will leave now and come back at 1:30.

(Whereupon, at 12:10 p.m., the conference was adjourned for lunch, to be reconvened at 1:30 p.m.)

AFTERNOON SESSION

(1:30 p.m.)

DR. PRICE: I think we will reconvene.

MR. SHELOR: Very good.

I think now we are ready to hear from Bill Bailey with the M&O, TRW. He is going to be talking about system analysis and trade-off studies.

MR. BAILEY: The first chart, please.

(New viewgraph)

I am from the M&O and I will describe our plan for system analyses and trade studies.

(New viewgraph)

This chart shows the focus of our system level studies. The focus is to provide sensitivities and tradeoffs to support design decisions, and performance criteria for inclusion in specifications. For example, certain information is needed from system studies for the MRS Title I design, which is scheduled to begin in March of 1992, and I will describe that shortly. There have been many studies conducted in the past, typically directed toward defining system and sub-system requirements and evaluating alternative concepts, so we will build upon this base of existing prior work. We are not starting from ground zero here.

We will also work toward facilitating closure on issues that continue to be outstanding despite all this past work, issue like consolidation and use of the dual purpose casks. We will try to establish bases for responding to changes.

(New viewgraph)

In order to identify candidate studies, we reviewed a number of documents written for or by DOE over the past six or eight months which identified studies that these documents felt were needed now. These, first and foremost, are the OCRWM functional analyses documents, which we have heard described earlier today. There were some ten studies recommended from these documents. One major OCRWM internal document identified over 17 studies, 34 management issues, and some 13 design issues. The OCRWM strategic principal document identified some 10 technical issues, 7 management issues and so on.

These are not mutually exclusive. There is a lot of overlap. Some are sub-studies of the other and so forth, as well as these other documents noted here from which we distilled our initial cut at a set of studies that we felt needed to be done at this point in time.

Since that time we have received ongoing feedback from OCRWM. We have been working closely to refine this set of studies, to iterate on it and particularly within the M&O from the MRS design team.

(New viewgraph)

In the future we anticipate that study requirements are going to be generated as a result of regulatory or policy changes, and perhaps directed support to the Negotiator and ongoing specifications development. In addition, we expect that functional analyses, RAM, safety, security, human factors programs, are also going to generate requirements for more study, and in particular, the ongoing sub-system design activities.

(New viewgraph)

For example, as I alluded to before, inputs are needed for the MRS specification by early 1992. This data is based on the need or goal to have an operating MRS by January 1998. The particular information needed is expected annual receipt rates for the spent fuel for the MRS, shipping rates from the MRS to MGDS, processing requirements -- and here we are talking about selection of specific burn up and age combinations, or even assemblies by number to facilitate, for example, a deep management strategy for the MGDS. This would have implications or impacts on the selection of storage technology for the MRS. For example, if selection is required, then pool or vault storage might be better than others. And then, of course, there is consolidation.

MRS packaging requirements: MRS packaging at the MRS probably would only be a consideration if we are talking about multiple repositories. For a single repository, it would be more cost effective to do it at the MGDS.

By technology selection methodology we are referring here to the process of selecting a single alternative when multiple MOEs are used, and this is the issue that frequently comes up of how to weigh safety versus cost. It is important for the selection of the storage technology for the MRS, and it comes up in several of our studies. So we are looking at this issues at this point in time.

(New viewgraph)

The studies that we have underway as a result of this process today are three: First, a study of system throughput rate; an issue of assessment for the MRS; and a study of the system implications of the hot versus cold repository. These studies have each been under way for some two to three months and will be completed in calender year 1992.

(New viewgraph)

Now I will describe each one of these studies starting with the throughput study.

(New viewgraph)

The background on this study is that there has been a 3,000 metric tons per year reference throughput that has sort of been around for some time. It really doesn't have a clearly documented rational. It was originally based on simple logistics calculation when two repositories were being considered, and the ground rule was that there would be many new starts for new reactors and probable license extensions.

There has been a recent, as yet unpublished in final form, study conducted to look at the throughput issue and they recommended much higher throughputs than this. That study used life cycle cost exclusively as the measure of effectiveness. There were two very key assumptions made: First that there were no inventory constraints on the MRS, which meant that capacity at the MRS was allowed to increase substantially to 40, 50, 60,000 tons; secondly, that post shutdown storage cost at the reactors would be charged to the program. This turned out to be a major cost driver.

There is some controversy over whether that is a valid charge to the program or not, and so consequently in our studies for now, we are looking at that both ways, charged to the program and not charged to the program. But in some ways, a decision on that has to be made.

(New viewgraph)

The objectives of these studies are to develop data to establish a throughput rate design basis for each of the NWMS system elements and to determine their sensitivities. One major difference, I think, between the studies that we are doing now and those that have been done before is that we are all part of a team now that includes the design and operations organizations. We are working very closely together so that configurations and costs we use will be consistent with what the operation people are doing and vice versa. One recurrent theme throughout these studies is that we will pay particular attention to identifying constraints and cost drivers as they occur.

(New viewgraph)

Our approach, as always, is to review prior studies. We have developed and published our initial set of some 31 scenarios, and we have also been asked by our operations people to look at additional scenarios that are specific concerns they have, and we are doing that. Within our list of scenarios we are looking at so far, the first are all cases that correspond to existing regulations in terms of inventory and capacity limitations and the 1998 and 2010 start dates.

We will look at selectively leaving some of those constraints to determine what the impacts are. We have selected our initial set of software tools, and I will describe those on the next chart. We will use various measures of effectiveness to reflect both cost and safety. Life cycle cost will be one measure of effectiveness, others will be factors such as numbers of shipments, numbers of waste handling operations, things that are surrogates for risks for public concerns.

(New viewgraph)

The software tools that we are using now which are currently operational for us are, first of all, the characteristics data base, which provides projections of spent fuel discharges from the reactors, and then secondly, a waste stream analysis model, and we are using a model called the Waste Stream Analysis Model, WSA, which characterizes the nature of nuclear waste streams and supports various acceptance strategies, which vary in our scenarios.

For cost analyses we are using the System Engineering Cost and Analysis Model, SECAM, which is a parametric type of model which is suitable for doing these kind of studies.

And there is an interface model which operates in between which reorganizes the data from WSA to be input to SECAM and also allows us to add the high level waste stream.

(New viewgraph)

These are some of the principal study features. Some of them are obvious. Just looking down the list here: discounting can affect which throughput has the lowest life cycle cost. For example, this next bullet, which refers to post shutdown cost, are much more important for low throughputs than for high throughputs. So since these costs occur well in the future, whether or not discount is included or how much discount is included can affect that optimization.

Going further down the list: the mixed truck/rail transport alternatives. The modal split is always a significant concern. We are currently basing our estimated modal split on FICA data. We will probably work in some of the NSTI estimates as well downstream. That split, by the way, at the present time is 30 percent rail from the reactors, and it is based on just looking at this, assuming rail will be used wherever there is a spur currently on the reactor facility property.

(New viewgraph)

The expected results of this study are to provide recommendation for expected annual receipt rates and shipping rates of spent fuel for the MRS, and receipt rates of high level waste and spent fuel for the MGDS in terms of MTUs and breaking it down according to truck casks, rail cask, and so forth. This data will typically be provided as ranges, not necessarily as single numbers, to reflect uncertainties in the cost and technology and also possible insensitivity in the life cycle cost. For example, if life cycle cost is flat over a range of throughput, then rather than just picking a value in that range, we will show the entire range.

(New viewgraph)

The next study is the MRS issues assessment.

(New viewgraph)

By way of background, there has been much prior work here. There have been many studies, or series of studies, conducted by and for the MRS Commission as well as other studies sponsored by OCRWN, but there still remains unresolved issues. We will talk about some of these in a moment. As I mentioned, the MRS design schedule requires certain specification inputs by January of 1992.

(New viewgraph)

The objectives, then, of this study are to identify, which we have done, and analyze these key issues and then provide a basis for making decisions, especially those that may affect MRS Title I design.

(New viewgraph)

Unlike the throughput study, this study is not focused on a single issue, but rather there are many issues. So we will be building on past work. Much of the output from this study will be in the form of white paper, not necessarily all based on computer analyses. Working with the MRS organizations we have identified a number of issues. We are in the process of evaluating those, and our objective is to work toward facilitating resolution of these issues through: (1) assessments based on existing literature; and (2) doing more supporting analyses where it is required.

(New viewgraph)

Without any further suspense, these are the issues that we are looking at at the moment. Some of these are being addressed as parts of the other studies, such as throughput rate, which we have just talked about. Also, the consolidation issue will be treated in more detail in a following study. The concerns here, or the options here, with consolidation are, of course, to be able to reduce the volume of fuel and thereby get more fuel and transportation casks and particularly at the MGDS be able to get more fuel in the waste packages which could also have implications on thermal strategy. There are also criticality issues and so forth.

Going down the list: MRS capacity versus MGDS lag storage capacity. What we are talking about here is if blending of fuel is required at the MRS, perhaps to support a heat management strategy at the MGDS, there is maybe a cost tradeoff of doing it at the MRS versus using lag storage at the MGDS.

Waste packaging location, again, would probably only be efficient at the MRS if we had multiple repositories.

The hot versus cold emplacement issue refers to the idea that for the cold repository, the primary options are either to disperse the fuel in the repository or let it cool longer. So if we take the options or mix the options of letting it cool longer, it either has to stay for a longer period of time at the reactors, perhaps well after shutdown, or the MRS capacity has to be expanded. So in the cold repository that is the primary impact on the MRS design.

For hot repository there is the possibility of wanting to do blending or selecting fuel by burn up in age, which could impact, as I said, the storage mode.

MRS role potentially in the storage of retrieved waste packages. 10 CFR 60 requires that spent fuel and high level waste be retrievable for 50 years following the first emplacement. So the big question is: If any fuel did have to be retreated, what we do do with it? One option would be at the MGDS to put it back into transportation casks and ship it back to the MRS, which would be a concern and an impact on the MRS. So what we would be doing in this case is trying to scope this problem and determine what the options are and what the impacts will be.

Commonality issues. There are a number of things that are common to the MGDS and MRS. There are efficiencies there that can be taken advantage of. Within M&O we have set up a commonality working group and we are addressing these commonality issues.

Impact of receiving damaged fuel. This is referring here mainly to the issue of possible damage during transit and the need to sample the atmosphere in the cask before opening to avoid any problems of gas releases. So the impacts here are the decontamination times involved, which takes time and resources and impacts our schedules.

MR. VERINK: Does this mean there has been some decision about the question of possibly using the same cask as the storage mode, a third mode?

MR. BAILEY: There hasn't been a decision made, but that would be something we would look at.

MR. VERINK: I didn't see it listed.

MR. BAILEY: I did mentioned dual purpose and I didn't mention multi-purpose.

MR. VERINK: In placement as well?

MR. BAILEY: There is certainly momentum against doing that. There have been some studies that indicate that may not be feasible, but it is not ruled out. There are a number of people in organizations that still believe and do believe that that is a very viable candidate, so we will not exclude it.

DR. PRICE: Also on your list you don't have anything about co-location with cask maintenance?

MR. BAILEY: Yes. Well, that was discussed and we felt that was probably a sub-system issue, but that could be on this list too, because if it were located at the MGDS instead of the MRS, it might be a system type of consideration. But for now, that is being looked at by our storage people. That may be something that we will look at downstream.

(New viewgraph)

Expected results are recommendations on these issues, identification of commonalities that I was referring to. There is an ongoing interrelationship between this study and the other two studies and that will be reflected in providing some data specifically to this study from the other studies. That is what this third line refers to.

(New viewgraph)

The third study underway is the study of the system implications of hot versus cold repository.

(New viewgraph)

The background on this is, as you know, that the repository thermal loading strategy is still in development. What we will try to do is determine what are the bounds on the rest of the system, or the impacts on the rest of the system, of a range of thermal loading strategies. There are numerous system implications that result from the selection of a particular thermal regime, such as MGDS capacity and MRS capacity, which I just mentioned. Retrievability might be easier from a cold repository than from a hot repository. In the case of a hot repository, blending or fuel selection might be a requirement. And it could, in the case of a cold repository, require stretching out the emplacement time.

(New viewgraph)

The objectives of this study are, then, to determine the impacts on all of the system of a range of thermal loading concepts, from cold to hot, and to determine the corresponding throughput schedules which meet those thermal loading scenarios.

(New viewgraph)

Our approach is to review the prior work that has been done. There has been a great deal of work in the past at the laboratories. They are continuing to do work. There is much work going on right now that has a particular impact on this, and we will consequently pay more attention to the more recent work, but we will look at the past work for historical reasons.

We will identify and determine this information which is needed to describe the scenarios we will be looking at; these are storage limitations, alternative designs, and as possibly a separate MOE, we will look at preclosure safety and health differences with different thermal regimes, and affects on mining costs.

Having defined these scenarios which correspond to different thermal loading strategies, we will evaluate that they will differ primarily -- in fact, we will structure them so that they differ primarily in factors which have systemwide impacts, because that is the objective of this study. We are not necessarily trying to solve the problem of what the temperature in the repository should be, but rather determine what the impacts are on the rest of the system of a range of possibility. And that is what this third bullet is. We will compete those impacts.

(New viewgraph)

That is shown in this next chart. So the overall results will be an evaluation using our system measures of effectiveness for each of the scenarios which represent this range of thermal management strategies, again from cold to hot. We will, as always, be looking to identify what are the major cost drivers, and in the case of the repositories that tend more toward hot, determine what are the impacts and consequence of blending or fuel selection, and for the cases that tend more toward cold, determine what are the impacts on MRS size, emplacement time and the possible need to increase MGDS size or even go to a second repository.

New studies will be identified and undertaken as we go along. It is expected that these studies well probably generate a need for looking at additional things. We already have in mind possible follow-up studies downstream, and they will be generated, as I mentioned early on, from the ongoing activities that we are now undertaking.

Any questions?

DR. CHU: Yes. On the MRS issue studies, or for that matter, the systems throughput studies, I just want to be clear on what the free parameters are and what the assumed locked parameters are. The need for an MRS is, I take it, a given. The issues that you have generated to be resolved are: given that we have an MRS, or there will be one, then how do you answer this or that quantitative question?

MR. BAILEY: Then the question is: How do we address all of those issues that I mentioned? Would it be very advantageous to have relief on the 15,000 ton maximum capacity or the 10,000 ton linkage between the MRS and MGDS? And when the Negotiator is successful in providing a site, then we will tailor everything toward that.

DR. CHU: A capacity limit of zero tons is not in the range of parameters?

MR. BAILEY: It hasn't been thus far. Now, if we are asked by DOE or we feel it is important to look at that case of no MRS, then we will, but that has not been in --

DR. CHU: I have another question along similar lines in terms of what is assumed as a given and what is being traded off; that is: Of the plans that I have seen for a store-only MRS, that facility shall be used as a marshaling yard; that is, material will come in and then be repackaged and go out from there to the repository as opposed to a true pure store-only yard for some temporary length of time. And then once the repository is open, then the MRS just becomes yet another source of waste materials. Is the marshaling yard concept also locked in as a given?

MR. BAILEY: Not as a given, but in many of our scenarios there is pass-through, which after the MRS reaches a certain capacity and more fuel is coming in, again, depending on the selection strategy, or the loading strategy for the MGDS, we may just be passing fuel straight through the MRS. It may come in by truck and just be loaded immediately into a rail cask.

DR. CHU: That is what I meant.

MR. BAILEY: Or if it comes in by rail, it may just be put into a unit train and taken directly without ever going into storage at the MRS?

MR. SHELOR: That's true, but that scenario doesn't preclude it still being served. If you had interruptions somewhere else in the system, you can always draw from the inventory.

DR. CHU: Yes, but right now the concept is that it is a pass-through. If there is an MRS, then it is a pass-through. It will serve as a pass-through on its way to the repository as opposed to a holding yard where, for one reason or another, you need the capacity at some central location. Once the repository is opened, then the MRS has a function which is no different function from all the other origins.

MR. SHELOR: Well, no --

DR. CHU: I don't want to debate the merits of the plan, I just want to understand what are the parameters that are being --

MR. SHELOR: With the possible exception, obviously, of the system operational parameters. As I indicated, if there is an interruption in truck or rail transport from that distributor reactors to the MRS, we could maintain a repository replacement schedule just from the inventory at the MRS. So in that sense, it is an operational consideration as well as a lag storage.

The other part obviously is, I think, upon examination you will see there may be a real need for the MRS as reactors are decommissioned, in terms of essentially transferring that spent fuel to an MRS so that the reactor can be decommissioned on a fixed and preplanned schedule. There are a lot of variables to look at, but the cost of decommissioning after the end of the reactor useful life is pretty much a function of when you get spent fuel out.

DR. CHU: Let me repeat that the reason for my asking the question is not arguing for the merit, or for any one configuration versus another, but rather just to get a flavor for how many parameters are being freed up in the trade. That is all.

DR. FABRYCKY: I would like to follow up on that question because it does pertain to general purpose modeling, that is, free parameters, ranges. I heard a good deal of attention being placed on two ranges, like for example, on the thermal loading issue where we don't know for sure which way to go there, and the mixed rail/truck arena, for example, 70/30. You are not fixing those? You are allowing your modeling to do anything from zero or one, perhaps, and 100 percent of the other?

MR. BAILEY: Yes, that is a baseline from which we will run variations.

DR. FABRYCKY: Good. And that holds true, for example, on your throughput, 3,000 MTU per year?

MR. BAILEY: Oh, yes.

MR. SHELOR: Just from a historical view point, it is not a very solid basis, but the 3,000 MTU per year on a throughput rate, years ago it just so happened to coincide with our then-projected discharge rate of the reactor over a fairly large number of years.

DR. FABRYCKY: Like Dr. Chu said, we need to keep these things open and allow them to go to zero in some instances.

MR. BAILEY: Yes. That is just a starting point.

Anything else?

DR. PRICE: Yes. Considering the input to the MRS, and at this point the focus of your studies to provide some kind of information for design decisions with respect to the MRS, I presume, ways in which a material could come to you could be by the plain vanilla cask, could by dual purpose cask?

MR. BAILEY: To the MRS?

DR. PRICE: Yes, to the MRS. It could be by a universal cask, could be by a waste package at the utility placed in a transportation cask if someone were to invent another way that other people haven't talked about yet. There may be other concepts out there in which it could be received which it would seem to me would have a dramatic impact on what the MRS is -- what its design would be and how it would function.

Are you, at this point, able to be flexible enough to consider such variations in concept as input into the MRS?

MR. BAILEY: We are flexible enough, provided the data are available at the time. That is something we have to work with our transportation people and OCRWM transportation people on and our storage people on, to define what the pieces are that we can look at. Mainly, the real problem in looking at a lot of pieces like that is just having the data to characterize it.

DR. FABRYCKY: However, if the modeling approach is general enough, you can do some "if/then."

MR. BAILEY: That's right.

DR. PRICE: Were you tasked with any requirement or have any requirement given to you to minimize handling?

MR. BAILEY: Well, we did list that as one of our measures of effectiveness, numbers of handling operations, so that will show up as a parameter. We will prefer or give preference to those cases where numbers of handlings is minimized or is less. It wasn't actually given to us as a directive to minimize, but that is one of our measures of effectiveness.

DR. PRICE: I would like to read recommendation 6 from our third report, which is our recommendation to the Secretary and Congress: "A Workshop should be scheduled on ways to minimize the handling of waste in the life cycle process. The workshop should address the interactions among the major system components: storage, transportation and disposal. The scope should included potential technologies, possible regulatory impediments, and institutional incentives and barriers to such an integrated system." That was our recommendation.

We have received back from the Department of Energy the following response to that recommendation: "DOE agrees that a workshop would be helpful in identifying and resolving issues surrounding multiple handling of waste, but believes such a workshop should be preceded by a systems study. The study would address the issues identified by the Board, including potential technologies, possible regulatory impediments, and institutional incentives and barriers. The results of the study would then be used as a focus of a workshop to address the evaluated issues.

"DOE will initiate planning for the system study and subsequent workshop to discuss ways to minimize waste handling in the life cycle process as recommended by the Board. DOE will work with the Transportation and Systems Panel and staff to identify specific topics for the study and potential participants for the workshop."

So this is the response of DOE which would, in my understanding of such a system study, certainly involve these concepts. I also read in something that came across my desk -- and things seem to come across my desk fivefold; I think it increases five times every week, the amount of material that seems to come across -- a statement that the O&M is not tasked to do any conceptual studies. Now, I don't know where that statement actually came from in basis and fact, in terms of conceptual studies, that the O&M is not going to work in conceptual areas, such as in dual, universal or some other variant of the vanilla cask.

MR. BAILEY: Maybe I should defer that to Dwight.

MR. SHELOR: I don't know the source of that statement. It may well have been that that statement was based on the tasks that were identified for the first six months transition period for the M&O. I am certain that we can't afford to do that in the long term. However, during the initial start up through the transition period for the M&O, we felt that there were some tasks that they could do that would be of use to OCRWM at this time.

So I don't believe there were any conceptual tasks in the first six months, but I think in the long term certainly there will be a lot of conceptual tasks, which is part of the systems engineering effort. I might go on. I think that the response to the Board's recommendation that you just read, we are consistent with that at this point. I think the studies that Bill was referring to now really will save a lot of time in setting up a workshop to organize it around and provide some information.

DR. PRICE: But these studies that we have just heard aren't really what I would understand to be a robust system study. That would address really the conceptual aspects of minimizing handling that involves not only the MRS but a lot more.

MR. SHELOR: Maybe we can talk more specific about it. I think that minimizing handling is an interesting -- and a necessary, by the way -- objective. But maybe I am mistaken, but I put it in the same context of optimizing a system, because the question is: When I say I am optimizing the system, what am I optimizing it for? Because there are many figures or measurements of effectiveness, none of which may necessarily be minimized when I have an optimum system. I think the study and the optimization, there will be trade-offs in the number of fuel handling operations in the total system. So to optimize a system for minimum fuel transfer or fuel handling may not necessarily be the optimum overall system.

DR. PRICE: I am sure we would agree with you on that. We don't have a quarrel there at all. As a matter of fact, I am sure we will stand side by side on multiple objective optimization. There is no question in my mind about that as being important. Weighting and so forth is something you might debate, but certainly not the question of whether it should be multiple objective.

MR. SHELOR: I think the other thing, clearly, that I believe we are talking about here is: can we now take one step back and come up with conceptual overall systems that do have minimum handling operations? And as Woodie indicated, that might be with a zero capacity MRS and that type of thing. In my opinion, we certainly should look at all of those.

DR. PRICE: As I understand the response of DOE to this, they are really saying, yes we ought to take this look. The only thing that I thought was missing in the response has certainly to do with your good offices and function and that is: since we have already agreed a schedule is important, and setting schedules, they said they would work with us and our staff on topics. There was nothing said about when.

MR. SHELOR: When? Okay. I would prefer not to make a commitment of when today, but I will commit to get with you very shortly and we will talk about when we can do it. I am only hedging right now because of the transition phase that we are in. I need to understand more clearly what our resources and capabilities will be. I will get back with you.

DR. PRICE: This actually is no small study, as I would look at it. It is a considerable task to undertake.

MR. SHELOR: That is why I am hedging with my resources.

DR. FABRYCKY: I wonder if I could ask about the degree of thought or planning that might have been given to focusing on throughput and developing a general purpose source-to-sink simulator to actually run this Nuclear Waste Management System on computer?

MR. BAILEY: Well, development of a system model is one of our objectives. Within our organization we have a model development group that is looking into that and that is something that is ongoing at the present time. In order to facilitate these studies at this point in time, we are using the system tools. But that is a long-term objective.

DR. FABRYCKY: These things are not far out. These tools are here now, GPSS and others, and getting power is not a problem any longer. This is not a system that is operating at the speed of light, like, say, the space network system is for NASA. I think this can be run on a computer and played with and "what-ifs" can be done and trade-off studies can be tried then in a simulation mode. I would really encourage that these thoughts be accelerated along this line. You are saying you have a group in place?

MR. BAILEY: Absolutely.

MR. SHELOR: Again, I concur entirely. Again, it is our resource allocation. We have finite resources that we have to allocate. But I believe that it is the type of modeling and capabilities that we need to play all of the waters.

DR. FABRYCKY: It will have to be done parametrically because so much is not known, using ranges.

DR. PRICE: But as far as cost goes, we don't need to do a cost study on this. But I recommend that the potential cost implications, particularly if you take the wrong track, can be so enormous that the input into your resources to set it up and look at it carefully in advance, that is really infinitesimally small by comparison.

MR. SHELOR: You are absolutely correct.

DR. FABRYCKY: In fact, to follow-up on that, it goes back to what Dwight said earlier. We are committing so much early on, percentagewise, total cost, and committing to configurations early on, that anything that we can do to accelerate the knowledge available early on would be a great help. These kinds of look-ahead simulators are useful in that regard. It is indirect experimentation, obviously, because we don't have anything to experiment on directly. Therein, of course, is a real benefit to play with it on a computer.

MR. SHELOR: Exactly.

DR. PRICE: Thank you.

MR. SHELOR: I would like to introduce Bill

Hoessel, who has agreed generously to try to fill in for Tom Woods on a discussion on the relative decision analysis and uniform decision-making process.

MR. HOESSEL: As Dwight said, I am filling in for Tom Woods. Tom has thought much more deeply about this matter than I, and I can't hope to match his eloquence on this, but I would sure like to convey to you where our approach is for this subject and to try to entertain the questions on it.

(New viewgraph)

Our purpose is to review the process for uniform decision making that has been developed, is in development actually, for this program. In particular, we would like to address the issue that has come up about synchronization of decisions in this program.

In order to do that, I want to cover a little bit of background which is fairly important in getting the context for how we got where we are today, discuss functional needs. The heart of our answer is right here in these two bullets, which is the functional dependence, which Dwight alluded to earlier this morning in his brief, the answer to this question, as well as the uniform decision-making process. And then also you folks noted some disconnects in the DOE approach to the ESF. We would like to show you what our thought process is there. Then we will summarize what we have gone through.

DR. FABRYCKY: Can I ask for just a bit of help on the uniform decision making, some definition. What is meant by that? What are you trying to achieve in that regard? This does not mean that an artist sketches something and everybody bows to it and it becomes fixation and everybody is uniformly thinking about the same thing? That doesn't mean a group of "yes" men.

MR. HOESSEL: The choice of terminology is probably very unfortunate. In the MSIS there is a little paragraph that recognizes a desire to have a uniform process spread throughout the program. In our minds, and I believe this is a fair restatement of Dwight's goals, we are basically imposing what I will call some discipline on how you set up decision problems, how you establish the attributes that you would like to allay in the decision process, and so on.

DR. FABRYCKY: I am hearing exactly what I want to hear. You are speaking to the process and not to the actual activity.

MR. HOESSEL: That is correct.

DR. PRICE: I suggest you reword that so that is says "uniform process for decision making," not "process for uniform decision making."

MR. SHELOR: I agree. It was a poor choice, but it gives us a chance to talk about it. In addition to that and equally important and one of the areas of Bill's forte -- one of the things we want to be able to implement in this process for decision making, if you will, is: how and when do we get stakeholder, public, involvement? How do we introduce value judgments from the stakeholders and the public and other interested parties in decisions that are made in the program? It is another important aspect of this, and one that Dr. Bartlett has alluded to many times.

(New viewgraph)

MR. HOESSEL: In terms of background, this is more of a recitation of facts, if you will, than a statement of good or bad regarding what has been done in the past, but as Dwight mentioned earlier this morning, site suitability has been a program priority, and we have been, as you recognize, issue-driven for quite a while. It is frankly very pivotal to the success of the program; if you don't get suitability, you don't have a program. So historically this is what has been.

The MSIS is about a year and a half old and the systems engineering effort has been a part of the program for quite a while. It really began in earnest about a few months after that particular activity got going and significant amounts of money were then put on some of the systematic approach to functional decomposition, functional block diagrams, and what have you. So we are really talking about something that as this becomes a controlled part of the program, we can shift to a systems activity. So we are really only talking about a year's worth of heritage.

(New viewgraph)

In that time, we have basically -- as pointed out earlier today, this is the Battelle effort. There was a functional analysis of the physical system and ESF functional analysis as well, and a very massive effort to look at requirements. Then the combination of a functional analysis as well as the requirements leads us to what we will call functional needs, which tend to confine the solution space to what is, in fact, feasible too.

At the same time, programmatic activity has been going on. We have been examining program processes as part of that functional analysis and basically, as Dwight mentioned earlier, a lot of these processes have been developed through a group interaction which has some core members from the Westinghouse team, as well as quite a bit of DOE and other participation.

Basically, if it were up to us, the core team is a bunch of old Air Force type people and this would have come out looking like an F-16. So we need not only to get buy-in from DOE, but as well to get relevance to the program. So we have married that and believe that the functions that we have are now quite relevant and tailored to the program.

Again, as mentioned earlier, 5,000 of the requirements really relate to programmatic things, so we have had to do requirements analysis as well. Again, a needs analysis based on the same marriage between functions and requirements -- and we have formulated a design process as part of this activity which really recognizes and tries to head off some of the things that were done in the ESF.

In the interest of time, perhaps, we have looked at how this design process really ought to go and how all the interactions between design and design function and other functions really work. I can tell you that the functional block diagram for that particular process is very fiercely knotted with all the other functions that we deal with in this 16 function breakdown.

Again, as part of that we created a uniform procedure for decision-making. This particular activity comes up throughout all the functions: design, permeated with such decision making, system engineering. Most functions we have have a decision-making task within them.

(New viewgraph)

The real crux of the answer of how we believe the synchronization will go or should go is really resident in this functional dependence idea. We have, as I mentioned, very tightly knotted functional block diagrams. We also, in the process, have developed a timeline analysis, which is the dynamic model alluded to earlier. It turns out that the folks doing this particular activity are distinct from the ones doing the functional block diagrams, so they code up what they see, literal coding, and then they display it in terms of dynamic output and everybody says, "Whoa, that is not what we meant."

So we have a good internal check and balance, if you will, to ensure some of those interfaces are correct, and a lot of that wasn't known beforehand and had to be discovered after some of this dynamic modeling was done. So we think we have an excellent tool by which to get at the dependencies, and again, that is where the key to the synchronization is going to take place. If we enlarge the task, we have to enlarge the whole zone and cycles too. We capture that right here.

In addition, over and beyond what we do in the physical system, there is a whole host of other things that are interfaces, or that are functional interactions, that we have to worry about. Some are given by the external relations dealing with the various Indian tribes, the state, what have you. There are institutional agencies we have to interact with, NRC, EPA, and so on, as well as some legal and socioeconomic factors that may not be embodied in any law, any 10 CFR or any other, but are just simply facts that we know about. They are also incorporated in our process, when we know them.

(New viewgraph)

DR. FABRYCKY: Could I ask you to go back to the prior slide. You have functional dependence on this particular slide that you have up there now. I meant to ask a while ago, under programmatic functional analysis, you have a needs analysis.

MR. HOESSEL: Yes.

DR. FABRYCKY: That is an analysis of the what? The needs for certain programmatic functions to be performed as a result of, and as a consequence of?

MR. HOESSEL: The marriage of the requirements. To us, the need means that we have a function which tells us what has to be done. The requirements tells us how well. And it is those two which mean we have to do a function to a certain degree, to a certain level of goodness. So it is a constrained function. That is our interpretation of what that means.

DR. FABRYCKY: But this is not a derivative -- well, I guess it is a derivative of the need to dispose of in a permanent way, nuclear waste. It could be traced from that, can it?

MR. HOESSEL: Yes.

I had not actually seen that particular term. Tom, I think, borrowed it from your little paper, but that is our interpretation of how we, in fact, drive out the need.

DR. FABRYCKY: As long as it is driven from the mission.

MR. HOESSEL: Right.

(New viewgraph)

The other part of the answer, but the primary part of the answer, resides in the dependencies. The other part is that we have a decision process which we believe helps in the accurate choice and balancing of different multiple objectives, multiple measures, and all of these different cycling and functional dependencies that you can get involved in.

As I mentioned before, uniformity means there was to be a disciplined process that tried to prevent a lot of just seat-of-the-pants type decision-making process. In other words, if you go through the trouble of defining attributes, identifying constraints and so on, it is a classic kind of decision framework, you will have done enough to guarantee that you probably can't get by with a seat-of-the-pants type answer right there.

The process that we developed is, we believe, quite tailored to the program characteristics. As Dwight mentioned, this program is a public program par excellence. So a decision process has to be able to incorporate different stakeholders' values, somehow work with those in a legitimate, rigorous sort of way. I happen to be a disciple of Kenneth Arrow, so we don't do certain things in that process in trying to make this thing technically correct from a theoretical point. So you don't get in trouble from somebody who is arguing just on a scientific basis.

The other things that we worry about is the fact that there is multiple objectives. There are large uncertainties, both in parameters estimates and in states, of nature and states of the world, and we try to capture those. Nonquantifiable considerations are part of it. That is pretty much that.

What we try to do is a very flexible process that can help set up a decision program and then cycle through and try to arrive at a good balanced answer from the different alternatives that we create.

We are considering this factor. It wasn't at any time, to be honest, a factor up front as to how do you create a decision process that worries about these things. But right now we don't see any real limitation of the decision-making process to handle this, because most of these generally find their way in the design of the alternative in the first place. The designer has to worry about all those cascading affects in the formulation of the alternative. The other possibility is you can treat some of those as constraints. So we can handle that. The process is rich enough to handle, I think, these kind of factors.

Right now we have a PC version, which I call a prototype code. It runs. It seems to do the right things, and we have tested it on a particular historic example, which is the previous study, that cut down from five sites to three. We have done that about six years ago, perhaps. And we have used that as a test case, a very realistic type of test case for the complexity level of the decisions we will be looking at here. The thing works quite well. Two seconds of run time and you get same ranking as the manual check indicates.

We also have incorporated a feature in that code which sort of tells us that we create alternatives, and before we toss one out, we have to have a rationale for doing that. Either it violates a constraint, it is dominated by another alternative, or what have you. So as part of the printout, we cycle through and simply say what has been tossed out and why. This program, of course, is under a great deal of scrutiny from various sources, so we believe that a good solid record of the decisions is going to be very essential in the case in selling our particular choices for certain options, so we have tried to incorporate that as part of the code.

(New viewgraph)

Also a report that describes that methodology is in the printshop right now. We are going to send it to Dwight. It has somewhat limited distribution. It has never been circulated in DOE, so we would like to have it reviewed and assessed. But that is simply to tell you where we are at in terms of the deliverables.

DR. PRICE: You can imagine, Dwight.

MR. SHELOR: Yes, I will.

DR. PRICE: What Dwight is saying is he will provide us with a copy of that.

MR. HOESSEL: Now, to swing over to the ESF vis-a-vis repository.

As you know some ESF decisions were made, driven by the site suitability kind of criteria. The data we needed in order to characterize the site was the main driver in selecting a particular design. Thus far in the program the main requirement related to ESF was to try to preserve an option for repository use. There isn't any requirement that says you have to have it as part of the repository. I would say we have probably kept a second priority focus on that particular issue.

At the same time conceptual design work has been going on. It has very little marriage between what we do about the conceptual design and the ESF choices. And, of course, the disconnected has been noted. Our approach for resolving that is kind of the content of the next two charts. I may have to get some help in this because it speaks to program-type decision.

(New viewgraph)

I call your attention to a typo which should be a "do" in here.

Basically, if you are going to do this process from a system engineering, functional analysis point of view, you start over here. You take the physical systems, break them down, and somewhere around here you will get a thing called isolated waste, or a similar type of function, and then you will come up with a natural setting as part of the process that does that isolation.

A number of different requirements are placed against that natural setting, such as 10 CFR 60 and 960. So you have got requirements and a set of functions that that setting has to fulfill. From that we derive the data needs in order to answer that particular question of when have I got that particular function satisfied.

The next step is you back into an acquisition plan that provides you that particular information, and then you consolidate all that information and perhaps get a set of test requirements that could maybe be used piggy-back and get multiple questions answered with one particular test. Then split that out into your test facility design requirements. That is the procedure that we are following in the programmatic functional analysis. That is not what was done for the ESF, but this is what the process we are following.

(New viewgraph)

The next chart basically replicates this one and says that we are going to have to somehow achieve a marriage between the two.

Basically we are going to pop out of this process ESF design requirements based on the theory. At the same time, you have the ESF concept as it exists today. And what do we do? At that point our thought is we simply have to surface that as a choice. In other words, if the ESF had a 15-foot hole, conceptual design said you need 20, you can redesign and make everything fit 15, or you can do something perhaps to the ESF. But at this point we would surface the trade study, or a particular major decision. So I believe that represents what our intent is for the marriage.

MR. SHELOR: Yes. And I think what is actually being done now is much closer to that than you had alluded to, because I think the obvious need to bring the ESF requirements and a design in sync with the repository conceptual design is recognized by everyone. I think we have taken two other approaches.

In the system requirements development we went back and did a mission analysis which actually looked at those data and our test and parameters that would be required in the ESF to satisfy the site suitability determination and the site characterization data needs as well as the repository design data needs. We looked at all of them together and have then produced the Exploratory Study Facility Requirements document and we are comparing that with the existing Exploratory Studies Design Requirements document and bringing this into sync.

Over the next year now we will go back and re-examine the proposed repository conceptual design, which I think is an extremely important activity because, as we know, many of the potential repository operational requirements may provide constraints on ESF at this particular time that need to be considered. One example, which I think I will make up a little bit and use pieces of, for example, the slope of the emplacement drift in the ESF has piqued our interest in many cases, but it is not just because it looks bad but it comes all the way back to an operational requirement consideration in handling waste. If the slope were too deep, you may actually have to transfer the waste package three times before you got down to the emplacement horizon.

So again, that introduces additional problems in shielding and/or remote operation and what have you. So I think it is very important that we have the opportunity to make sure that the functional and operational requirements of the repository are considered in the design and construction of the ESF.

(New viewgraph)

Just to summarize, I will try to capture what we said. Focus has been on site suitability. some of the choices and decision that have been made have been driven by that particular focus. We are now, of course, into it a big way, the system engineering program, in order to help structure how this program is managed from here on out. We have got the functional analyses, both for the physical system and the program side, and as I mentioned, this uniform procedure for helping, and the plan for how we might reconcile ESF with conceptual design.

Any other questions?

(No response)

DR. PRICE: I want to especially thank you, Mr. Hoessel, for stepping in on short notice and helping us out. We do appreciate that.

What I think I would like to do at this time, I notice our schedule calls for a break at some time in the future. I don't think we need to take a break right at this moment, but rather I would like to ask if there are any comments or questions from the floor of any of the presenters who may be still here. If those from the floor would like to come forward and identify themselves and make their comments.

MR. GREENBERG: Members of the Board, my name is Art Greenberg. I am with M&O. I am prompted to come speak to you to clarify something that was said by you, Dr. Price, and also a question that was brought up by Dr. Fabrycky, so that the Board doesn't leave here without this kind of clarification.

If a piece of paper has crossed your desk, Dr. Price, that says the M&O is not doing any design, that is a piece of paper that you can at least cut out and throw it away; it is incorrect.

M&O is in a position to do conceptual design when it is appropriate for its functions to involve that kind of task. While we are meeting here today, conceptual design of the MRS is taking place, funded by DOE and being done primarily by our partner of the M&O. It is intended to lead to a design basis for going into Title I at the appropriate time.

That leads me then to talk briefly and make some comments about the system studies that you saw earlier that Bill Bailey presented. That is an interesting example of a case where, in order to support the kinds of design, even preliminary or conceptual design decision that the MRS group needs to make, some basis for understanding the relative sensitivity and importance of individual independent design variables on dependent figures of merit needs to be in place for reference purposes. The primary motivation for this first tentative step that we have taken into the system studies area is to develop, if you might think of it in terms of input/output matrixes: You change this and the consequences are that.

There are so many independent variables involved in the system as a whole, and even in one of the system elements like the MRS that we felt, and Dwight Shelor's organization felt, that we had to explore a variety of them in order to see which ones were drivers in terms of design and measures of effectiveness. And that is the reason for the studies. They are not really aimed at providing an optimum configuration, but rather a table of accounts, you may think of it as, that the designers can use in making some of their initial selections.

Later on there will, indeed, be system studies that are intended to arrive at some form -- I hate to use the word of optimized system element -- at least an element which achieves the acceptable balance between a variety or perhaps conflicting figures of merit.

For that purpose we will undoubtedly have computer models at that point. That is another reason for doing preliminary system studies, to find out what parameters are the drivers so we know which parameters should be incorporated in models. I think we all have experience with computer simulations that start to build from the bottom up and end up with such massive constructs that while they may eventually be capable of answering any question, we may lose interest by the time it is in operating capability.

The trick is to isolate though parameters that are important and that are the minimum set of parameters that allow you to arrive at the first order trades and optimizations that you are seeking. Again, that is another purpose for the system studies that Bill Bailey described today.

We recognize, Dr. Fabrycky, the importance of computer simulations and models and the M&O organizational construct that we presented to the Department years ago and that we put into practice eight months ago. We had an organizational element which is dedicated solely to the function of finding out what models are out there. A lot of work has been done, good scientific work, good model development, to find out those that are, in fact, going to be usable, can be adopted as is, or should be adapted, and what other models need still to be created so we can have the capability to answer the kind of "what if" requests that people will continually be asking. The highest priority model on our list is an overall systems model. That addresses specifically the question that you brought up.

DR. PRICE: Thank you very much for those informative remarks.

Any question you might want to ask?

(No response)

DR. PRICE: Anybody else?

(No response)

DR. PRICE: Well, if not, we are prepared at this time to stand adjourned, but not before I express my real appreciation for each of the speakers, recognizing the double duties some were called to for the one who was ill, and also just the fact that you put in the amount of work you did to give to us this fine presentation today. We appreciate it very much. Thank you very much.

MR. SHELOR: Thank you.

(Whereupon, at 2:45 p.m., the conference was adjourned.)